MAGAZINE 2022

Formula Student Germany

AN INTERNATIONAL DESIGN COMPETITION OF SKILLS, SPEED AND SPIRIT

15TH - 21TH AUGUST 2022 | HOCKENHEIM

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A special thanks goes to the numerous volunteers who contributed significantly in the realisation of the sixteenth Formula Student Germany.

Editorial

Jennifer Stratmann
OT Communications & Media

Dear reader,

It's FSG time again! Finally, we are back with a fully fledged version of Formula Student Germany (FSG) in Hockenheim. After the cancellation in 2020 and the event in 2021 with a reduced size we are especially happy to have almost 100 teams onsite this year. Another special and exciting factor at FSG 2022 is the rule change with regards to Driverless and the challenge that comes with it. With the merge of Formula Student Driverless (FSD) into the combustion and electric class and the introduction of the Driverless Cup all teams at FSG need to present their prototypes capabilities with and without a driver. Starting on page 24 we interviewed several teams on their way of handling these challenges and how they manage to be successful in the long run. In a very honest and compelling conversation starting on page 72, Sebastian Hoppe, Board Member, and Johannes Kratzel, EC Event Support, share their views on the strategy and the long-term perspective of FSG.

To make sure that more than 2600 students from 23 nations experience a well-organized, fair and fun competition it takes over 400 volunteers each year. Many faces of the FSG Officials and job profiles are familiar to those who join the competition more than once. However, many FSG jobs operate mainly in the background. Therefore, we portraited some of the profiles starting on page 78 to give an impression how diverse the tasks are during a Formula Student Event. Finally, Robert Weingart, OT Design Event, has put together a comprehensive "How-to-Engineering Design Event" to give the teams a hands-on guide to excel their static discipline.

Beyond the mentioned reads we pickled this year's magazine with many more interesting articles and facts about the FSG – so we hope you enjoy the read!

Liebe Leserinnen und Leser,

es ist wieder FSG-Zeit! Endlich sind wir wieder mit einer umfassenden Version der Formula Student Germany (FSG) in Hockenheim dabei. Nach der Absage 2020 und dem verkleinerten Event in 2021 freuen wir uns besonders, dass in diesem Jahr fast 100 Teams vor Ort sind. Ein weiterer besonderer und spannender Faktor bei der FSG 2022 ist die Regeländerung in Bezug auf Driverless und die damit verbundene Herausforderung, der die Teams sich stellen. Mit der Zusammenlegung der Formula Student Driverless (FSD) in die Verbrenner- und Elektroklasse und der Einführung des Driverless Cups müssen alle Teams auf der FSG ihre Prototypen mit und ohne Fahrer präsentieren. Ab Seite 24 haben wir mehrere Teams interviewt, wie sie mit diesen Herausforderungen umgehen und wie sie es schaffen, auf Dauer erfolgreich zu sein. In einem sehr ehrlichen und spannenden Gespräch ab Seite 72 sprechen Sebastian Hoppe, Boardmitglied, und Johannes Kratzel, EC Event Support, über ihre Ansichten zur Strategie und zur langfristigen Perspektive der FSG.

Um sicherzustellen, dass über 2600 Studierende aus 23 Nationen einen gut organisierten, fairen und unterhaltsamen Wettbewerb erleben, sind jedes Jahr über 400 Freiwillige erforderlich. Viele Gesichter der FSG Offiziellen und Stellenprofile sind denjenigen vertraut, die mehr als einmal an dem Wettbewerb teilnehmen. Viele Aufgaben der FSG laufen jedoch eher im Hintergrund ab. Deshalb haben wir einige der Profile ab Seite 78 porträtiert, um einen Eindruck zu vermitteln, wie vielfältig die Aufgaben bei einem Formula Student Event sind. Schließlich hat Robert Weingart, OT Design Event, ein umfassendes „How-to-Engineering Design Event" zusammengestellt, um den Teams einen praktischen Leitfaden für ihre statische Disziplin an die Hand zu geben.

Darüber hinaus haben wir die diesjährige Ausgabe mit vielen weiteren interessanten Artikeln und Fakten über die FSG gespickt. Wir wünschen Ihnen viel Spaß beim Lesen!

Content
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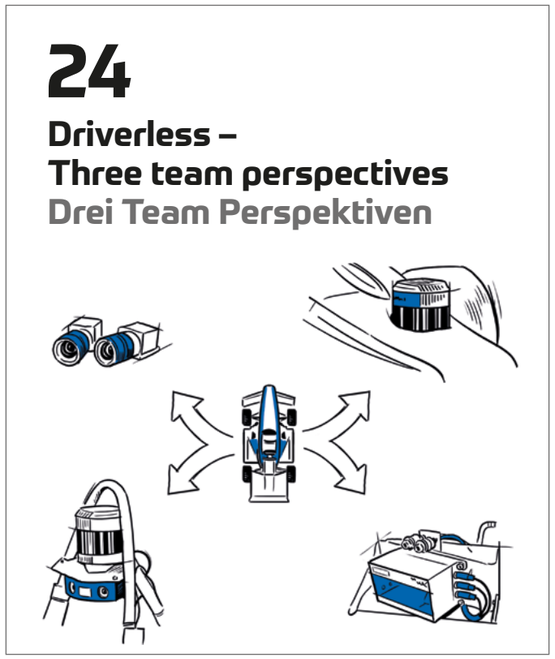
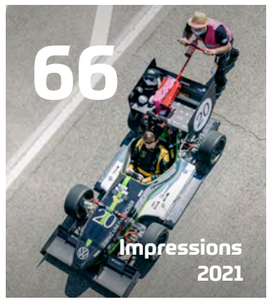
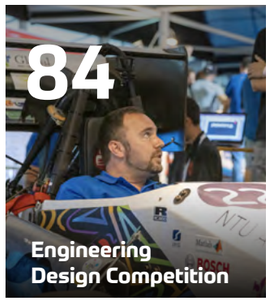
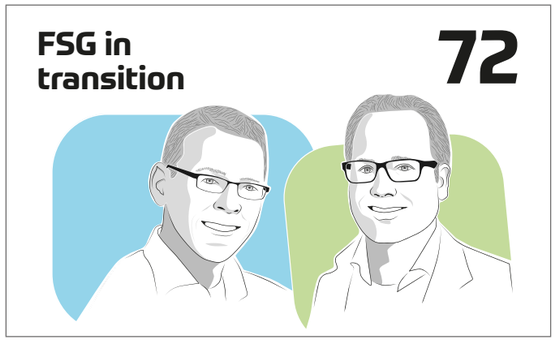








Introduction
Einführung

The Challenge

Formula Student Germany (FSG) is an international design competition for university students, based on the Formula SAE rules and guidelines. Teams from around the world have the task of designing a single-seated, formula car with either a combustion or electric drive train and to manufacture a functional prototype. Starting this year, the teams also have to incorporate autonomous features to successfully complete some dynamic disciplines. This development poses a big challenge to all teams with regards to vehicle design since the prototype must master both scenarios without disadvantaging either of them. The teams that are already more advanced in the field of autonomous systems may additionally compete in the Driverless Cup. It includes more complex disciplines that have to be completed by the autonomous system (further information on page 14).

Along with these technical aspects, the teams are asked to develop a viable business plan which demonstrates that their product – a prototype race car – could become a rewarding business opportunity that creates a monetary profit. Therefore, the racecar must not only have manageable handling and possess good acceleration and braking ability, but should also be inexpensive to buy and run. Other important aspects of the vehicle include aesthetics, ergonomics, and use of off-the-shelf components. The vehicle design is judged by experts from the automobile, motorsport and supplier industry. The teams are then able to score points in various static and dynamic events, which will ultimately decide the overall ranking of the competition. The team that combines design, financial planning, marketing strategy and performance on the track best, will win Formula Student Germany.

Practical Experience

FSG enriches the teaching content of a course of study with challenging and practical experience in the fields of manufacturing and production, whilst not neglecting the practice-oriented requirements relating to profitability and market relevance. The aspects assessed by the competition correspond directly to the demands of the different branches of the industry for new product development, which is why they are not merely restricted to vehicle design. By working as an interdisciplinary team, the students learn firsthand how to combine the economic and technical goals of product development. At the same time, they gain expertise on how to defend the proprietary solutions and to assert these against competing developments.

Herausforderung

Die Formula Student Germany (FSG) ist ein internationaler Konstruktionswettbewerb für Studierende, der sich an dem Wettbewerb der amerikanischen Society of Automotive Engineers (SAE) anlehnt. Die Aufgabe für die Teams aus der ganzen Welt besteht darin, ein einsitziges Formel-Fahrzeug mit einem Elektro- oder Verbrennungsmotor zu konstruieren und einen fahrfertigen Prototypen herzustellen. Erstmals in diesem Jahr ist die Implementierung von autonomen Systemen in allen Fahrzeugen laut Regelwerk vorgeschrieben, um alle Disziplinen erfolgreich zu absolvieren. Diese Änderung stellt die Teams vor allem mit Blick auf die Fahrzeugauslegung vor eine große Herausforderung. Nun müssen sie den Prototypen sowohl für das autonome Konzept als auch für den klassichen Ansatz mit Fahrern und Fahrerinnen auslegen, ohne dabei ein Szenario zu vernachlässigen. Die Teams, die bereits Erfahrung in der Entwicklung von autonomen Fahrzeugen besitzen, haben zusätzlich die Möglichkeit am Driverless Cup teilzunehmen. Bei diesem neuen Event Format muss das autonome System weitere komplexe und herausfordernde Disziplinen absolvieren (weitere Infos s. Seite 14).

Parallel zu der technischen Entwicklung müssen die Teams auch einen tragfähigen Businessplan präsentieren, der zeigt, dass auf Basis ihres Produktes – ein Prototyp eines Rennwagens – ein lohnendes Geschäftsmodell entwickelt werden kann. Daher muss der Rennwagen nicht nur ein beherrschbares Handling, sowie gute Beschleunigungs- und Bremswerte haben, sondern auch günstig in der Anschaffung und im Unterhalt sein. Wichtige Nebenaspekte des entwickelten Fahrzeuges sind Ästhetik, Ergonomie und die Verwendung von Serienbauteilen. Bewertet werden die Fahrzeugkonzepte von Experten und Expertinnen aus der Automobil-, Motorsport- und Zulieferindustrie. In verschiedenen statischen und dynamischen Disziplinen können die Teams wichtige Punkte sammeln, die letztlich über die Gesamtplatzierung entscheiden. Den Sieg der Formula Student Germany erringt das Team mit dem besten Gesamtpaket aus Konstruktion, Finanzplanung, Verkaufsargumentation und Rennperformance.

Praxisnahe Erfahrung

Die FSG bereichert die Lehrinhalte des Studiums um herausfordernde und praktische Erfahrungen in den Bereichen Konstruktion und Fertigung, ohne dabei die praxisrelevanten Voraussetzungen in Bezug auf Wirtschaftlichkeit und Marktrelevanz zu vernachlässigen. Die im Wettbewerb abgefragten Aspekte entsprechen den Anforderungen verschiedener Industriebereiche hinsichtlich Produktneuentwicklungen und sind daher nicht nur für den Fahrzeugbau anwendbar. Durch die Arbeit in einem interdisziplinären Team lernen die Studierenden, die wirtschaftlichen und technischen Ziele einer Produktentwicklung in Einklang zu bringen. Dabei üben sie auch, ihre eigens entwickelten Lösungen zu verteidigen und gegenüber konkurrierenden Entwicklungen durchzusetzen.

An International Design Competition
Ein internationaler Konstruktionswettbewerb

Formula Student Combustion (FSC) / Formula Student Electric (FSE)

As a team the students work together to design and manufacture a prototype racecar, based on a hypothetical manufacturing contract. In order for the participating teams to be compared, their designs, plans and cars are judged by experts. Each team has the chance to win in total a maximum of 1000 points over the course of static events, dynamic events and through proving the efficiency of their car. The team with the best overall combination of design, track performance, financial planning and marketing strategy will be a winner of FSG. In theory it is possible to win the overall competition without being the best in (or even being eliminated from) one or more disciplines. Similarly, teams can win the top prize in one or more of the disciplines and still have no chance at an overall victory.

Bei der FSG entwickeln Studierende in einem Team unter der Annahme eines fiktiven Konstruktionsauftrags einen Rennwagen Prototypen. Um einen Vergleich der startenden Teams zu ermöglichen, werden die Konzepte, Planungen und Fahrzeuge von Experten bewertet. Insgesamt kann jedes Team in drei statischen und fünf dynamischen Disziplinen maximal 1000 Punkte erhalten. Den Gesamtsieg erringt das Team mit dem besten Gesamtpaket aus Konstruktion, Rennperformance, Finanzplanung und Verkaufsargumentation. Prinzipiell kann also auch ein Team den Gesamtwettbewerb gewinnen, das in einer oder mehreren Disziplinen nicht zu den Besten zählt oder sogar ausscheidet. Andererseits können durch dieses Bewertungssystem auch Teams einen Titel in einer oder mehreren Disziplinen erringen jedoch ohne eine Chance auf den Gesamtsieg haben.

Static Events

The Formula Student Germany competition is designed to introduce the participating students to the interdisciplinary approach of today's automotive industry. This not only includes technical understanding, but also economic and communication abilities such as presentation techniques or financial planning skills. Therefore, the three static events demand collaboration across the team in the areas of design and layout, construction, marketing and pricing of a product. They also require specialized expertise from different technical and financial courses of study. The teams win up to 325 points of the possible 1000 in the three static events, and each individual event is weighted differently. A panel of experienced experts from the automobile, motorsport, and supply industries judge the performance of each team.

Engineering Design – 150 points
At the start of the engineering design competition, the students must hand in an eight-page technical description of their car. It must show both their design and how the design will be applied to their chosen construction. Based on this document, the members of the jury will evaluate the layout, technical design, construction, and implementation of the production of the actual vehicle. During a discussion at the Event the teams need to proof their knowledge to the judges. It focuses mainly on clarifying technical details, exploring the thinking behind the chosen design, as well as the corresponding technical understanding of the students. The evaluation will not only assess the quality of the technical solution in question but also the reasons behind the concept.

Cost and Manufacturing – 100 points
Cost is a decisive factor in the design of any product. In the cost analysis event, the teams must gather the calculative size of the vehicle, its components, and the necessary manufacturing steps and record all of this in a written cost report. The students must then answer questions from the judges relating to the cost report on their prototype. In addition the teams are asked to create a real case, which is a specific task to evaluate the cost and manufacturing knowledge in a certain field. The real case task is published on the competition website prior to the competition.

Business Plan Presentation – 75 points
Each team presents their business plan for the constructed prototype to a fictitious manufacturing company represented by judges. During a ten-minute presentation, the team must demonstrate why their design best fulfils the demands of their target group and show how their design can be successfully marketed. The presentation will be followed by a five-minute discussion and question round with the judges. In this event the content, structure, and editing of the presentation, as well as the team's performance in delivering it, will be evaluated alongside their answers to the questions of the panel.

Total number of possible points in the static events: 325

Last software-check before heading to the track /
Finales Prüfen der Software bevor es auf den Track geht

Statische Disziplinen

Der Formula-Student-Wettbewerb soll die teilnehmenden Studierenden an die interdisziplinäre Arbeitsweise in der Industrie heranführen. Dazu zählen nicht nur technisches Verständnis, sondern auch wirtschaftliche und kommunikative Fähigkeiten, wie z. B. Präsentationstechniken oder Kompetenzen in der Finanzplanung. Daher wird in drei statischen Disziplinen sowohl die teamübergreifende Zusammenarbeit bei Konzept, Auslegung, Konstruktion, Vermarktung und Preisgestaltung eines Produktes als auch spezielles Fachwissen aus verschiedenen technischen und wirtschaftlichen Studiengängen gefördert und gefragt. In den drei statischen Disziplinen können die Teams maximal 325 Punkte erreichen, wobei die Einzeldisziplinen unterschiedliche Gewichtungen haben. Bewertet werden die Leistungen der Teams durch eine Jury aus erfahrenen Experten und Expertinnen der Automobil- und Zulieferindustrie sowie dem Motorsport.

Engineering Design – 150 Punkte
Zu Beginn des Engineering Design-Wettbewerbs reichen die Studierenden eine achtseitige technische Beschreibung zu ihrem Fahrzeug ein, um das Konzept sowie Besonderheiten der Konstruktion darzustellen. Die Juroren und Jurorinnen bewerten auf Basis der Unterlagen das technische Konzept, die Auslegung, Konstruktionen sowie Umsetzung in der Fertigung am realen Fahrzeug. Die Teams müssen ihnen dabei zu allen Fragen in einer Diskussion Rede und Antwort stehen. In den Gesprächen geht es um die Abfrage der technischen Details, die Hintergründe für die Wahl eines Konzepts und das dazugehörige technische Verständnis. In die Bewertung fließen also nicht nur die Qualität der vorliegenden technischen Lösungen ein, sondern auch die Gründe für die gewählten Lösungen.

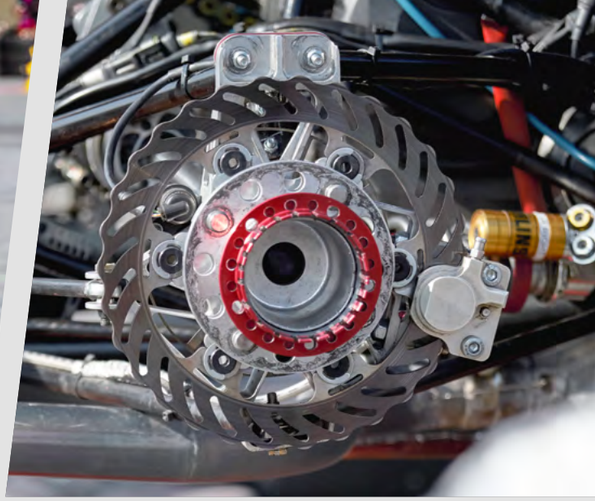
Cost and Manufacturing – 100 Punkte
Die Kosten sind für Gestaltung eines Produktes ein entscheidender Faktor. Bei der Disziplin Cost Analysis müssen sich die Teams mit den kalkulatorischen Größen des Fahrzeugs, seiner Bauteile und der notwendigen Fertigungsschritte auseinandersetzen und diese schriftlich in einem Cost Report festhalten. Zu den eingereichten Unterlagen müssen sich die Studenten mit ihrem Prototypen einer Diskussion mit den Juroren stellen. Bewertet werden neben der Aufbereitung und Vollständigkeit des schriftlichen Reports auch das Verständnis der Fertigungsprozesse sowie der Gesamtpreis. Darüber hinaus werden die Teams gebeten, einen Real Case zu erstellen, das heißt eine spezifische Aufgabe zur Bewertung der Kosten und des Fertigungswissens in einem bestimmten Bereich. Die Aufgabe für den Real Case wird vor dem Wettbewerb auf der Website veröffentlicht.

Business Plan Presentation – 75 Punkte
Mit ihrem Business Plan präsentieren die Teams einem potenziellen Investor oder Partner, vertreten durch die Juroren und Jurorinnen, ihren Geschäftsplan für den gebauten Prototyp. Die Teams stellen in einem zehnminütigen Vortrag dar, weshalb ihr Konzept am besten für die Zielgruppe geeignet ist, und eine gewinnbringende Investition darstellt. Der Präsentation folgt eine fünfminütige Diskussions- und Fragerunde mit den Juroren. Bei dieser Disziplin werden Inhalt, Aufbau und Aufbereitung des Vortrags sowie der Auftritt der Teams ebenso bewertet wie die Antworten auf die Fragen der Juroren und Jurorinnen.

Gesamtzahl der möglichen Punkte in den statischen Disziplinen: 325

Observing the competition while waiting for the next run /
Beobachtung des Wettbewerbs beim Warten auf den nächsten Run

The autocross course with its many curves and chicanes /
Der Autocross Parcours mit seinen vielen Kurven und Schikanen



High performance break system specialised for racecars /
Hochleistungsbremssystem speziell für Rennwagen

Dynamic Events

The cars that the students design will not only be assessed when stationary. Their performance on the racetrack will also be put to the test. Each dynamic event tests different features of the vehicles. The car's performance with regards to maximum longitudinal and lateral acceleration, race performance, efficiency and endurance will be examined and evaluated. With this year's rule change the teams are challenged to complete their runs in Skid Pad and Acceleration with and without a driver. Both attempts will count towards the overall score in each discipline. A maximum of 675 points can be scored over the course of the four dynamic events and the efficiency event.

Acceleration – 50 points + 75 points driverless
The vehicle's acceleration from a standing start is measured over a 75 meter straight. In addition to traction, the correct engine design is especially important, either in terms of greater power or the highest possible torque. The fastest cars cross the line in less than four seconds and can reach speeds of over 100 km/h by the end of the stretch. A maximum of 50 points can be scored during the run with a driver. For the driverless run 75 points can be achieved.

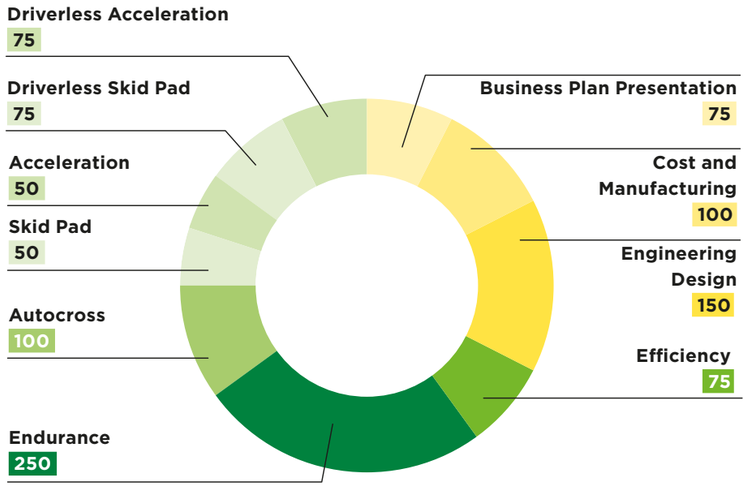
Skid Pad – 50 points + 75 points driverless
During the Skid Pad event, the cars must drive a figure of 8 circuit lined with track cones, performing two laps of each circle. In each case, the second lap will be measured. The lap time gives a comparative value for the maximum possible lateral acceleration of the car. Most of the cars use aerodynamics to raise the contact pressure and thus, increase lateral acceleration. As with all the dynamic events, knocking over any of the cones results in a time penalty. Similar to Skid Pad, the run with driver can collect up to 50 points and the driverless attempt up to 75 to achieve the overall 125.

Autocross – 100 points
In the autocross event, the cars traverse a kilometer-long track with straights, curves, and chicanes. A fast lap time is a sign of high driving dynamics, precise handling and good acceleration and braking ability. Once again, time penalties occur for those who knock over any cones. The autocross rankings decide the starting positions for the endurance competition that follows.

Endurance – 250 points
The endurance race represents almost a third of all available points and is consequently the most important event of the Formula Student Germany competition. The cars must demonstrate their capacity for endurance over a handling track of 22 km. All the prototypes' features are crucial for this event, from acceleration and handling to driving dynamics. The skill of the driver is also tested here, as they may only familiarize themselves with the track before the race by walking the length of the course (Course Walk). Each team gets just a single try, and the drivers must be changed at the halfway point. There can be up to four cars on the circuit at any given time and so overtaking maneuvers must be performed frequently. Overtaking is signaled by a blue flag and is only permitted at specially marked sections of the track. A team will receive no points at the end if they are more than a third slower than the fastest team overall.

Efficiency – 75 points
During the endurance race, fuel consumption (FSC cars) or energy consumption (FSE cars) is precisely recorded. However, the absolute fuel and energy consumption is not what is used to calculate the efficiency score, but rather the consumption relative to speed. This is to prevent teams from driving particularly slowly in the endurance competition to score as highly as possible in the efficiency category.

Total number of possible points in the dynamic events: 675



Point distribution of the dynamic and static disciplines at a glance (a maximum of 1000 points can be achieved) /
Punkteverteilung der dynamischen und statischen Disziplinen im Überblick (erreicht werden können maximal 1000 Punkte)

The racecars build by the students can reach a speed of more than 100km/h /
Die von den Studierenden gebauten Rennwagen können eine Geschwindigkeit von über 100 km/h erreichen

Dynamische Diszplinen

Die von den Studierenden entwickelten Fahrzeuge werden natürlich nicht nur im Stand bewertet. Sie müssen ihre Performance auch auf der Rennstrecke unter Beweis stellen. In jeder dynamischen Disziplin werden andere Eigenschaften des Fahrzeugs getestet. Neben der maximalen Längs- und Querbeschleunigung werden auch die Rennperformance, Effizienz und Haltbarkeit der Formel-Rennwagen ermittelt und bewertet. Mit der diesjährigen Regeländerung stellen sich die Teams der Herausforderung die Disziplinen Skid Pad und Acceleration mit und ohne Fahrer zu absolvieren. Beide Versuche fließen dann in die Gesamtwertung mit ein. In den insgesamt fünf dynamischen Disziplinen können maximal 675 Punkte erzielt werden.

Acceleration – 50 Punkte + 75 Punkte Driverless
Auf einer 75 Meter langen Geraden wird die Beschleunigung der Fahrzeuge aus dem Stand gemessen. Hier kommt es neben der Traktion vor allem auf eine richtige Auslegung des Getriebes und eine möglichst hohe Leistung, bzw. ein hohes Drehmoment an. Die schnellsten Fahrzeuge absolvieren diese Prüfung in einer Zeit unter vier Sekunden und erreichen am Ende der Messstrecke Geschwindigkeiten von mehr als 100 km/h. 50 Punkte und 75 Punkte können jeweils für die Versuche mit und ohne Fahrer erreicht werden.

Skid Pad – 50 Punkte + 75 Punkte Driverless
Beim Skid Pad durchfahren die Rennwagen einen mit Pylonen begrenzten Parcours in Form einer Acht. Jeder Kreisring wird zweimal umrundet. Gemessen wird jeweils die zweite Runde. Die Rundenzeit gibt einen Vergleichswert für die maximal erzielbare Querbeschleunigung der Fahrzeuge. Bei den meisten Fahrzeugen werden durch den Einsatz aerodynamischer Hilfsmittel der Anpressdruck und damit die Querbeschleunigung erhöht. Das Umstoßen von Pylonen wird mit einer Zeitstrafe belegt. Analog Acceleration sammeln die Teams jeweils bis zu 50 Punkte für den Runde mit Fahrer und 75 Punkte für den autonomen Versuch um 125 Punkte zu erreichen.

Autocross – 100 Punkte
Bei der Disziplin Autocross fahren die Rennwagen über einen etwa ein Kilometer langen Kurs mit Geraden, Kurven und Schikanen. Eine schnelle Rundenzeit ist ein Indikator für eine hohe Fahrdynamik, ein präzises Handling sowie gute Beschleunigungs- und Bremseigenschaften. Auch hier werden umgestoßene Pylonen mit einer Zeitstrafe geahndet. Die Platzierung im Autocross entscheidet auch über die Startreihenfolge im nachfolgenden Endurance-Wettbewerb.

Endurance – 250 Punkte
Das Endurance-Rennen stellt mit fast einem Drittel aller erreichbaren Punkte die Hauptdisziplin des Formula-Student-Wettbewerbs dar. Über eine Renndistanz von 22 Kilometern müssen sich die konstruierten Rennfahrzeuge unter Dauerbelastung beweisen. Bei dieser Disziplin sind alle Eigenschaften der Prototypen wichtig, von der Beschleunigung bis zum Handling und der Fahrdynamik. Zusätzlich ist auch das Geschick der Fahrer und Fahrerinnen gefragt, da die Strecke vor dem Rennen nur zu Fuß abgeschritten werden darf (Course Walk). Jedes Team hat einen einzigen Versuch, wobei nach der Hälfte der Distanz ein Fahrerwechsel erfolgen muss. Es sind bis zu sieben Fahrzeuge gleichzeitig auf der Strecke, wodurch es oft auch zu Überholvorgängen kommt. Diese werden von der Rennleitung veranlasst und finden in eigens dafür eingerichteten Überholzonen statt, an denen die Strecke breiter ist. Das langsamere Fahrzeug bekommt dafür von den Streckenposten durch blaue Flaggen signalisiert, dass es einen schnelleren Teilnehmer überholen lassen muss. Die Teams erhalten nur dann Punkte, wenn sie höchstens ein Drittel langsamer waren als das schnellste Team. Auch hier werden Pylonenfehler durch Zeitstrafen geahndet.

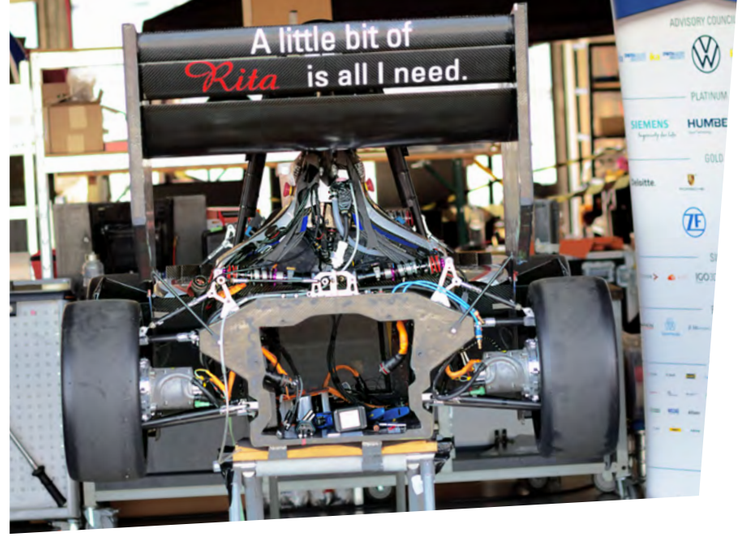
Efficiency – 75 Punkte
Während des Endurance-Rennens wird der Kraftstoffverbrauch (FSC-Fahrzeuge), bzw. der Energieverbrauch (FSE-Fahrzeuge) gemessen. Bei der Berechnung der Effizienz und der Punkte wird allerdings nicht der absolute Kraftstoff-/Energieverbrauch gemessen, sondern der Verbrauch in Relation zur Geschwindigkeit. Dadurch wird verhindert, dass Teams während des Endurance-Wettbewerbs besonders langsam fahren, um eine möglichst hohe Punktzahl in der Efficiency-Disziplin zu erreichen.

Gesamtzahl der möglichen Punkte in den statischen Disziplinen: 675

The complete FSG Competition Handbook 2022:

https://fsg.one/comp-handb-22

By using the sensors the autonomous car is able to scan the track /
Der Parcours wird mittels Sensoren gescannt



Not safety-related, but definitely worth a look: Many teams give their cars a personal touch /
Nicht sicherheitsrelevant, aber auf jeden Fall einen Blick wert: Viele Teams geben ihren Autos eine persönliche Note

Driverless Cup

With merge of the Formula Student Driverless (FSD) class into FSE and FSC the next important step of the strategy to integrate autonomous driving into FSG is realized this year. Whilst some teams may have previous experience with autonomous cars thanks to their participation in FSD, most of the teams start with the basic development of their autonomous system. To balance these different experience levels the Driverless Cup (DC) was created. In the DC the teams can put their advanced level of autonomous driving to the test and gain up to 600 points to win the additional trophy. Competing with the same vehicle and team, dedicated dynamic disciplines must be completed. Moreover, during the Engineering Design Event the teams are challenged on their deep understanding by the industry experts and gain extra points that count towards the over DC score.

Mit der Zusammenlegung der Formula Student Driverless (FSD) Klasse mit FSE und FSC wird in diesem Jahr der nächste wichtige Schritt der Strategie zur Integration des autonomen Fahrens in die FSG umgesetzt. Während einige Teams dank ihrer Teilnahme an der FSD bereits Erfahrung mit autonomen Fahrzeugen haben, beginnen die meisten Teams mit der grundlegenden Entwicklung ihres autonomen Systems. Um diese unterschiedlichen Erfahrungsstufen auszugleichen, wurde der Driverless Cup (DC) ins Leben gerufen. Im DC können die Teams ihr fortgeschrittenes Niveau des autonomen Fahrens unter Beweis stellen und bis zu 600 Punkte sammeln, um die zusätzliche Trophäe zu gewinnen. Mit demselben Fahrzeug und demselben Team müssen spezielle dynamische Disziplinen absolviert werden. Darüber hinaus werden die Teams während des Engineering Design Events von Branchenexperten und -expertinnen zu ihrem tiefen Verständnis herausgefordert und erhalten zusätzliche Punkte, die in die Gesamtwertung des DC einfließen.

Static Disciplines

Since the DC teams compete with the same car in all disciplines at the competition, the cost and business plan do not need to be judged separately in the Driverless Cup. Only during the Engineering Design Event the team's advanced understanding of the autonomous system is put to the test.

Engineering Design – 150 points
The teams that participate in the DC are evaluated by the judges based on a slightly different allocation of points. More focus is put on the autonomous functionality and the low voltage electrics and electronics.

Total: 150 points

Statische Disziplinen

Da die DC Teams über den gesamten Wettbewerb hinweg mit demselben Auto antreten, müssen die Kosten und der Geschäftsplan beim Driverless Cup nicht getrennt bewertet werden. Nur während des Engineering Design Events wird das fortgeschrittene Verständnis des Teams für das autonome System auf die Probe gestellt.

Engineering Design – 150 Punkte
Die Teams, die am DC teilnehmen, werden von den Juroren auf der Grundlage einer etwas anderen Punkteverteilung bewertet. Es wird mehr Wert auf die autonome Funktionalität und die Niederspannungselektrik und -elektronik gelegt.

Gesamtpunktzahl: 150 Punkte

Dynamic Disciplines

The driverless Dynamic Disciplines Skid Pad, Acceleration, Autocross and Trackdrive make up the remaining 450 points.

DV Acceleration – 75 points,
Skid Pad – 75 points, Autocross – 100 points
The disciplines Acceleration, Skid Pad and Autocross test the car's autonomous capabilities with regards to acceleration, handling, and steering. The setup is identical to the events at FSC and FSE.

Trackdrive – 200 points
The autonomous vehicles will race in a track race over ten laps on a 200 to 500 meter long coned course.

Total: 450 points

Dynamische Disziplinen

Die fahrerlosen Disziplinen DV Skid Pad, DV Acceleration, DV Autocross und Trackdrive machen die restlichen 450 Punkte aus.

DV Acceleration – 75 Punkte,
Skid Pad – 75 Punkte, Autocross – 100 Punkte
In den Disziplinen Acceleration, Skid Pad und Autocross werden die autonomen Fähigkeiten des Autos in Bezug auf Beschleunigung, Handling und Lenkung getestet. Das Setup ist identisch mit den Disziplinen der FSC und FSE.

Trackdrive – 200 Punkte
Die autonomen Fahrzeuge fahren in einem Trackrace über zehn Runden auf einem 200 bis 500 Meter langen, gekegelten Kurs.

Gesamtpunktzahl: 450 Punkte

Safety Regulations

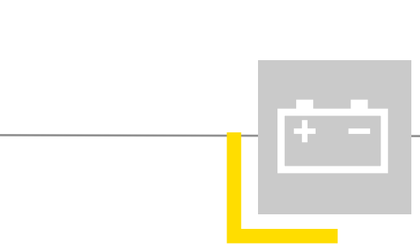
Sicherheit und Regeln

A series of safety measures and regulations must be observed for every prototype car competing. This is to ensure safety and a leveled playing field between the teams. It is important as all teams are at different levels, whether it is be different qualifications in terms of experience, personal ability or financial resources. Every car must pass Scrutineering (technical inspection and approval) in order to be allowed to participate in the dynamic categories. Teams are awarded various stickers for each safety check they pass. They must be placed at their car to show it has passed a particular test. For both the FSC and the FSE series there are also system-specific differences in terms of operation safety that have to be followed during scrutineering.With regards to the potential autonomous functionalities of the all the FSC and FSE prototypes the team must fulfill some special requirements. Each vehicle must be equipped with a so-called RES (Remote Emergency System), which fulfills two functions. By means of this remote control, the required emergency brake system (EBS) can be triggered and the vehicle can be stopped in emergency situations. At the same time, the RES control system enables the "Go" signal to be sent to the vehicle at the start of the dynamic disciplines. Furthermore, all vehicles are equipped with different coloured signal lamps, which indicate the respective operating states of the vehicle. In autonomous mode, a yellow signal is illuminated, whilst a blue light indicates the status of the RES. These systems must be tested during the Inspection.

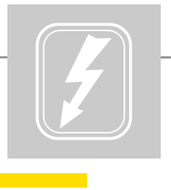
Da alle Fahrzeuge Prototypen sind, müssen die Teams eine Reihe von Sicherheitsmaßnahmen und Regeln einhalten. Auf diese Weise wird zudem eine Chancengleichheit zwischen den Teams gewährt, die mit unterschiedlichen Voraussetzungen in Bezug auf Erfahrung, personelle Kapazitäten und finanzielle Ressourcen an den Start gehen. Das erfolgreiche Absolvieren des sogenannten Scrutineerings (technische Abnahme) ist die Grundvoraussetzung für die Zulassung eines Fahrzeugs zu den dynamischen Disziplinen. Für jeden erfolgreich absolvierten Check erhalten die Teams einen Aufkleber, der auf dem Fahrzeug angebracht werden muss. Bei FSC und FSE gibt es Unterschiede bei der Betriebssicherheit, die beim Scrutineering berücksichtigt werden müssen. Aufgrund der Einführung der Driverless Komponenten in FSC und FSE muss jedes Team auch hier einige besondere Anforderungen erfüllen. Jedes Fahrzeug muss mit einem sogenannten RES (Remote Emergency System) ausgestattet sein, das zwei Funktionen erfüllt. Mit dieser Fernbedienung kann das erforderliche Notbremssystem (EBS) ausgelöst und das Fahrzeug in Notsituationen angehalten werden. Gleichzeitig ermöglicht das RES, dass das „Go"-Signal zu Beginn der dynamischen Disziplinen an das Fahrzeug gesendet wird. Darüber hinaus sind alle Fahrzeuge mit verschiedenfarbigen Signallampen ausgestattet, die die jeweiligen Betriebszustände des Fahrzeugs anzeigen. Im autonomen Modus leuchtet ein gelbes Signal, während ein blaues Licht den Status des RES anzeigt. Diese Systeme müssen während des Scrutineering getestet werden.

Accumulator (only FSE)
The ‘Accumulator’ is a technical term for the battery. It is built up of battery cells that can be connected in various series and parallel configurations. For the electrically powered Formula Student cars, the ‘Accumulator’ is the sole source of energy that enables the cars to drive. This is critical to safety if it is incorrectly designed or built. To protect for this, it is checked before the teams may compete in the dynamic events. Overheating of the cells can lead to fire. A temperature-logging device is installed by the FSG scrutineers, to ensure that the monitoring of the cell temperature is accurate. The batteries are sealed once the inspection has been carried out. The teams must transport their ‘Accumulator’ on a specially designed trolley so that it can be moved away should there be any risk of the cells overheating.

Electrical Inspection (only FSE)
During electrical scrutineering, the electrical safety of the electric car is tested. That means all systems required by the regulations are checked regarding their functional capacity. For example, system checks include the insulation-monitoring device, correct operation of the signal light (the Tractive System Active Light, which displays the status of the high voltage system) and the sound that indicates that the vehicle is ready to race. In addition, general safety aspects are checked, such as whether the wires have been laid correctly mechanically and whether the high voltage energy storage device is assembled according to regulation.



Batterie (nur FSE)
Der Akkumulator, kurz Akku, ist der technische Fachbegriff für die Fahrzeugbatterie. Diese besteht aus einer Vielzahl an Zellen, die in Reihe oder parallel geschaltet sind. Für elektrische Formula-Student-Fahrzeuge ist der Akku die einzige Energiequelle, die das Fahrzeug antreibt. Daher ist der korrekte Aufbau des Bauteils essentiell für die Fahrzeugsicherheit. Um eventuelle Fehlfunktionen und Ausfälle zu vermeiden, werden die Akkus vor den dynamischen Disziplinen genau geprüft. Bei Überhitzung der Zellen kann ein Brand entstehen, weswegen für die genaue Überwachung der Zelltemperatur durch die FSG Scrutineers Temperatursensoren angebracht werden. Der Transport der Akkus außerhalb des Fahrzeuges sowie das Laden muss auf speziellen Transportwagen geschehen, welche im Falle einer Überhitzung schnell abtransportiert werden können.



Electrical Inspection (nur FSE)
Während der Electrical Inspection wird die elektrische Sicherheit der Elektrofahrzeuge überprüft, d.h. alle durch das Regelwerk vorgeschriebenen Systeme werden auf ihre Funktionsfähigkeit getestet. Zu den geprüften Systemen gehören u.a. die Isolationsüberwachung, die korrekte Funktionsweise des Signallichts (Tractive System Active Light, das die Aktivität des Hochvoltsystems anzeigt) und der Signalton, der die Fahrbereitschaft des Fahrzeugs signalisiert (Ready To Drive Sound). Es werden aber auch allgemeine Sicherheitsaspekte wie z. B. mechanisch einwandfrei verlegte Leitungen oder der regelkonforme Einbau des Hochvolt-Energiespeichers überprüft.

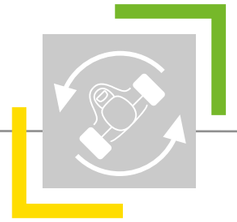
Discussion of the technical key data / Erörterung der technischen Eckdaten

Electrical Inspection needs to be done as detailed as possible by the scrutineers / Die elektrische Überprüfung wird so detailliert wie nur möglich von den Scrutineers durchgeführt

Tech and Safety (FSC and FSE)
For this inspection, all the components and accessories of the racecar that are considered relevant to safety according to the regulations are checked. These include the framework, wheel suspension, steering, braking, rims, and tires. Other details, such as the layout of the fuel lines, the fixture of the air intake system, the observance of appropriate cockpit size and the correct functioning of the kill switch are all checked. In addition to this, all drivers must show that when in a ready-to-race condition, i.e., strapped in to the driving seat wearing their full racing suit and helmet, they can exit their vehicle within five seconds.

Has everything been assembled in a safe way? / Wurde alles sicher montiert?

Tilt Table (FSC and FSE)
The tilt table test checks whether any operating fluids are leaking, and roll-over protection regulations are met. The car must be brought to the test in a ready to race condition, with all fluids and a full tank of petrol. The driver is strapped in and the car is set at an angle of 60 degrees. This corresponds to a lateral acceleration force of 1.7g. No fuel or other fluids are allowed to leak out at this angle. The race car only passes this test if the upper wheels remain on the floor.



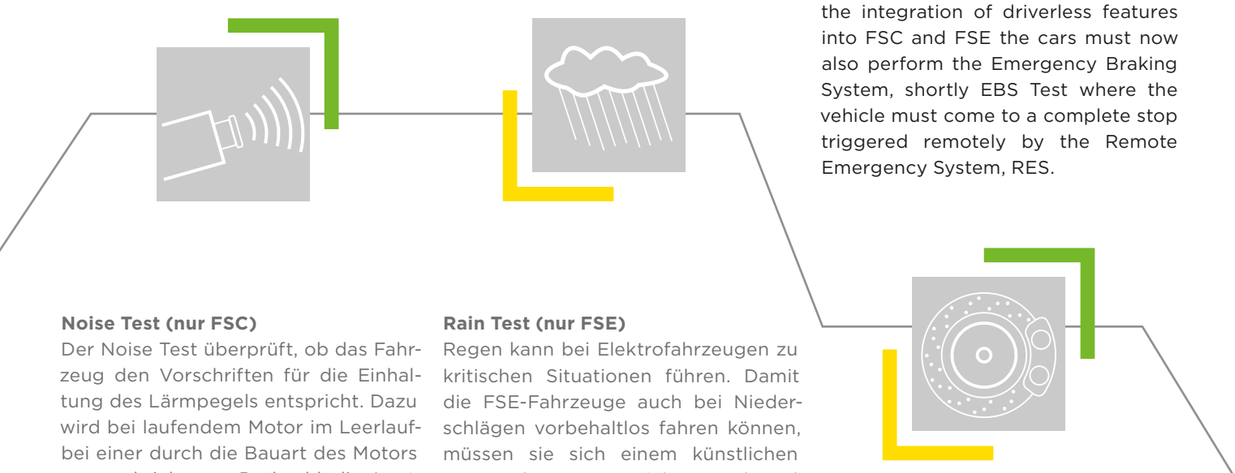
Tech and Safety (FSC und FSE)
Bei dieser Abnahme werden alle sicherheitsrelevanten Bau- und Zubehörteile des Rennwagens, die durch das Regelwerk vorgeschrieben sind, geprüft. Dazu gehören unter anderem die Rahmenstruktur, die Radaufhängung, Lenkung, Bremsen, Felgen und Reifen. Auch Details wie die Verlegung der Kraftstoffleitungen, die Befestigung des Ansaugsystems, die Einhaltung der Cockpitgröße oder die korrekte Funktionsweise der Notschalter werden geprüft. Zusätzlich müssen alle Fahrer und Fahrerinnen zeigen, dass sie in einem fahrfertigen Zustand, d.h. voll eingekleidet und angegurtet, das Auto innerhalb von fünf Sekunden verlassen können.

Tilt Table (FSC und FSE)
Beim Tilt Table Test wird überprüft, ob keine Betriebsflüssigkeiten austreten und die Regularien zum Überrollschutz erfüllt werden. Die Fahrzeuge müssen startklar, mit allen Flüssigkeiten und vollgetankt, zum Test gebracht werden. Das Fahrzeug mit angeschnalltem Fahrer wird bis zu einem Winkel von 60 Grad geneigt. Dies entspricht einer Querbeschleunigung von 1,7g. Bei diesem Winkel dürfen kein Kraftstoff oder andere Flüssigkeiten austreten. Nur wenn die oberen Räder auf dem Boden bleiben, besteht der Rennwagen den Tilt Table Test.

Noise Test (only FSC)
The noise test checks whether the car complies with the provisions for the acceptable noise level. In order to measure the volume, the engine is run in neutral at a rotation speed. The speed depends on the type of engine. In neutral, the noise level must not exceed 103 dBC or be any greater than 110 dBC at a specified rotation speed.

Rain Test (only FSE)
Rain can lead to critical situations for electric cars. In order to be allowed to operate during rainfall with no reservations, the FSE cars must undergo an artificial rain shower. During the artificial rainfall, the car's high voltage system is activated and the appropriate components can be checked to see if they are sufficiently insulated and protected from water.

Brake Test & EBS Test (FSC and FSE)
The brake test checks whether a braking system is able to lock all four wheels of the car simultaneously and bring the vehicle to a controlled stop. However, since the FSE cars can also use their electric motor braking system, if the driver is operating an electric vehicle, in addition they must deactivate the high voltage system after accelerating and then come to a complete stop with all four wheels locked in order to demonstrate that the mechanical braking system functions properly in the case of a fault in the high voltage system. Because of the integration of driverless features into FSC and FSE the cars must now also perform the Emergency Braking System, shortly EBS Test where the vehicle must come to a complete stop triggered remotely by the Remote Emergency System, RES.



Noise Test (nur FSC)
Der Noise Test überprüft, ob das Fahrzeug den Vorschriften für die Einhaltung des Lärmpegels entspricht. Dazu wird bei laufendem Motor im Leerlauf bei einer durch die Bauart des Motors vorgeschriebenen Drehzahl die Lautstärke gemessen. Der Lärmpegel darf dabei im Leerlauf nicht höher als 103 dBC und nicht höher als 110dBC bei der vorgeschriebenen Drehzahl sein.

Rain Test (nur FSE)
Regen kann bei Elektrofahrzeugen zu kritischen Situationen führen. Damit die FSE-Fahrzeuge auch bei Niederschlägen vorbehaltlos fahren können, müssen sie sich einem künstlichen Regenschauer unterziehen. Während der künstlichen Beregnung des Fahrzeuges wird bei aktiviertem Hochvoltsystem kontrolliert, ob die verwendeten Komponenten ausreichend isoliert und gegen Regen geschützt sind.

Brake Test (FSC und FSE)
Der Bremstest dient zur Überprüfung, ob das Bremssystem in der Lage ist, alle vier Räder des Fahrzeugs gleichzeitig zu blockieren und dadurch das Fahrzeug zu einem kontrollierten Stillstand zu bringen. Die FSE-Fahrzeuge dürfen auch den elektrischen Antrieb zum Bremsen nutzen. Um eine einwandfreie Funktion des mechanischen Bremssystems bei einem Fehler im Hochspannungssystem nachzuweisen, muss der Fahrer nach dem Beschleunigen das Hochvoltsystem deaktivieren und anschließend mit vier blockierenden Rädern zum Stehen kommen. Aufgrund der Integration der fahrerlosen Funktionen in FSC und FSE müssen die Fahrzeuge nun auch die Prüfung des Notbremsensystem (Emergency Braking System, kurz EBS) absolvieren, bei der das Fahrzeug durch das ferngesteuerte Notfallsystem (Remote Emergency System, RES) zum Stillstand gebracht werden muss.

Checking the insulation of the electrical components in the Rain Test /
Überprüfung der Isolierung der elektrischen Komponenten im Rain Test

Be ready: waiting for the final sign /
In den Startlöchern: los geht's wenn die Flagge geschwenkt wird

Happy faces after successfully passing the technical inspection /
Zufriedene Gesichter nach erfolgreichem Bestehen der technischen Abnahme

Adherence to the Rules
Vehicles must conform to regulations and, from a technical point of view, be safe at all times, even after passing scrutineering. The authorised technical experts or the race stewards can remove a car from the competition at any time in the case of a breach of regulation or safety requirements, for example, if a car is leaking fluids, is too loud, or if the insulation is not up to standard. The car cannot return to the competition until the fault has been repaired. Cars are also inspected again following the endurance race in order to exclude the possibility of a violation during the race. This is why the cars are placed in a parc fermé after the endurance competition, and the team members are not permitted to touch them until all the inspections have been successfully performed.

Einhaltung des Regelwerks
Die Fahrzeuge müssen auch nach bestandenem Scrutineering zu jeder Zeit regelkonform und sicherheitstechnisch unbedenklich sein. Die offiziellen technischen Sachverständigen oder die Rennleitung können Fahrzeuge bei einem Verstoß gegen das Reglement oder die Sicherheitsanforderungen jederzeit aus dem Wettbewerb nehmen, z.B. wenn Flüssigkeiten austreten, das Fahrzeug zu laut oder die elektrische Isolation nicht gewährleistet ist. Die Fahrzeuge können erst dann wieder am Wettbewerb teilnehmen, wenn der Mangel behoben wurde. Nach dem Endurance-Rennen werden die Fahrzeuge erneut geprüft, um Regelverstöße während des Rennens ausschließen zu können. Hierfür werden die Fahrzeuge in eine „Parc-Fermé" abgestellt und dürfen von den Teammitgliedern solange nicht mehr berührt werden, bis die letzte Abnahme erfolgt ist.

Flags

During the dynamic events, flags are used to communicate with the drivers. The various colours and patterns have different meanings, and all drivers must understand and obey any flag signal they receive during the competition. Infringements of flag signals can be penalised with various penalties, ranging from time penalties to disqualification.

Your session has started, enter the course!
Deine Fahrt beginnt. Fahr auf die Strecke!

Your session has been completed.
Exit the course!
Deine Fahrt ist beendet.
Verlass die Strecke!

Pull into the passing zone to be passed by a faster competitor!
Fahr in die Überholzone, damit ein schnelleres Fahrzeug passieren kann!

Pull into the penalty box for discussion concerning an incident that may cause a time penalty!
Fahr in die Kontrollzone zur Diskussion eines Vorfalls! Ggf. Zeitstrafe!

Pull into the penalty box for a mechanical inspection of your car!
Fahr in die Kontrollzone für eine technische Untersuchung des Fahrzeugs!

Flaggen

Bei den dynamischen Disziplinen werden zur Kommunikation mit den Fahrern Flaggen eingesetzt. Die verschiedenen Farben und Muster haben unterschiedliche Bedeutungen. Alle Fahrer müssen die Flaggen kennen und beachten, wenn sie diese während des Wettbewerbs gezeigt bekommen. Verstöße gegen geschwenkte Flaggen können mit verschiedenen Sanktionen geahndet werden, die von Zeitstrafen bis zur Disqualifikation reichen können.

Come to an immediate safe controlled stop on the course! Pull to the side of the course.
Komm sofort kontrolliert zum Stehen.
Halte am Rand der Strecke.

Something is on the track that should not be there. Be prepared for evasive maneuvers to avoid debris or liquids!
Es ist etwas Unerwartetes auf der Strecke.
Sei bereit, Flüssigkeiten oder Bruchstücken auszuweichen!

Something has happened beyond the flag station. No passing unless directed by the track marshals. Stationary: Danger! Slow down, be prepared to take evasive action. Waved: Great Danger! Slow down, evasive action is most likely required, be prepared to stop.
Etwas ist hinter der Flagge passiert. Fahr nicht vorbei ohne Anweisung der Streckenposten. Flagge gehalten: Gefahr! Fahr langsam, sei bereit zum Ausweichen. Flagge geschwenkt: Große Gefahr! Fahr langsam, Ausweichen wird erforderlich sein. Sei bereit anzuhalten.

Last safety check /
Letzte Sicherheitsüberprüfung

Driverless –
Three Team Perspectives

The introduction of the autonomous concept to Formula Student is not only a major change from an organizational perspective. Above all, the teams have to adapt their work structures and constructional designs significantly. We spoke with three teams and asked them about their approaches, challenges and own experiences whilst adding autonomous components. We thank you, Revolve NTNU, HAWKS Racing and EcurieAix for the great insights and are pleased to be able to present three very different perspectives.

Nicht nur aus organisatorischer Perspektive ist die Einführung des autonomen Konzeptes in die Formula Student als ein großer Wandel anzusehen. Vor allem die Teams müssen ihre Arbeitsstrukturen und Konstruktionen maßgeblich anpassen. Wir haben mit drei Teams gesprochen und sie nach ihren Ansätzen, Herausforderungen und eigenen Erfahrungen im Hinblick auf die Ergänzung der autonomen Komponenten gefragt. Wir danken euch Revolve NTNU, HAWKS Racing und EcurieAix für das Interview und freuen uns, drei ganz unterschiedliche Perspektiven darstellen zu können.

01

ecurieaix
RWTH AACHEN

Team Name: EcurieAix

University: RWTH Aachen

Interview Partner: Frederick Lockemann, Group Leader

Group name: Driverless Software

Members in EcurieAix: 75

First year with an autonomous vehicle: 2016

FSG Interviewer: Tim Schulte, Communication & Scrutineering

02

NTNU revolve

Team Name: Revolve NTNU

University: Norwegian University of Science and Technology

Interview Partner: Gina Sofie Fasseland, Group Leader

Group name: Autonomous Systems

Members in Revolve NTNU: 60

First year with an autonomous vehicle: 2018

FSG Interviewer: Jennifer Stratmann, OT Communication

03

HAWKS RACING

Team Name: HAWKS Racing

University: University of Applied Sciences Hamburg

Interview Partner: Moritz Höwer, Former Group Leader

Group name: Driverless

Members in HAWKS Racing: 51

First year with an autonomous vehicle: 2021

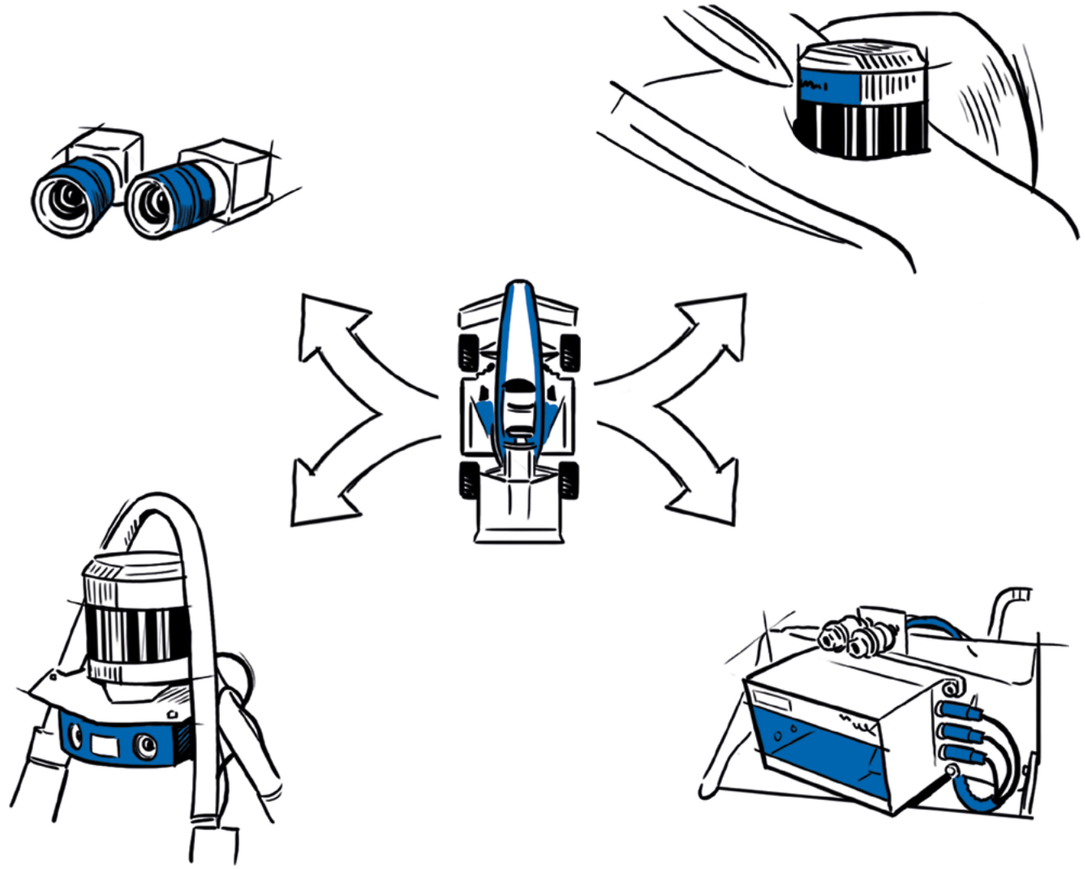
FSG Interviewer: Fabian Maknapp, Communication & IT Support

01

Interview with Frederick Lockemann, Head of Driverless Software at EcurieAix – the Formula Student Team of RWTH Aachen

How do you perceive the development of the Driverless competition in the past years?
As members of the software group, we are of course pleased that Driverless is now firmly anchored with the competition and not just an additional option for the “big” teams in Formula Student – with all the advantages and disadvantages that come with it. It turns out that the victory is fought out among the teams that have the best understanding of the vehicle and work in a well-structured environment, not necessarily the best code in detail. So, we are happy that we are now working more with the whole team, who before, as probably in most other teams, often focused heavily, also for resource reasons, on the new EV car with their developments instead of maintaining the old car.

Wie siehst du die Entwicklung des Driverless Wettbewerbs in den vergangenen Jahren?
Als Mitglieder der Software-Gruppe freut es uns natürlich, dass Driverless mittlerweile im Wettbewerb fest verankert ist und nicht nur eine zusätzliche Option für die „großen“ Teams der Formula Student ist - mit allen Vor- und Nachteilen, die das mit sich bringt. Es zeigt sich, dass der Sieg unter den Teams ausgetragen wird, die das beste Fahrzeugverständnis haben und einer gut strukturierten Umgebung arbeiten, nicht unbedingt den besten Code im Detail. Daher sind wir froh, dass wir mittlerweile mehr mit dem gesamten Team zusammenarbeiten, die sich zuvor oftmals stark auf das neue EV Auto mit ihren Entwicklungen fokussiert haben, anstatt das Altfahrzeug in Stand zu halten.



As usual, Formula Student teams are quick to adapt, implement, copy, and develop: as soon as a concept emerges new to one team or industry, it is also quickly found in many teams in the following years. A decoupled suspension system is perhaps the best example here. But there has also been a clear trend in code about what methods teams are driving in the various blocks of the pipeline: YOLO for perception, GraphSLAM as a SLAM algorithm, Kalman-Filter for state estimation, Delaunay triangulation for planning and Model Predictive Control probably describes most software packages. The competition will therefore most likely be decided at the ends of the pipeline in the future: Who knows his car best and has the fastest control on the one hand, and who can still provide sufficient data for his perception with the most minimal sensor setup on the other hand.

In this context, what is your opinion on lidar sensors: a supposedly easy entry into autonomous driving?
Lidar sensors are for new teams certainly the fastest and easiest way to get good data. But at the same time they are super expensive with a limited amount of suppliers. Especially now that there are so many teams, it is almost impossible to get a sponsorship for such a device, which is probably why not all teams can buy one. Also, the big teams often give the sensors to the new car. Perhaps the FSG could have put together a package with a supplier, with a collective order and a quantity discount, instead of letting each team blow up the mailboxes of certain industrial companies individually, as it is usually the case. In principle however, this is also a problem in some other departments. Personally, I find the trend towards lidar-only very sad, as working with cameras is very exciting; an active area of research and just more interesting for industry for cost reasons.

Wie üblich sind Formula Student Teams schnell im Adaptieren, Implementieren, Kopieren und Entwickeln: Sobald ein Konzept bei einem Team oder in der Industrie neu auftaucht, so ist es in den folgenden Jahren auch schnell bei vielen Teams zu finden. Ein entkoppeltes Fahrwerk ist hier vielleicht das beste Beispiel. Aber auch im Code hat sich ein klarer Trend entwickelt, welche Methoden die Teams in den verschiedenen Blöcken der Pipeline fahren: YOLO für perception, GraphSLAM als SLAM-Algorithmus, Kalman-Filter für State-estimation, Delaunay triangulation für Planning und Model Predictive Control beschreibt vermutlich die meisten Softwarepakete. Der Wettbewerb wird daher in Zukunft wahrscheinlich an den Enden der Pipeline entschieden werden: Wer kennt sein Auto zum einen am besten und hat die schnellste Regelung, und wer kann andererseits mit einem kleinstmöglichen Sensor-Setup noch ausreichend Daten für seine Perception bereitstellen.

Wie stehst du in diesem Zusammenhang zum Thema Lidar–Sensoren: Ein vermeintlich einfacher Einstieg in autonomes Fahren?
Für neue Teams sind Lidar-Sensoren sicherlich der schnellste und einfachste Weg, um an gute Daten zu kommen. Gleichzeitig sind sie aber auch sehr teuer bei einer begrenzten Menge an Lieferanten. Gerade jetzt, wo es so viele Team gibt, ist es nahezu unmöglich noch neu an ein Sponsoring für ein solches Gerät zu kommen. Daher werden vermutlich auch nicht alle Teams einen erwerben können. Oftmals setzen vor allem auch die großen Teams die Sensoren in den neuen Prototypen ein. Vielleicht hätte man als FSG ein Paket mit einem Lieferanten schnüren können, mit zentraler Bestellung und Mengen-Rabatt. So sprengt nicht jedes Team mit ihren Einzelanfragen die Postfächer gewisser Unternehmen. Das ist aber grundsätzlich auch ein Problem in einigen anderen Fachbereichen. Persönlich finde ich den Trend lediglich Lidar zu nutzen schade, da ich das Arbeiten mit Kameras sehr spannend finde. Weiterhin ist es ein Bereich in dem sehr intensiv geforscht wird und der auch für die Industrie aus Kostengründe interessant ist.

EcurieAix – RWTH Aachen

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The competition will therefore probably be decided at the ends of the pipeline in the future: Who knows his car best and has the fastest control on the one hand, and who can still provide sufficient data for his perception with the most minimal sensor setup.

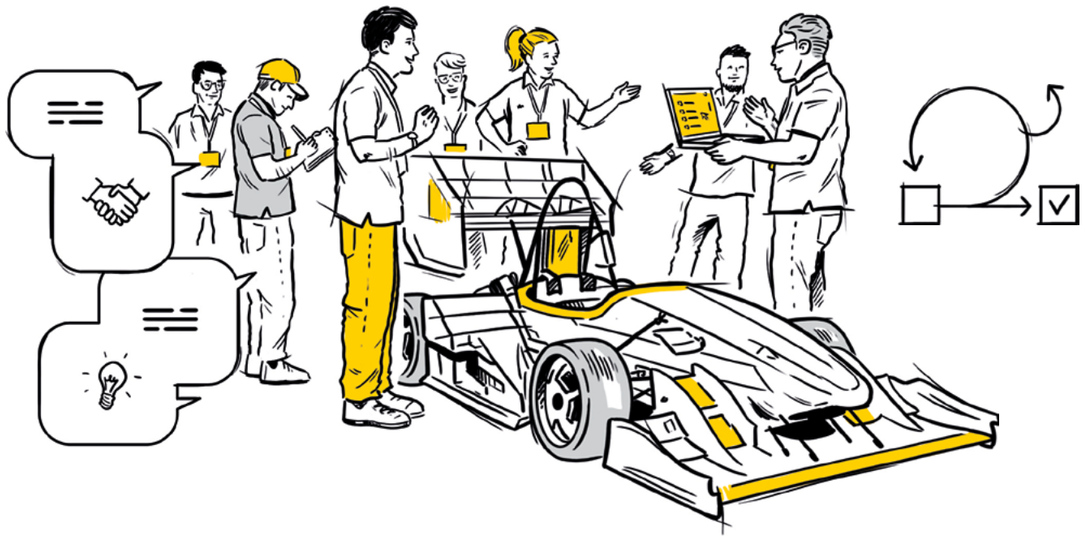
Der Wettbewerb wird daher in Zukunft wahrscheinlich an den Enden der Pipeline entschieden werden: Wer kennt sein Auto zum einen am besten und hat die schnellste Regelung, und wer kann andererseits mit einem kleinstmöglichen Sensor-Setup noch ausreichend Daten für seine Perception bereitstellen.

Especially for young teams, the ARWO (Autonomous Racing Workshop) is a perfect opportunity to learn something about autonomous driving – may this be also a role model for other departments?
We are very big fans of the workshop that the team of the Hamburg University of Technology organizes every year – sharing new research areas, mistakes made in the past or disadvantages of certain concepts help both large and small teams. Everyone is free to choose what information they want to share with the others and get a little competitive advantage accordingly. I think such an event would also be interesting for various other disciplines, such as chassis or powertrain. The time frame, in a smaller, selected round allows for completely different conversations than perhaps at the Academy, which of course is always helpful. Perhaps it is possible to offer more workshops in the fall if there is enough willingness.

What do you wish for the future?
"Wireless Communication" with the vehicles, which would theoretically be allowed according to the current ruleset, is in our opinion a direction Formula Student should not go with autonomous driving. If you want to win, the probability that you will resort to it is given. But is this how you imagine autonomous driving? - No. A corresponding rule would at least increase the inhibition threshold not to do it, since control by the organizer is difficult anyway. I'm also very curious to see how the topic of "grip estimation" will develop in the coming years.

Gerade für junge Team ist der ARWO (Autonomous Racing Workshop) eine perfekte Gelegenheit etwas für autonomen Fahren zu lernen - vielleicht auch ein Vorbild für andere Bereiche?
Wir sind sehr großer Fan von dem Workshop den das Team der Technischen Universität Hamburg jedes Jahr auf die Beine stellt. Der Austausch über neue Forschungsbereiche, Diskussionen zu Fehlern, die in der Vergangenheit begangen wurden oder auch Nachteile bestimmter Konzepte helfen sowohl großen, als auch kleinen Teams. Jedem ist frei überlassen, welche Informationen man mit den Anderen teilen möchte, um sich entsprechend einen kleinen Wettbewerbsvorteil zu erhalten. Ich denke, dass ein solches Event auch für diverse andere Fachbereiche, wie Chassis oder Antriebsstrang interessant wäre. Der zeitliche Rahmen, in kleinerer, ausgewählter Runde ermöglicht ganz andere Gespräche als vielleicht bei der Academy, die natürlich auch immer hilfreich ist. Vielleicht schafft man es bei genügend Bereitschaft im Herbst auch weitere Workshops anzubieten.

Was wünschst du dir für die Zukunft?
„Wireless Communication" mit den Fahrzeugen, was nach aktuellem Stand theoretisch erlaubt wäre, ist unserer Meinung nach, eine Richtung in die die Formula Student mit dem autonomen Fahren nicht gehen sollte. Möchte man gewinnen, ist die Wahrscheinlichkeit, dass man darauf zurückgreift, gegeben. Stellt man sich aber so autonomes Fahren vor? - Nein. Eine entsprechende Regel würde zumindest die Hemmschwelle erhöhen, es nicht zu machen, da Kontrolle durch den Veranstalter ohnehin schwierig ist. Weiterhin bin ich sehr gespannt, wie sich das Themenfeld „Reibwertschätzung" in den kommenden Jahren entwickeln wird.



02

Interview with Gina Sofie Fasseland, Head of Autonomous Systems at Revolve NTNU – the Formula Student Team of the Norwegian University of Science and Technology

To give our readers a general impression about your working conditions, can you tell us how your team is organized?
For my group, the autonomous systems group, we are uniquely organized in the way that we have no specializations within the group; everyone in the group has the same title as autonomous systems engineers, and we work together in an agile team. So, we spend most of our time working together (pair programming) rather than programming on our own projects.

Can you specify your working tools and methods?
We mainly use GitHub projects, which is an excellent management system for software development projects. Next to this we also use other common tools, like a Kanban board. However, it's not only about the methods and tools; I think one of the keys to our successful collaboration is that we focus on meeting weekly and talking to each other a lot.

How have you implemented this kind of iterative process?
In reality, it is always going to be an individualized version of agile methodology because you can never perfectly follow a book- you have to adapt it to what you need. For us, that means one common backlog for all the issues for the autonomous pipeline. We work in sprints that are two weeks long. At the end of each sprint, we have a meeting where we go through all the issues we worked on. We also do a retrospective on what went well and what did not. With this analysis, we plan the next two weeks and prioritize what needs to be done continuously.

Um unseren Lesern einen allgemeinen Eindruck von euren Arbeitsbedingungen zu vermitteln, kannst du uns sagen, wie euer Team organisiert ist?
In meiner Gruppe, der Gruppe für autonome Systeme, sind wir insofern einzigartig organisiert, als dass es keine Spezialisierungen innerhalb der Gruppe gibt; jeder in der Gruppe hat denselben Titel als Ingenieur für autonome Systeme, und wir arbeiten in einem agilen Team zusammen. Wir verbringen also die meiste Zeit damit, zusammenzuarbeiten (Pair Programming), anstatt an unseren eigenen Projekten zu programmieren.

Kannst du eure Arbeitsmittel und -methoden etwas genauer beschreiben?
Wir verwenden hauptsächlich GitHub-Projekte, ein hervorragendes Verwaltungssystem für Softwareentwicklungsprojekte. Daneben verwenden wir auch andere gängige Tools, wie z. B. ein Kanban-Board. Es geht aber nicht nur um die Methoden und Tools. Ich denke, einer der Schlüssel unserer erfolgreichen Zusammenarbeit ist, dass wir uns auch auf wöchentliche Treffen konzentrieren.

Wie habt ihr diese Art von iterativem Prozess umgesetzt?
In Wirklichkeit wird es sich immer um eine individualisierte Version der agilen Methodik handeln, denn man kann sich nie perfekt an das Lehrbuch halten - man muss es an die eigenen Bedürfnisse anpassen. Für uns bedeutet das ein gemeinsames Backlog für alle Themen der autonomen Pipeline. Wir arbeiten in Sprints, die zwei Wochen lang sind. Am Ende jedes Sprints haben wir ein Treffen, bei dem wir alle Themen durchgehen an denen wir gearbeitet haben. Weiterhin machen wir eine sogenannte „Retrospektive", was gut und was nicht gut gelaufen ist. Anhand dieser Analyse planen wir die nächsten zwei Wochen und setzen Prioritäten, was fortlaufend erledigt werden muss.

Do you prioritize your tasks together?
100%. So that is one of the key things about having an agile team where we share the workload: our team members are responsible for the pipeline as a whole, not just one particular system. For example, there is a system called SLAM – and many organizations will have a person whose job is to work on the SLAM system only. Since everyone can work on everything in our group, we look through the backlog together at the beginning of each two-week sprint and decide what needs to be done first. Then we allocate who does what. Consequently, that means that on some weeks everyone works on different issues, and on other weeks many people work together on one challenging thing.

Do you set annual goals you focus on?
Yes, of course. Our goal this year was to ensure that the EV/DV merger itself is successful. This means that our focus was improving current systems and developing things in a more reliable, stable, and maintainable fashion.

Setzt ihr gemeinsam Prioritäten bei euren Aufgaben?
100%. Das ist einer der wichtigsten Aspekte eines agilen Teams, in dem wir uns die Arbeit teilen: Unsere Teammitglieder sind für die Pipeline als Ganzes verantwortlich, nicht nur für ein bestimmtes System. Es gibt zum Beispiel ein System namens SLAM - und in vielen Teams gibt es eine Person, deren Aufgabe es ist, nur am SLAM-System zu arbeiten. Da in unserer Gruppe allerdings jeder an allem arbeiten kann, gehen wir zu Beginn jedes zweiwöchigen Sprints gemeinsam das Backlog durch und entscheiden, was zuerst erledigt werden muss. Dann teilen wir zu, wer was macht. Das bedeutet, dass in manchen Wochen jeder an verschiedenen Themen arbeitet und in anderen Wochen arbeiten viele Leute gemeinsam an einer schwierigen Sache.

Setzt ihr euch jährliche Ziele, auf die ihr euch konzentriert?
Ja, natürlich. Unser Ziel in diesem Jahr war es, sicherzustellen, dass die EV/DV-Fusion selbst erfolgreich ist. Das bedeutet, dass wir uns darauf konzentriert haben, die bestehenden Systeme zu verbessern und die Dinge zuverlässiger, stabiler und wartbarer zu machen.

> **What works for us might not work for you and your team! Try out the way of working that suits you best. If it doesn't work, change it. My group has changed the way we do meetings three times this year.**
>
> **Was für uns funktioniert, muss nicht unbedingt für euch und euer Team gelten! Probiert die Arbeitsweise aus, die euch am besten zusagt. Wenn es nicht funktioniert, ändert es. Meine Gruppe hat die Art und Weise, wie wir Sitzungen abhalten, in diesem Jahr dreimal geändert.**

Revolve NTNU – Norwegian University of Science and Technology

Read the full interview on our website / Das gesamte Interview gibt es auf unserer Website zu lesen

In comparison with the traditional project management, the agile approach allows flexibility and quick wins on the one hand, but also entails a lot of time pressure on the other hand. How do you handle this in a volunteer project like the Formula Student is?
It depends, so even though the sprints are two weeks long, we have a meeting every week. That means in the middle of a sprint, we have a short meeting where we just go through the current sprint issues and say where we are with them. Regarding the time investment we ask everyone for, it always depends on the individual group. While some of our team's departments have rigid office hours, it did not work for us. Instead, we try our best to be present at the office, even if we are doing things that might not be related to Formula Student all the time. For example, I am at the office every single day from morning to night, but I do my schoolwork at the office as well. So even though I might not be working on the project, my team members can still go: “Hey Gina, can I talk to you about this?” So our collaboration is based on just being around each other a lot and talking, having lunch, and socialising. However, in this context, we also should mention that we are very thankful for our excellent working spaces and facilities.

Do you have one advise for the teams?
What works for us might not work for you and your team! Try out the way of working that suits you best. If it does not work, change it. My group has changed the way we do meetings three times this year because we tried one way and found out, “Oh, this didn't really work. Great. Let's try it slightly differently. Let's try two meetings, two shorter meetings instead of one long one; let's try one every other week.” Listen to each other's feedback and change it until you find something that actually works!

Im Vergleich zum traditionellen Projektmanagement ermöglicht der agile Ansatz einerseits Flexibilität und schnelle Erfolge, bringt aber andererseits auch viel Zeitdruck mit sich. Wie geht man damit bei einem ehrenamtlichen Projekt wie der Formula Student um?
Das hängt davon ab. Obwohl die Sprints zwei Wochen lang sind, haben wir jede Woche ein Meeting. Das bedeutet, dass wir in der Mitte eines Sprints ein kurzes Treffen abhalten, bei dem wir die aktuellen Themen des Sprints durchgehen und sagen, wie weit wir damit sind. Was den Zeitaufwand angeht, den wir von jedem verlangen, so hängt das immer von der jeweiligen Gruppe ab. Während einige Abteilungen unseres Teams feste Bürozeiten haben, hat das bei uns nicht funktioniert. Stattdessen versuchen wir unser Bestes, um im Büro anwesend zu sein, auch wenn wir Dinge tun, die nicht immer mit der Formula Student zu tun haben. Ich bin zum Beispiel jeden Tag von morgens bis abends im Büro, aber ich mache auch meine Uniarbeiten im Büro. Auch wenn ich nicht an dem Projekt arbeite, können meine Teammitglieder trotzdem zu mir kommen: „Hey Gina, kann ich mit dir darüber reden?” Unsere Zusammenarbeit basiert also darauf, dass wir viel zusammen sind und uns unterhalten, zu Mittag essen und den engen Kontakt pflegen. In diesem Zusammenhang sollten wir aber auch erwähnen, dass wir sehr dankbar für unsere hervorragenden Arbeitsräume und -einrichtungen sind.

Hast du einen Rat für die Teams?
Was für uns funktioniert, muss nicht unbedingt für euch und euer Team gelten! Probiert die Arbeitsweise aus, die euch am besten zusagt. Wenn es nicht funktioniert, ändert es. Meine Gruppe hat die Art und Weise, wie wir Sitzungen abhalten, in diesem Jahr dreimal geändert, weil wir eine Methode ausprobiert und festgestellt haben: „Oh, das hat nicht wirklich funktioniert. Na toll. Versuchen wir es auf eine etwas andere Weise. Versuchen wir es mit zwei Besprechungen, zwei kürzeren Besprechungen anstelle einer langen; versuchen wir es mit einer Besprechung alle zwei Wochen.“ Hört euch das Feedback der anderen an und ändert es, bis ihr etwas findet, das wirklich funktioniert!

03

Interview with Moritz Höwer, former Head of Driverless at HAWKS Racing – the Formula Student Team of the University of Applied Sciences Hamburg

When did you start planning a driverless car?
It must have been in spring 2018, during the H14 Vicky season. I was not even part of HAWKs yet, but I had already been approached by Stefan Bergman (head of the electronics department at that time). However, the real planning phase of the car started in the summer of 2018 after the events.

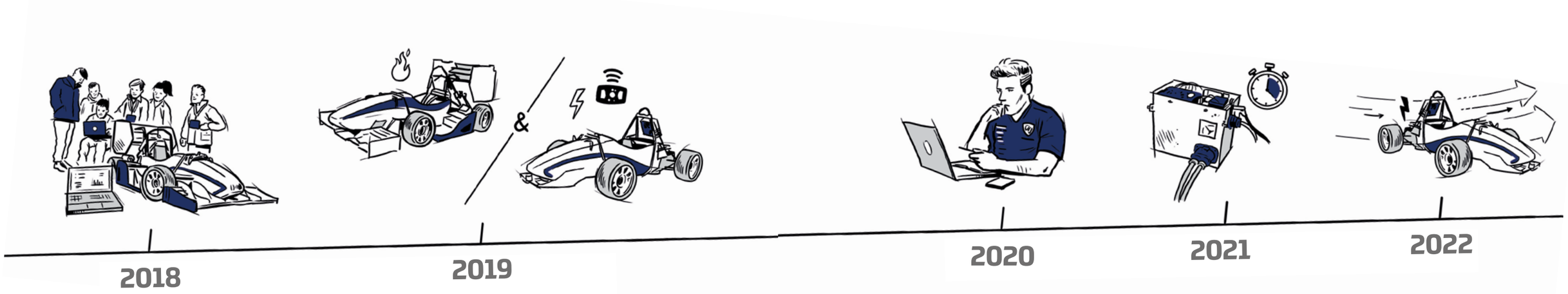
At the beginning you planned to build a combustion engine DV, but now you have decided to build an electric DV, what were the reasons for that?
Originally, the plan was to build a combustion engine DV. We wanted to take an existing and reasonably working car and then “only” integrate the DV systems and software. Finally, we did the preliminary work in the first year, i.e. secured the financing, and already developed and manufactured a few individual components such as the DV-actuators. In summer 2019 however, our chosen base car came back from the event with an engine damage. As a result, we had a lot of internal discussions on the feasibility of our plan. As a result, we had a lot of internal discussions. One of the things that came out of the conversations with the team as well as with the alumni was: “Just put a small mini electric motor in there, it doesn't need to have 80 kW”. At about the same time, the FSG also informed us that they wanted to phase out the combustion engine class in the future. This led to a new plan: We focused on the fact that we wanted to build primarily a driverless car and therefore did not need so much power. That means we built a low-voltage 48-volt powertrain with 5 to 10 kW of power. We were aware that we would not be able to compete in electric racing with it, but it should definitely be enough for the first driverless season. In this way, we were able to gain experience for a real electric car.

Wann habt ihr angefangen ein Driverless Auto zu planen?
Im Frühjahr 2018 müsste das gewesen sein, also in der H14 Vicky Saison. Da war ich noch nicht mal bei HAWKS, aber wurde von Stefan Bergman (damals Leiter der Elektronikabteilung) bereits angesprochen. Mit der Planung des Autos wurde dann im Sommer 2018 nach den Events angefangen.

Am Anfang war geplant ein Verbrenner DV zu bauen, ihr habt euch jetzt dennoch für ein Elektro DV entschieden, was waren die Gründe dafür?
Ursprünglich war der Plan einen Verbrenner DV zu bauen richtig. Wir wollten ein halbwegs funktionierendes Auto nehmen und dann „nur“ DV-Systeme und DV-Software integrieren. Dazu haben wir im ersten Jahr die Vorarbeit geleistet, also die Finanzierung gesichert, bereits ein paar einzelne Komponenten wie die DV-Aktoren entwickelt und gefertigt. Im Sommer 2019 hatten wir jedoch das Problem, dass unser Basisauto mit einem Motorschaden von den Events wiedergekommen war. Das führte zu vielen internen Diskussionen zur Umsetzbarkeit unseres Plans. Aus den Teamreihen und den Gesprächen mit den Alumni kam unter anderem die Aussage: „Wir bauen einfach einen kleinen Mini-Elektromotor da rein, der muss ja keine 80 kW haben“. Ziemlich zeitgleich wurde von der FSG kommuniziert, dass es in der Zukunft keine Verbrennerklasse auf der FSG geben wird. Daraufhin entstand ein neuer Plan: Wir legten den Fokus darauf, ein Driverless Auto zu bauen und brauchten somit nicht so viel Leistung. Das heißt wir bauten einen Low-Voltage 48 Volt Antriebsstrang mit 5 bis 10 kW Leistung. Uns war bewusst, dass wir damit zwar nicht wettbewerbsfähig in der Elektro Klasse mitfahren konnten, aber für die erste Saison Driverless sollte es auf jeden Fall ausreichen. So konnten wir schon einmal Erfahrung für ein richtiges Elektroauto zu sammeln.

Therefore, I recommend the two-track approach by building a test car for DV first, if you have the resources.

Ich würde tatsächlich empfehlen, wenn man die Ressourcen hat, so zweigleisig zu fahren, dass man sich erstmal ein Testauto für DV baut.



HAWKS has been building combustion engines for 20 years now. The decision to switch to electric was certainly not without controversy. Can you tell me how this was received by the team as well as from the university side?
This was not the first time that HAWKS had discussed electrification. A few years ago, there was an idea that ended up as a concept study in the bachelor's thesis, concluding that this change would not work in the set up of our university. The combustion hardliners in the team referred to this work for a long time. They argued that the topic had already been studied but did not result in a recommendation. However, that was the minority luckily. In fact, there were an astonishing number of people in the team who were in favour of the project - including long-time internal combustion HAWKers, as well as former engine managers. In addition, the team's leadership was basically united in favour of electric at the time of the decision. In fact, the university was very pleased about this, because most of the representatives, especially from the dean's office, would have preferred electric for a long time anyway.

HAWKS hat nun 20 Jahre lang Verbrenner gebaut. Die Entscheidung auf Elektro umzusteigen war bestimmt nicht unumstritten. Kannst du mir erzählen, wie das sowohl im Team als auch von der Hochschulseite aus aufgenommen wurde?
Es war nicht das erste Mal, dass bei HAWKS über die Elektrifizierung diskutiert wurde. Es gab vor ein paar Jahren schon einmal die Idee, die dann in der Bachelorarbeit als Konzeptstudie geendet ist, mit dem Ergebnis, dass der Wechsel an der Hochschule so nicht gehe. Auf diese Arbeit beriefen sich die Verbrenner Hardliner im Team lange. Es wurde damit argumentiert, dass das Thema ja bereits untersucht wurde und nicht funktioniere. Glücklicherweise war diese Meinung in der Minderheit. Es gab tatsächlich erstaunlich viele im Team, die dafür waren - auch langjährige Verbrenner-HAWKSer, teilweise auch ehemalige Motorleiter. Und die Teamleitung war im Prinzip geschlossen für den Umstieg auf Elektro zu dem Entscheidungszeitpunkt. Tatsächlich hat sich die Hochschule darüber sehr gefreut, weil die meisten Vertreter, vor allem aus dem Dekanat, sowieso schon lange eigentlich lieber Elektro gehabt hätten.

HAWKS Racing – University of Applied Sciences Hamburg

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After you built a working driverless car last year, you did not manage to go to Hockenheim. What was the reason for that?
The short answer is: the car was not finished, or rather it failed because it was not yet ready to drive at VSV (Vehicle Status Video). The drivetrain cost us a lot of time, even if it was only a small battery. Despite buying a lot of parts, we had problems that we did not expect. So, the biggest challenge was to get the whole thing running in a reasonable way so that all the safety systems would work.

How should the Driverless development at HAWKS be continued?
We are currently driving double tracked. On the one hand, we now have our DV test vehicle, which has already been driven and is almost finished. We are using it as a test platform to further develop the software. These activities suffered a lot last year and therefore we did not advance as much as planned. Adding the fact that we did not compete in DV last year we decided on a change of plan. Now we do not do the DV integration into the EV car directly but much rather tackle the changeover to a real high voltage (HV) electric car for the time being. However, during the redesign, we made sure that the steering and brake systems were designed in such a way that the future DV actuators have already been considered by the constructors.

Many other teams are now facing the same change, switching from a combustion car to a driverless and electric car in one. Would you like to give these teams some advise to keep in mind?
Switching from combustion non driverless to electric driverless presents two very different challenges at the same time. Therefore, I recommend the two-track approach by building a test car for DV first, if you have the resources. However, now that Driverless is no longer a separate class, it is more difficult to vote on this approach. We as a team do not regret the intermediate step. However, now you have to compromise on your performance in Hockenheim. That is why it is always difficult to justify this approach as well as to find the time for building two cars in parallel.

Nachdem ihr jetzt letztes Jahr ein funktionierendes Driverless Auto gebaut habt, habt ihr es nicht geschafft nach Hockenheim zu fahren. Woran hat das gelegen?
Die kurze Antwort ist: das Auto war nicht fertig bzw. war zum Zeitpunkt der VSV nicht fahrbereit. Viel Zeit hat uns der Antriebsstrang gekostet, auch wenn es nur kleiner Akku war. Trotz vieler Kaufteile gab es Probleme mit denen wir nicht gerechnet hatten. Also war die größte Herausforderung das Fahrzeug sinnvoll zum Laufen zu bringen, sodass auch alle Sicherheitssysteme funktionieren.

Wie soll die Driverless Entwicklunh bei HAWKS weitergeführt werden?
Wir fahren aktuell zweigleisig. Auf der einen Seite haben wir jetzt unser DV-Testfahrzeug, das bereits gefahren und quasi fertig ist. Auf dieser Testplattform wird die Softwareentwicklung weiter vorangetrieben. Die hat in der letzen Saison stark gelitten. Daher sind wir noch nicht so weit fortgeschritten wie ursprünglich geplant. Parallel dazu – auch aufgrund der Tatsache, dass wir eben letztes Jahr nicht mit einem DV angetreten sind – haben wir entschieden, dass wir dieses Jahr mit dem Elektroumstieg nicht auch direkt EV & DV machen, sondern erstmal nur den Umstieg auf ein richtiges HV-Elektroauto angehen. Allerdings haben wir direkt bei der Neukonstruktion darauf geachtet, dass die entsprechenden Stellen in der Lenkung und dem Bremssystem so konzipiert wurden, dass die zukünftigen DV-Aktoren bereits berücksichtigt sind.

Viele andere Teams stehen jetzt ja genau vor demselben Wechsel, das heißt vom Verbrenner Auto gleichzeitig zu einem Driverless Elektroauto umzusteigen. Würdest du diesen Teams noch einen Rat mitgeben wollen worauf Sie achten müssen?
Von Combustion aufElektro und gleichzeitig auf Driverless umzusteigen, bringt zwei ganz unterschiedliche Herausforderungen mit sich. Das heißt, ja, ich würde tatsächlich empfehlen, sofern möglich zweigleisig zu fahren und ein Testauto für DV aufzubauen. Dadurch, dass Driverless keine separate Klasse mehr ist, ist es schwieriger diesen Ansatz zu verargumentieren. Als Team bereuen wir diesen Zwischenschritt nicht. Nichtsdestotrotz wird man so seine Performance in Hockenheim negativ beeinträchtigen. Das ist natürlich schwer im Team zu vermitteln, vor allem wenn man gleichzeitig an zwei Autos parallel arbeitet.

Awards 2022

Results:

https://fsg.one/results

	Formula Student	Combustion	Electric	Driverless
OVERALL	1st Place Overall	SUN	SUN	SUN
	2nd Place Overall	SUN	SUN	SUN
	3rd Place Overall	SUN	SUN	SUN
DYNAMICS	Acceleration Winner	SAT	SAT	–
	Autocross Winner	SUN	SUN	–
	Endurance Winner	SUN	SUN	–
	Skid Pad Winner	SAT	SAT	–
	Most Fuel/Energy Efficient Car	SUN	SUN	–
	DV Acceleration	SAT	SAT	–
	DV Skid Pad	SAT	SAT	–
	DV Autocross	–	–	SUN
	Trackdrive	–	–	SUN
STATICS	Business	SAT	SAT	–
	Cost	SAT	SAT	–
	Design	SAT	SAT	SAT
SPECIAL AWARDS	FSG Siemens Digital Twin Engineering Excellence Award		SAT	

STATUS/STAND: 14.07.2022

Schedule 2022

https://today.formulastudent.de

Mon, 8th of August

13:00	C E	Technical Inspection-, Registration- & Entrance Order Available	V	Website

Mon, 15th of August

08:00 - 08:30	E	Registration + Entrance for 30 Teams (7 Members)	11+8	South Stand, Pits
08:00 - 23:59	E	Pits available	8	Pits
09:30 - 10:00	E	Registration + Entrance for 10 Teams (7 Members)	11+8	South Stand, Pits
10:00 - 20:00	E	Technical Inspections (A, D, E, M & P)	2+3	Charging Tent, Dynamic Area
10:00 - 22:00	E	Charging Tent available	2	Charging Tent
12:00 - 12:30	E	Registration + Entrance for 30 Teams (7 Members)	11+8	South Stand, Pits

Tue, 16th of August

07:00 - 22:00	E	Charging Tent available	2	Charging Tent
07:00 - 23:59	E	Pits available	8	Pits
07:45 - 12:30	E	Event Control	5	Event Control
09:00 - 13:00	E	Technical Inspections (A, D, E, M & P)	2+3	Charging Tent, Dynamic Area
09:00 - 19:00	C E	Emergency Brake System (EBS) Test	12	Start/Finish Line
13:00 - 19:00	C E	Engine Test *	3	Dynamic Area
13:00 - 19:00	C E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area
14:00 - 19:00	C E	Event Control	5	Event Control
15:00 - 17:30	C	Registration for 30 CV Teams	14	Ticket Centre
15:30 - 19:00	C	Entrance for 30 CV Team Vehicles + All Members	0	Venue
15:30 - 23:59	C E	Pits & Recreation Tent available	8+10	Pits, Recreation Tent
21:00 - 22:00	C E	Team Welcome	7	Marquee Above Pits

Wed, 17th of August

06:00 - 22:00	E	Charging Tent available	2	Charging Tent
06:00 - 23:59	C E	Pits & Recreation Tent available	8+10	Pits, Recreation Tent
07:45 - 12:30	C E	Event Control	5	Event Control
07:45 - 18:00	C E	Ticket Centre	14	Ticket Centre
08:00 - 13:00	C E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area
08:00 - 18:00	C E	Welding Station	8	Welding Station
09:00 - 18:00	C E	FSG Academy On Site	11	South Stand
09:00 - 19:00	C E	Emergency Brake System (EBS) Test	12	Start/Finish Line
09:00 - 19:00	C E	Engine Test	3	Dynamic Area
10:10 - 18:05	E	Business Plan Presentation	1+9	BW Tower, Ravenol Tower
10:15 - 16:15	C	Cost Analysis, Engineering Design	7	Marquee Above Pits
13:00 - 18:30	C E	Practice Track DV + MV	3	Dynamic Area - A
13:00 - 20:00	E	Team Photos	7	Marquee Above Pits
14:00 - 19:00	C E	Event Control	5	Event Control
14:00 - 19:00	C E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area

Thu, 18th of August

06:00 - 18:30	C E	Recreation Tent available	10	Recreation Tent
06:00 - 22:00	E	Charging Tent available	2	Charging Tent
06:00 - 23:59	C E	Pits available	8	Pits
07:45 - 12:30	C E	Event Control	5	Event Control
07:45 - 18:00	C E	Ticket Centre	14	Ticket Centre
08:00 - 13:00	C E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area
08:00 - 18:00	C E	Welding Station	8	Welding Station
08:30 - 18:30	C E	Practice Track DV + MV	3	Dynamic Area - A
08:30 - 18:30	C E		13	Test Area - B
08:40 - 15:30	C	Business Plan Presentation	1+9	BW Tower, Ravenol Tower
08:45 - 15:40	E	Cost Analysis, Engineering Design	7	Marquee Above Pits
09:00 - 12:00	C E	Emergency Brake System (EBS) Test	12	Start/Finish Line
09:00 - 18:00	C E	FSG Academy On Site	11	South Stand
09:00 - 19:00	C E	Engine Test	3	Dynamic Area
11:15 - 17:30	C	Team Photos	7	Marquee Above Pits
14:00 - 19:00	C E	Event Control	5	Event Control
14:00 - 19:00	C E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area
15:00 - 18:00	C E	Driverless Skidpad	3	Dynamic Area - B
16:00 - 19:00	C E	Emergency Brake System (EBS) Test *	3	Dynamic Area
17:00 - 17:30	C E	Presentation: Realisation of a FS Hydrogen Car	7	Marquee Above Pits
17:30 - 19:00	C E	Business Plan Presentation Finals	7	Marquee Above Pits
18:30 - 19:30	C E	Staging for Panoramic Photograph	3	Dynamic Area
19:00 - 21:00	C	Engineering Design Finals (not public)	6	FSG Forum

Fr, 19th of August

06:00 - 22:00	E	Charging Tent available	2	Charging Tent
06:00 - 23:59	C E	Pits & Recreation Tent available	8+10	Pits, Recreation Tent
07:15 - 12:30	C E	Event Control	5	Event Control
07:45 - 18:00	C E	Ticket Centre	14	Ticket Centre
08:00 - 12:00	C E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake *	2+3	Charging Tent, Dynamic Area
08:00 - 18:00	C E	Welding Station	8	Welding Station
08:30 - 11:30	C E	Manual Skidpad	3	Dynamic Area - B
08:30 - 18:30	C E	Engine Test	3	Dynamic Area
08:30 - 18:30	C E	Practice Track DV	13	Test Area - B
08:30 - 18:30	C E	Practice Track MV	3	Dynamic Area - A
09:00 - 10:00	C E	Design Review	7	Marquee Above Pits
09:00 - 11:50	C E	Cost Finals	1	BW Tower 4.floor
09:00 - 17:00	C E	Emergency Brake System (EBS) Test *	3	Dynamic Area
09:00 - 18:00	C E	FSG Academy On Site	11	South Stand
09:30 - 12:30	C E	Driverless Acceleration	12	Start/Finish Line
10:00 - 12:00	C E	Design Feedback: Judges available	7	Marquee Above Pits
12:00 - 12:45		Press Guided Tour	1	Assembly at entrance BW Tower
13:00 - 14:00		VIP & Press Reception	1	BW Tower 5.floor
13:00 - 18:00	C E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake *	2+3	Charging Tent, Dynamic Area
13:30 - 16:30	C E	Manual Acceleration	12	Start/Finish Line
14:00 - 19:00	C E	Event Control	5	Event Control
15:00 - 15:25	C E	Driverless Autocross Course Walk	3	Dynamic Area - B
15:30 - 18:30	C E	Driverless Autocross	3	Dynamic Area - B
19:00 - 22:00	E	Engineering Design Finals (not public)	6	FSG Forum

Sat, 20th of August

06:00 - 22:00	E	Charging Tent available	2	Charging Tent
06:00 - 23:59	C E	Pits available	8	Pits
07:15 - 12:30	C E	Event Control	5	Event Control
07:45 - 18:00	C E	Ticket Centre	14	Ticket Centre
08:00 - 12:00	C E	Driverless Trackdrive	3	Dynamic Area - B
08:00 - 18:00	C E	Welding Station	8	Welding Station
08:30 - 18:30	C E	Practice Track DV + MV	13	Test Area - A
08:30 - 18:30	C E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake *	2+3	Charging Tent, Dynamic Area
08:30 - 19:00	C E	Engine Test	3	Dynamic Area
13:00 - 13:25	C E	Autocross Course Walk	3	Dynamic Area
13:30 - 19:00	C E	Manual Autocross	3	Dynamic Area
14:00 - 19:00	C E	Event Control	5	Event Control
19:00 - 20:00	C E	Free Food powered by VW Group	0	Venue
21:00 - 22:30	C E	Awards Ceremony - Part I	7	Marquee Above Pits

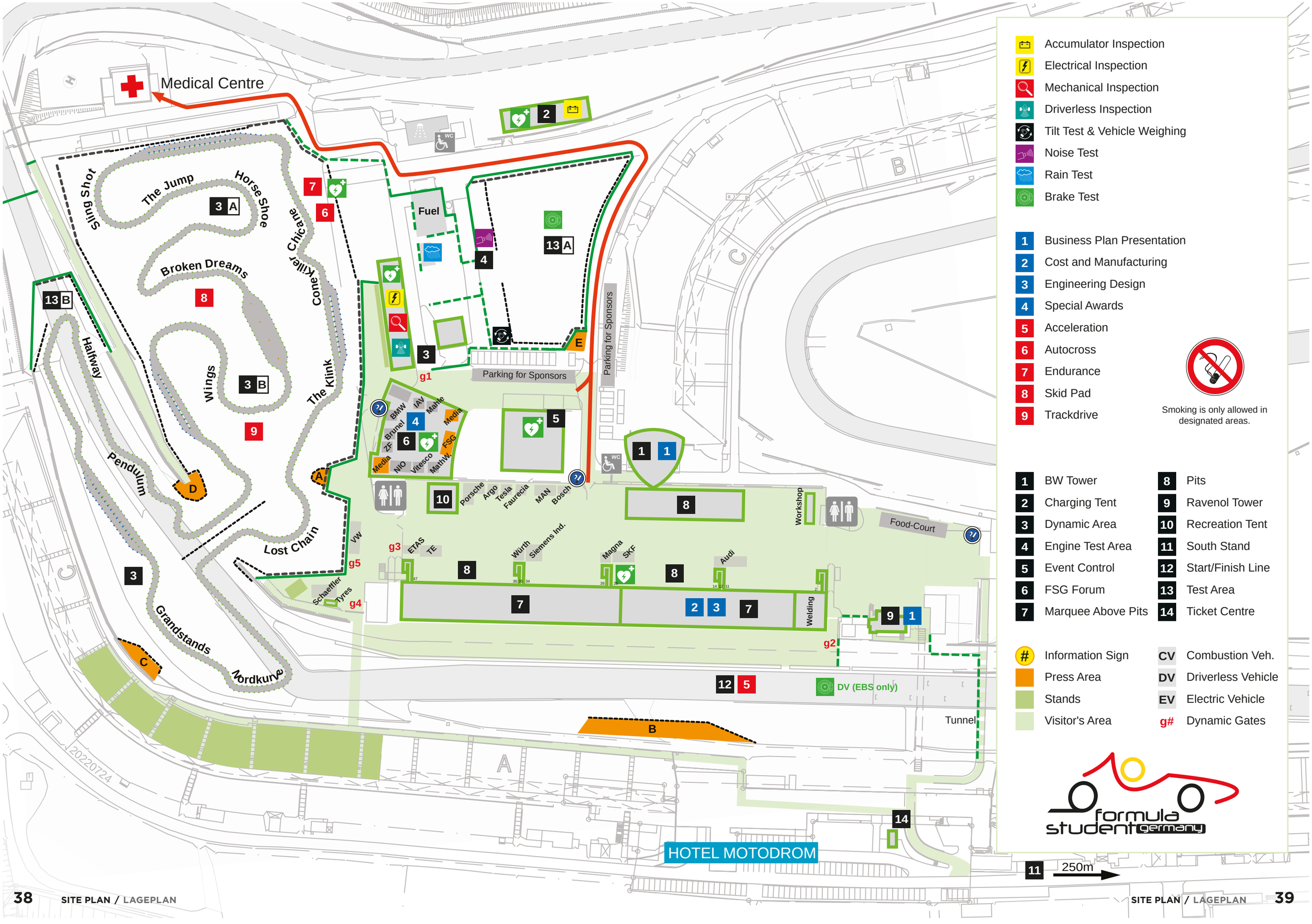
Sun, 21th of August

06:00 - 15:00	C E	Recreation Tent available	10	Recreation Tent
06:00 - 19:00	C E	Pits available	8	Pits
06:00 - 19:00	E	Charging Tent available	2	Charging Tent
07:15 - 12:30	C E	Event Control	5	Event Control
07:45 - 18:00	C E	Ticket Centre	14	Ticket Centre
08:00 - 08:25	C E	Endurance Course Walk	3	Dynamic Area
08:00 - 18:00	C E	Welding Station	8	Welding Station
08:30 - 12:00	C E	Practice Track DV + MV	13	Test Area - A
08:30 - 16:30	C E	Engine Test	3	Dynamic Area
08:30 - 17:00	C E	Endurance	3	Dynamic Area
12:00 - 19:00	C E	Dismantling of Pits	8	Pits
14:00 - 19:00	C E	Event Control	5	Event Control
20:00 - 21:00	C E	Awards Ceremony - Part II	7	Marquee Above Pits
21:00 - 23:59	C E	MAHLE-Party	7	Marquee Above Pits

Abbreviations
CV - Internal Combustion Engine Vehicle, DV - Driverless Vehicle, EV - Electric Vehicle, MV – Manual driven Vehicle
Technical Inspections (A, D, E, M & P): Accumulator-, Driverless-, Electrical- Mechanical- & Pre-Inspection

* on request

STATUS/STAND: 27.07.2022


Medical Centre
Sling Shot
The Jump
Horse Shoe
Broken Dreams
Chicane
Killer
Cone
Halfway
Wings
The Klink
Pendulum
Lost Chain
Grandstands
Nordkurve
Fuel
Parking for Sponsors
Parking for Sponsors
g1
g2
g3
g4
g5
BMW
IAV
Mahle
Media
Brunel
ZF
FSG
NIO
Vitesco
MathW.
Porsche
Argo
Tesla
Faurecia
MAN
Bosch
Workshop
Food-Court
Würth
Siemens Ind.
ETAS
TE
Magna
SKF
Audi
Welding
Schaeffler
Tyres
VW
DV (EBS only)
Tunnel
HOTEL MOTODROM
20220724
A
B
C
D
E
WC
Accumulator Inspection
Electrical Inspection
Mechanical Inspection
Driverless Inspection
Tilt Test & Vehicle Weighing
Noise Test
Rain Test
Brake Test
1 Business Plan Presentation
2 Cost and Manufacturing
3 Engineering Design
4 Special Awards
5 Acceleration
6 Autocross
7 Endurance
8 Skid Pad
9 Trackdrive
Smoking is only allowed in designated areas.
1 BW Tower
2 Charging Tent
3 Dynamic Area
4 Engine Test Area
5 Event Control
6 FSG Forum
7 Marquee Above Pits
8 Pits
9 Ravenol Tower
10 Recreation Tent
11 South Stand
12 Start/Finish Line
13 Test Area
14 Ticket Centre
Information Sign
Press Area
Stands
Visitor's Area
CV Combustion Veh.
DV Driverless Vehicle
EV Electric Vehicle
g# Dynamic Gates
formula student germany
250m

Guided Tours

Time schedule / Führungszeiten Guided Tours

https://fsg.one/gtours

Exploring Formula Student Germany by yourself or on a Guided Tour

Welcome to Formula Student Germany. To help you make the most of your visit, we have prepared different tours for visitors, press and sponsors. You can follow the tour by following the numbered signs across the event site (see map above). If you wish, for a more personal experience, you can also sign up to be guided by one of our experienced tour guides.

Registering for a guided tour

If you would like to sign up for a guided tour, please head to the counter in the FSG forum, where you will be able to get more information on the timetable for the daily tours.

Exploring on your own

The information signs are numbered 1 to 11. Following them in order will take you from the large dynamic area to the technical inspection and then on to the pit lane. Along the way you will learn about the history of the competition as well as the different competitions running in parallel (Combustion, Electric and Driverless Cup). Don't be shy to ask team members anything you would like to know about their car, however, please remember they are participating in a competition, so make sure not to hinder them! From the pit lane, the tour takes you back to the large dynamic area. The tour will finish back at the FSG Forum, where you will be able to learn more about the future of the FSG competition.

Entdecken Sie die Formula Student Germany auf eigene Faust oder durch eine geführte Tour

Herzlich Willkommen bei der Formula Student Germany! Um das Beste aus Ihrem Besuch zu machen, haben wir verschiedene Touren für Besucher, Presse oder Sponsoren vorbereitet. Die Tour verläuft entlang nummerierter Event-Stationen, quer über das Wettbewerbsgelände (siehe Karte). Für eine noch persönlichere Erfahrung können Sie sich gerne für eine geführte Tour bei einem unserer erfahrenen Tourguides anmelden.

Registrierung für eine geführte Tour

Wenn Sie sich für eine Führung anmelden möchten, wenden Sie sich bitte an den Counter im FSG Forum. Dort bekommen Sie weiterführende Informationen über die Uhrzeiten der täglichen Führungen.

FSG auf eigene Faust

Wenn Sie den Schildern der Reihe nach folgen (1-11), gelangen Sie vom großen fahrdynamischen Bereich (Dynamic Area) über die technische Abnahme (Technical Inspection) in die Boxengasse (Pit Lane). Auf dem Weg werden Sie einiges über die Geschichte des Events sowie die unterschiedlichen parallel stattfindenden Wettbewerbe (Combustion, Electric und Driverless Cup) in Erfahrung bringen können. Nutzen Sie die Gelegenheit und stellen den Teammitgliedern gerne jede Frage, die Ihnen auf der Seele brennt. Vergessen Sie dabei aber bitte nicht, dass sich die Studierenden im Wettkampf befinden und nicht behindert werden sollten. Von der Pit Lane führt die Tour zurück zum großen fahrdynamischen Bereich und endet am FSG Forum. Hier angekommen, warten noch weitere Informationen zur Zukunft der Formula Student Germany auf Sie.

We want to inform you via every possible channel. Stay tuned and have a look!

@FormulaStudentG

Twitter: Receive quick updates in abbreviated form.
https://fsg.one/tw

formulastudentgermany

Instagram: Get inspiration via picture and videos.
https://fsg.one/ig

@FSGeV

Facebook: Be informed daily by a brief summary of the highlights.
https://fsg.one/fb

formulastudenttv

Youtube Live-Stream:
The most important races will be broadcasted live.
▸ **Our tipp:** Do you already know our Youtube Playlist?
The best way to reminisce about previous highlights.
https://fsg.one/yt

LinkedIn

Follow our company page and connect with people who share the same passion.
https://fsg.one/in

Photos

FSG Media: Get access to all the official photos taken by our media team.
https://fsg.one/photos22

The Volunteers of FSG
Die Ehrenamtlichen der FSG

It takes around 400 volunteers to bring Formula Student Germany to life every year. The team of volunteer's function like a well-oiled machine, tackling the ever-growing challenges of the annual event with honed skill and passionate dedication. The volunteers are divided into different groups according to their skill set. For example, there are the Scrutineers, the Judges, the Red Shirts and the White Shirts. These are people who handle the many tasks of planning, organising and running the event, as well as helping out and answering questions. The colour of their shirt will tell you what their role is at FSG.

Über 400 ehrenamtliche Helfer sind Jahr für Jahr an der Organisation und der Umsetzung der Formula Student Germany beteiligt. Wie eine gut geölte Maschine meistern sie mit Leidenschaft und Engagement die stetig wachsenden Herausforderungen, die das Event jedes Jahr aufs Neue mit sich bringt. Das eingespielte Team setzt sich aus verschiedenen Funktionsbereichen zusammen. So gibt es beispielsweise die Scrutineers, die Juroren, die Red Shirts und die White Shirts, welche die Vielzahl an Aufgaben beim Planen, Organisieren und bei der Umsetzung vor Ort bewältigen und welche stets für Fragen rund um das Event zur Verfügung stehen. Anhand der Farbe ihres Shirts kann man leicht ihre Rolle bei der FSG erkennen.

White Shirts 2022

FRANK RÖSKE
Board

RAINER KÖTKE
Board (FSG e.V. Finance)

CATHARINA SCHIFFTER
EC (Communications)

PHILIPP BANDOW
EC (Digital Officer)

SEBASTIAN HOPPE
EC (Statics) & OT (Cost Event)

STEFFEN HEMER
EC (FS-Driverless)

ANKE LACHMANN
OT (VIP Lounge & Culina)

BJÖRN GERNERT
OT (IT)

CHRISTOPH BEISSWANGER
OT (Mechanical Inspection)

ESTHER TROMP
OT (Event Management)

DANIEL MAZUR
Board (GmbH Managing Director)

LUDWIG VOLLRATH
Board (FSG External Relations)

TIM HANNIG
Board (FSG e.V. Chairman)

JOCHEN SCHMIDT
EC (Dynamics)

SEBASTIAN SEEWALDT
EC (Rules)

SIMON DENSBORN
EC (Technical Inspection)

AARON BAUFELD
OT (Dynamics)

BARBARA DECKER-SCHLÖGL
OT (Event Support)

CHRISTIAN AMERSBACH
OT (FS-Driverless)

DANIEL BRONTSCH
OT (Cost Event)

FABIAN LIESCH
OT (IT & TK)

HINRICH GREFE
OT (Event Support)

JENS KEGELMANN
OT (Business Plan Presentation)

JOE MARTIN
OT (Design Event)

KONRAD BAYER
OT (Event Support)

MARTIN STOLLBERGER
OT (Driverless Inspection)

MATTHÄUS DECKER
OT (Event Support)

MORITZ HÖWER
OT (Scoring)

PHILIPP VAUDLET
OT (Pit Marshal)

SARAH BATTIGE
OT (Electrical Inspection)

SVEN GRUNDNER
OT (Back Office)

THERESA STACH
OT (Communications)

JENNIFER STRATMANN
OT (Communications)

JET TUITERT
OT (Mechanical Inspection)

JOHANNES SCHWARZER
OT (Event Support)

LEA VAUDLET
OT (Event Control)

MATHIAS GEBHARDT
OT (Electrical Inspection)

MATTHIAS BRUTSCHIN
OT (Security & Event Support)

NICOLE GEIER
OT (Registration, Tickets & Sustainability)

ROBERT WEINGART
OT (Design Event)

STEPHAN KRÜGER
OT (Pit Marshal)

TANJA HOFMANN
OT (Security)

YANNIC SCHRÖDER
OT (Timekeeping)

The **white shirts** are in charge of the yearlong task of planning the event and of ensuring that everything falls into place as it should on race day. They are the "go-to" people for sponsors, press, participants and visitors and they ensure that the competition runs without a hitch.

Die **White Shirts** sind für die ganzjährige Planung der Veranstaltung und deren reibungslose Umsetzung an den Renntagen verantwortlich. Sie sind Ansprechpartner für Sponsoren, Medienvertreter, Teilnehmer und Besucher und stellen sicher, dass der Wettbewerb ohne Komplikationen verläuft.

Blue Shirts 2022

Since FSG is essentially a design competition, a team's scoring in the static disciplines is a big factor in its overall standing. It is the job of the judges in their **blue shirts** to render these scorings. They look at the design, manufacturing quality and cost planning; they consider the economics of the project and whether the business plan is convincing. For this, they utilize their professional expertise, indispensable honesty and constructive criticism. Their feedback has resulted in the extensive improvements from the teams over the past years.

Da es sich bei der FSG im Wesentlichen um einen Konstruktionswettbewerb handelt, tragen die statischen Disziplinen in erheblichem Maße zur Gesamtwertung bei. Die in **blau gekleideten Juroren** bewerten die Entwicklung, Fertigungsgüte sowie das Kostenbewusstsein der Studenten. Sie betrachten die Wirtschaftlichkeit des Gesamtprojektes ebenso wie die Präsentation der detaillierten Geschäftspläne und nutzen dabei ihre Expertise und unvergleichlich ehrlich sowie konstruktive Kritik, welche bereits in vergangenen Jahren positiv zur Weiterentwicklung der Studenten beigetragen hat.

Business

BURKHARDT, Thomas / **CAVIGLIA**, Alberto / **FERKEN**, Reiner / **GAIER**, Michael / **GEIGLE**, Monika / **HEIDEMEYER**, Peter / **HERZHAUSER**, Erik / **HODGKINSON**, Raymond / **HODGKINSON**, Philip / **KESSENICH**, Martin / **MARCHEWICZ**, Christoph / **MERKL**, Julia / **NÄTHER**, Sylvio / **NUSCHELER**, Barbara Christine / **PETERS**, Jan / **REICHL**, Dominik / **SCHOLZ**, Thomas / **STRATEMEIER**, Frank / **WALTHER**, Vanessa

Design

AERTS, Joris / **ALAKSHENDRA**, Veer / **ALTENBURGER**, Nicolas / **BAENSCH**, Simon / **BRAIG**, Johannes / **BREMKAMP**, Joerg / **CINAR**, Jeyan / **COSTA**, Pedro / **DECKERS**, Jean-Noel / **DIPPOLT**, Alexander / **DÖLLE**, Norbert / **DOMME**, Markus / **ENDER**, Stefan / **EVANS**, David / **FELC**, Igor / **FERRAZ DE OLIVEIRA**, Matheus / **FRIES**, Benedikt / **FROEMMIG**, Lars / **FUCHS**, Jonas / **FURTADO**, John / **GARDUNO**, Luis / **GÍSLASON**, Óttar / **GORASIA**, Jay / **GOY**, Florian / **GREGER**, Klaus / **GRUBER**, Gregor / **GUACCI**, Mattia / **HACKL**, Andreas / **HANISCH**, Thomas / **HAUSER**, Mirko / **JAIPURIA**, Pranay / **KRAUS**, Mike / **KREIENBORG**, Christian / **LOPEZ**, Jose / **MATA**, Nuria / **MATZKE**, Stefan / **MUELBL**, Gregor / **MÜLLER**, Sebastian / **MÜLLER**, Marko / **MUR**, Lukas / **NIEMEYER**, Constantin / **NOWICKI**, Daniel / **PERRIN**, Ethan / **RAIHAN**, Dinar / **REINIG**, Michael / **REZSNYAK**, Tamas / **RICHTER**, Christian / **ROBERT**, Fabian / **RÖDER**, Johannes / **ROUELLE**, Claude / **RÜDINGER**, Maximilian / **SANTOS MORGADO DA COSTA**, Fabio / **SCHÄFER**, Simon / **SCHENK**, Christian / **SCHEUERMANN**, Michael / **SCHEUERMANN**, Michael / **SCHMÜLLING**, Christoph / **SCHRAML**, Marcel / **SCHULZ**, Mario / **SEILER**, Peter / **STABROTH**, Waldemar / **STELZIG**, Michael / **STOLLE**, Ludwig / **TORGOVNIKOV**, Eugen / **VAN DER PLOEG**, Chris / **VAN DER WIJST**, Hugo / **VAN DIJK**, Sander / **VAN MOORSEL**, Len / **VELA**, Nicolas / **WEBER**, Martin / **WEIMAR**, Jan / **WERNER**, HP / **WIESINGER**, Michael / **WITTE**, Christian / **WÖHLER**, Konrad / **WUNSCHHEIM**, Lukas / **ZEISLER**, Jöran / **ZIMMERMANN**, Hannes / **ZÖLS**, Thomas

Cost

BERTRAM, Michael / **BLASCHCZOK**, Thomas / **BRÜCKNER**, Jan / **BÜCHELER**, Matthias / **FRYE**, Hermann / **GRUNDNER**, Harald / **HERGETH**, Carl / **HERTH**, Martin / **KOCH**, Richard / **KREUTZ**, Kim / **KÜHNE**, Alexander / **LUNDBERG**, Alexander / **MEIER**, Peter / **MICHEL**, Martin / **NICKO**, Thomas / **SIBUM**, Alexander / **WINKLER**, Tino / **WOLPERT**, Sven

Red Shirts 2022

The **red shirts** have jurisdiction over event control and event support. The support team takes care of building up and taking down of every physical transformation that turns the Hockenheim Ring into Formula Student Germany. We need them to ensure that the event runs smoothly. They also act as the track marshals during dynamic events.

Furthermore, they are in charge of the event control team, serving as intermediaries between visitors, team members, sponsors and press, so that nobody on the FSG grounds can get left lost or stranded. The **red shirts** are the largest group of volunteers at FSG and are the ones who will do what it takes to overcome any challenges that might be faced during the event.

Die **Red Shirts** sind für die Bereiche „Event Control“ und „Event Support“ zuständig. Das Support-Team kümmert sich um den Auf- und Abbau aller infrastrukturellen Bestandteile, die den Hockenheimring in die Formula Student Germany verwandeln. Sie sind die fleißigen Helfer, welche sicherstellen, dass das Event ohne Störungen verläuft. Darüber hinaus kommen die ehrenamtlichen Helfer als Streckenposten während der dynamischen Disziplinen zum Einsatz.

Zudem besetzen sie das Event Control-Team und bilden damit die Schnittstelle zwischen Besuchern, Teammitgliedern, Sponsoren und Medienvertretern. Sie sorgen dafür, dass niemand hilflos auf dem Gelände zurückbleibt. Die **Red Shirts** stellen insgesamt die größte Gruppe ehrenamtlicher Helfer bei der FSG dar. Nur durch ihre Hilfe ist es überhaupt möglich, die vielseitigen und mitunter spontanen Herausforderungen während des Events zu meistern.

ANDERSEN, Sabrina / **BACH MELLERGAARD**, Simon / **BAEZ**, Marta / **BAGER**, Magnus / **BAIOLI**, Stefano / **BALASUBRAMANI**, Vignesh / **BAROLO**, Emanuele / **BEDENK**, Lena / **BORRMANN**, Daniel / **BOUDALI**, Omar / **BUHVESTOVA**, Jane-Ly / **BÜTTNER**, Franziska-Isabella / **CHOUDHARI**, Mohammadimran / **DEMEURICY**, Paul / **DESINGER**, Karina / **EDENHOFER**, Kathrin / **ELMASRY**, Yehia / **ENRÍQUEZ ROMERO**, Rafael / **FARINHA**, Pedro / **FINDEISEN**, Jan / **GONZÁLEZ CRUZ**, Irene / **GRASSHOFF**, Anna / **GRASSHOFF**, Lara / **HEIN**, Niklas / **HEUTER**, Pascal / **HIREMATH**, Vaibhav Shanmukhayya / **JEITNER**, Timo / **JOSTEN**, Jonas / **JUNEJA**, Karan / **KLEIN**, Christian / **KOHLER**, Fabian / **KOLB**, Luise / **KOTLARSKI**, Tobias / **KOTOWSKI RAMOS**, Philippe / **KÜHNE**, Alexander / **KURUGOD**, Vijay Shanker / **LANGE**, Jennifer Sissi / **LANSNICKER**, Liv / **LANSNICKER-DIETRICH**, Bärbel / **LEHKOBYT**, Oleksandra / **LEHMANN**, Alexandra / **LERINGER**, Nora / **LIEBHOLD**, Robert / **LIU**, Jo Yuan / **LORENZEN**, Morten / **LUGOSI**, Lilla / **MANIVANNAN**, Navaneet Gokul / **MARTYNUS**, Oliver / **MEYER**, Regina / **MIRET PROS**, Marc / **MIRONOVA**, Arina / **MOLITOR**, Juliane / **MÜLLER**, György / **MÜLLER**, Gábor / **MUÑOZ**, Paula / **MWEMA**, Faith / **NASSAR SARMIENTO**, Mauricio Andres / **NGUYEN**, Amely May / **PANDEY**, Rahul / **PARHAMMER**, Joshua / **PATIL**, Jainmejay / **PÉREZ MENDOZA**, Ana Cristina / **PETERS**, Jannik / **PHAM**, Phong / **PISSARRECK**, Mona / **POLLINI**, Isabel / **POSTER**, Lisa / **PRAJAPATI**, Kajal / **PROSSEL**, Dominik / **RAMASAMY**, Vikram / **RAO**, Mandar / **RODRÍGUEZ**, Pablo / **ROUTRAY**, Anubhav / **SANCHEZ**, Juan Sebastiam / **SCHÄFER**, Bastian / **SHAH**, Shanay / **SHINDE**, Ayush Machhindra / **SIDHIQUE**, Basith / **SINGH**, Yatin / **TCHIMOU**, Akouwa Inès / **TIRADO MAYER**, Alan / **TÓTH**, Álmos / **TRAISNEL**, Timothy / **TRANTA**, Bjoern / **TRUELSEN**, Thomas / **VADLAMUDI**, Yasonandan / **VALVERDE CEBRIÁN**, Marta / **VAUDLET**, Oliver / **WILDEBOER**, Dominic / **YILMAZ**, Miray

Scrutineers 2022

The **scrutineers** – the folks in **green** –are there to guarantee that all the vehicles are safe. They accomplish this by meticulously checking the cars for potential safety hazards and patiently assisting the teams with any technical problems (at the event as well as throughout the year). A team may not participate in the dynamic events with – out receiving the go-ahead from our **green shirted** volunteers.

Die **Scrutineers** – die „Leute in **Grün**“ – stellen die Sicherheit aller teilnehmenden Fahrzeuge sicher. Sie überprüfen die Boliden der Teilnehmer akribisch genau auf etwaige Sicherheitsmängel und stehen den Teams bei technischen Problemen mit ihrer Expertise helfend zur Seite (sowohl am Event selbst, wie auch während des Jahres). Als Team darf man ohne die Freigabe unserer **grün gekleideten** Helfer nicht an den dynamischen Disziplinen teilnehmen.

BAYERLEIN, Michael / **BENTO**, António / **BLEICHER**, Maximilian / **BROCKMANN**, Jan Thieß / **BUSCHMANN**, Johannes / **CORREIA**, André / **ECKERT**, Marcel / **FERREIRA**, Ricardo / **FRIEDEMANN**, Max / **GROH**, Jonas / **GUPTA**, Shivam / **HOHMUTH**, Richard / **HÖRSCH**, Moritz / **KLEIN**, Julian / **KUSHARE**, Pavan / **MOCH**, Fabian / **PANG**, Jacky / **ROSSAK**, Philipp / **RUPPRECHT**, Stefan / **SARRÓ VERDÚ**, Alejandro / **VAN DEN BRANDT**, Dennis / **VELZ**, Nicolas / **ALT**, Janine / **BÄUERLEIN**, Sonja / **BRECHTMANN**, Nick / **BUSCHHAUS**, Samuel / **CARNICERO CORTÉS**, Álex / **CLEMENS**, Oliver / **DIETZEL**, Michael / **FORMILAN**, Vittoria / **GIEST**, Carl / **GOPINATHAN**, Surendran / **HEIDBRINK**, Max / **IZQUIERDO SUSÍN**, David / **LUBKOWITZ**, Victor / **MAUSS**, Marius / **MUSCHALLE**, Carsten / **OEHMKE**, Martin / **POLT**, Markus / **SCHULTE**, Tim / **STEINFURTH**, Ulf / **THOMASSEN**, Kevin / **TIEMANN**, Maik

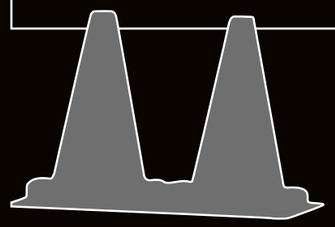
Communications & Media, Timekeeping & IT 2022

Behind the scenes we have the **IT experts**, who are tasked with timekeeping during the dynamic disciplines as well as ensuring that all teams are given a fair and equal assessment. Not only this, but it is thanks to them that everyone at FSG can enjoy a high-speed Internet connection through – out the entire event site!

Ebenfalls oft im Verborgenen arbeiten unsere in schwarz gekleideten **IT Spezialisten**, welche für die Zeitnahme bei den dynamischen Disziplinen verantwortlich sind und sicherstellen, dass jedes Team eine faire und gerechte Bewertung erhält. Doch nicht nur das: Dank ihnen steht allen Anwesenden bei FSG über das gesamte Eventgelände eine Highspeed-Internet-Verbindung zur Verfügung!

Timekeeping & IT

CONDE, Sergio / **GARLICHS**, Keno / **MICHALOWSKI**, Lars / **OROZCO PALMERO**, Daniel / **PETERSEN**, Torben / **REIMERS**, Dennis / **SCHLICHTER**, Jan / **TIMMERMANS**, Tristan / **VAN BALEN**, Johannes / **VAN LEEUWEN**, Tom



Finally, we have the FSG **media team**, whose contributions through their video and image materials of exceptional quality and creativity, allow us to relive the most stunning and unforgettable moments of the event again and again, long af - ter the smoke from the tires of the race cars has cleared.

Zu guter Letzt leistet das ebenfalls in **schwarz gekleidete Media-Team** in Form von Videos und Bildern seinen Beitrag, und sorgt mit beeindruckender Kreativität und Qualität dafür, dass wir die schönsten und unvergesslichsten Momente des Events auch lange nachdem sich der letzte Rauch qualmender Reifen verzogen hat, noch einmal durchleben können.

Communications & Media

BRAUSER, Austin / **DE JONG**, Stef / **DSOUZA**, Renita / **FURTADO**, Crystal / **GROBE**, Axel / **HAINDL**, Leon / **HEGEDUS**, Miki / **HOLTERMANN**, Jonas / **KLEIN**, Sinan Felix / **KOVÁCS**, Imre / **MAKNAPP**, Fabian / **MARU**, Vivek / **MOSCH**, Cornelius / **PARTENFELDER**, Maximilian / **PETERS**, Marcel / **RANKIN**, Alastair / **RAUBER**, Julian / **ROHRER**, Michael / **SCHIEWE**, Yannic / **SCHINDLER**, Corvin / **SCHUSTER**, Jakob / **SEIZINGER**, Paul / **SIMERT**, Noel / **TOSCH**, Sven / **WEBER**, Julia / **WINTERMANTEL**, Patrick / **ZILZ**, Stefan

Words from our Partners

We're building self-driving products and services to make the world's streets and roadways safe, accessible, and useful for all. Argo AI's technology is built to enable autonomous commercial services for delivery and ridesharing in cities.

Wir entwickeln selbstfahrende Produkte und Dienstleistungen, um die Straßen und Wegen der Welt für alle sicher, zugänglich und nützlich zu machen. Die Technologie von Argo AI wurde entwickelt, um autonome kommerzielle Dienste für die Bereitstellung und Mitfahrgelegenheit in Städten zu ermöglichen.

(Text: www.argo.ai, 2022.07.24)

Argo is reimagining the human journey.

Argo erfindet die menschliche Reise neu.

CHRISTIAN STARK
Talent Marketing, AUDI AG

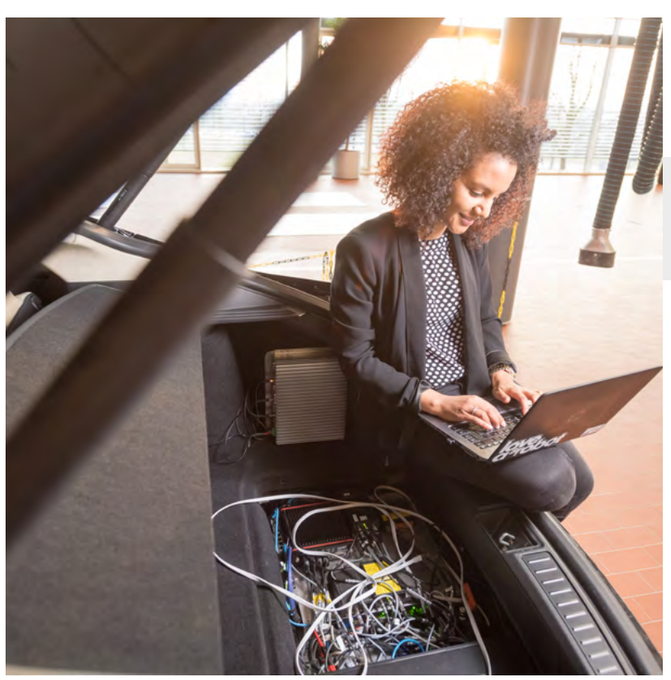
The fascination of Formula Student Germany: to us, being there means being part of a truly special atmosphere that we would not want to miss for anything. This is where we meet young, ambitious people from all over the world who are just as enthusiastic about automotive technology as we are at Audi.

Faszination Formula Student Germany: Dabei zu sein bedeutet für uns, Teil einer ganz besonderen Atmosphäre zu sein, die wir um keinen Preis missen möchten. Hier treffen wir junge und ambitionierte Menschen aus aller Welt, die von automobiler Technik genauso begeistert sind wie wir bei Audi.

OLIVER FERSCHKE
Head of HR Marketing BMW Group

Whether in R&D, IT or production, engineers play a pivotal role across the entire bandwidth of our operations. Without deep theoretical and practical know-how our visions for sustainable mobility would go nowhere. That is why we are always looking for tech-savvy students to apply their skills in highly agile and collaborative working environments.

Ob in F&E, IT oder Produktion, Ingenieure spielen bei der BMW Group eine zentrale Rolle. Nur mit fundiertem theoretischen und praktischen Know-How erreichen wir unsere Visionen für nachhaltige Mobilität. Deshalb sind wir immer auf der Suche nach technisch versierten Studenten, die ihre Fähigkeiten unter herausfordernden Arbeitsumgebungen anwenden.



HEIDI STOCK
Human Resources Management - Talent Acquisition

At Bosch, our vision is to transform our products into smart assistants for all humans by using artificial intelligence – as we do with autonomous driving. Behind this vision stand associates with individual competences, mindsets and experience – as diverse, as the teams of FSG. That's why we have supported FSG for many years.

Unsere Vision bei Bosch ist mit künstlicher Intelligenz unsere Produkte zu intelligenten Assistenten der Menschen zu machen. Wie beim autonomen Fahren. Dahinter stecken Mitarbeiter*innen mit individuellen Kompetenzen, Denkweisen und Erfahrungen – so vielfältig, wie die Teams der FSG, die wir jedes Jahr gerne unterstützen.

Brunel

MARKUS ECKHARDT
General Manager

Smart, autonomous, environmentally friendly: This is how we are shaping the future of mobility. For this, we need the talent, creativity and enthusiasm of FSG's budding engineers. Together, we share a passion for implementing forward-looking projects in engineering and IT. That is why Brunel has been supporting FSG since 2006.

Smart, autonom, umweltfreundlich: So gestalten wir die Zukunft der Mobilität. Hierfür benötigen wir das Talent, die Kreativität und Begeisterung der angehenden Ingenieure/-innen der FSG. Gemeinsam teilen wir die Leidenschaft für die Umsetzung zukunftsweisender Projekte im Engineering & der IT. Deshalb unterstützt Brunel die FSG bereits seit 2006.

ETAS

CHRISTOPH HARTUNG
President ETAS GmbH

Team spirit, commitment, passion for technology & innovation - these are the qualities that ETAS and the Formula Student teams have in common. We are feverish with our 30 teams when they show what they can do with their engineering skills, their heart and soul under the toughest conditions. We wish all teams the success to be at the forefront.

Teamspirit, Engagement, Leidenschaft für Technik & Innovation - das sind die Eigenschaften, die ETAS und die Formula Student-Teams verbinden. Wir fiebern mit unseren 30 Teams, wenn sie mit Ingenieurskunst und Herzblut unter den härtesten Bedingungen zeigen, was sie können. Wir wünschen allen Teams den Erfolg, ganz vorne mit dabei zu sein.

FORVIA faurecia

ANDREAS MARTI
Faurecia Group Country HR Director Germany

FSG participants and automotive supplier Faurecia have a lot in common: a passion for innovation, ambition, determination and the courage to find unusual and creative mobility solutions. We are proud to be a sponsor of the FSG and look forward to exchanging ideas with the dedicated and talented teams. We wish everyone lots of success!

Die Teilnehmer der FSG und der Automobilzulieferer Faurecia haben vieles gemeinsam: Leidenschaft für Innovation, Ehrgeiz, Zielstrebigkeit und den Mut zu ungewöhnlichen und kreativen Lösungen. Wir sind stolz, als Sponsor der FSG dabei zu sein, und freuen uns auf den Austausch mit denengagierten und talentierten Teams. Wir wünschen Allen viel Erfolg!

FORVIA faurecia

IAV

CHRISTIAN WILLENBERG
Employer Branding

With over 7600 members of staff, IAV is one of the world's leading providers of engineering services to the automotive industry. The company can look back on more than 35 years of experience in developing innovative concepts and technologies for future vehicle generations. For further information about IAV, go to www.iav.com/en/careers

IAV ist mit über 7.600 Mitarbeitern weltweit einer der führenden Engineering-Partner der Automobilindustrie. Das Unternehmen entwickelt seit über 35 Jahren innovative Konzepte und Technologien für zukünftige Fahrzeuggenerationen. Weitere Infos zu IAV erhalten Sie über unser Karriereportal www.iav.com/karriere

JOSEF-MARTIN LACKNER
Senior Manager Learning & Development Europe

Magna is a long-standing partner of Formula Student Germany because we believe in the development and nurturing of bold young minds in science, engineering, and technology. By encouraging young talents to learn today, they gain new perspectives to shape the future of mobility and automotive industry.

Magna ist langjähriger Partner der Formula Student Germany, denn wir glauben an die Entwicklung und Förderung mutiger junger Köpfe in Wissenschaft, Technik und Technologie. In dem wir junge Talente fördern, heute zu lernen, gewinnen sie neue Perspektiven, um die Zukunft der Mobilität und der Automobilindustrie zu gestalten.

REBECCA FAHRNHOLZ
Head of Recruiting & Employer Branding

We are a partner of Formula Student Germany, because – we want to support young people and their passion for engineering – we want to promote entrepreneurial thinking in the teams – it is simply great to believe in an idea and make it become reality – we are always looking for courageous students to revolutionize the commercial vehicle industry with us.

Wir sind Partner der Formula Student Germany, weil – wir junge Menschen und ihre Passion für Entwicklung unterstützen wollen – wir das unternehmerische Denken in den Teams fördern wollen – es einfach großartig ist gemeinsam eine Idee Wirklichkeit werden zu lassen – wir gemeinsam mit mutigen Student:innen die Nutzfahrzeugindustrie revolutionieren wollen.

DR.-ING. PETER WIESKE
Director Corporate Advanced Engineering Mechatronics

The passion for technology the talented and ambitious engineers share with us at Formula Student. Every year, new unique concepts emerge and find the appropriate stage at the Hockenheimring. We are happy to support the talents with the necessary resources and bring you a bit closer to your goal! Together we are successful. #StrongerTogether

Die Leidenschaft für Technologie teilen die talentierten Ingenieurinnen und Ingenieure bei der Formula Student mit uns. Jedes Jahr ergeben sich neue einzigartige Konzepte, die auf dem Hockenheimring die angemessene Bühne finden. Wir freuen uns die Talente mit den nötigen Ressourcen zu unterstützen! Gemeinsam sind wir erfolgreich. #StrongerTogether

DR. VEER ALAKSHENDRA
Automotive Competition Technical Lead

Employing a Model-Based Design approach to the automotive design process enables teams to design, test, validate and share their models within one environment. Using industry-standard tools such as MATLAB and Simulink help students tackle real engineering problems.
www.mathworks.com/fsg

Mit MATLAB und Simulink lösen Teams der Formula Student Germany reale, automobiltechnische Probleme. Studenten, die modell-basierte Entwicklung einsetzen, entwickeln schneller und besser. Modell-basierte Entwicklung (Model-Based Design) erlaubt Lösungen zu testen und zu validieren bevor diese im Fahrzeug eingesetzt werden.
www.mathworks.com/fsg

NIO

VICTORIA WAGNER
Manager Talent Acquisition Europe

NIO is a pioneer of premium smart EVs. We have built our products around our community to deliver an experience beyond expectations. #BlueSkyComing is not only a claim – it's our philosophy. We are excited to share our ideas for the future of sustainable e-mobility with talented FSG participants.

NIO ist ein Pionier für smarte Premium-EV's. Wir haben unsere Produkte für unsere Community entwickelt, um ein einzigartiges Erlebnis zu bieten. #BlueSkyComing ist nicht nur ein Motto - es ist unsere Philosophie. Wir freuen uns darauf, unsere Ideen für die Zukunft der nachhaltigen E-Mobilität mit talentierten FSG-Teilnehmern zu teilen.

PORSCHE

KONSTANZE MARINOFF
Director Human Resource Marketing

It's equally essential for Porsche and all Formula Student teams: To work with dedication, to fight for the best solution, day after day, to courageously explore new approaches and to face the competition with fairness and respect. We wish all participating teams exciting and successful days at the Hockenheimring.

Für Porsche, genauso wie für alle Formula Student Teams gilt: Mit Herzblut bei der Sache sein, Tag für Tag für die beste Lösung kämpfen, mutig neue Wege gehen und sich mit sportlicher Fairness dem Wettbewerb stellen. Wir wünschen allen teilnehmenden Teams spannende und erfolgreiche Tage am Hockenheimring und freuen uns auf den Austausch!

SCHAEFFLER

CORINNA SCHITTENHELM
Chief Human Resources Officer

Team spirit, commitment and passion for technology - these are the qualities that our employees and the Formula Student teams have in common. As a sponsor we are in close contact with the teams and support them with our know-how. The participants are welcome applicants for us. We pionieer motion.

Teamgeist, Engagement und Leidenschaft für Technik – das sind Eigenschaften, die unsere Mitarbeitenden und die Formula-Student-Teams verbinden. Als Sponsor stehen wir in engem Kontakt mit den Teams und unterstützen diese mit unserem Know-how. Die Teilnehmenden sind gern gesehene Bewerber*innen bei uns. We pioneer motion.

SIEMENS

KARL HERMANN DIETZ
Director Academic Business DACH

For the Siemens Digital Industries Software team, the competition and the week in Hockenheim are a highlight every year. Seven years FSG engagement! And still as enthusiastic as at the beginning. Team spirit, professionalism of the teams, spirit of the event - that is what distinguishes FSG. We look forward to talking to you at the booth.

Für das Team der Siemens Digital Industries Software ist der Wettbewerb und die Woche in Hockenheim jedes Jahr ein Highlight. Sieben Jahre FSG Engagement! Und immer noch begeistert wie zu Beginn. Teamgeist, Professionalität der Teams, Spirit der Veranstaltung – das ist es, was die FSG auszeichnet. Wir freuen uns auf die Gespräche mit Euch am Stand.

MY LINH PHAM
Head of Corporate University

Our vision: ‘A world of reliable rotation’. To make this a reality, we are working on optimized solutions for a wide range of applications. It requires experience, knowledge, flexibility & creativity. This is exactly what the FS teams bring with them. At SKF, young engineers who think ahead are offered the chance to help shape the future.

Unsere Vision: „Eine Welt in zuverlässiger Rotation“. Um sie zu verwirklichen, arbeiten wir an optimierten Lösungen für verschiedenste Anwendungen. Dafür sind Erfahrung, Wissen, Flexibilität & Kreativität nötig. Genau das bringen die FS-Teams mit. Jungingenieuren & IT‘lern, die weiterdenken, bietet SKF die Chance, den Fortschritt mitzugestalten.

KERSTIN GUTBELL
University Relations, EMEA Talent Attraction

TE Connectivity is happy to be part of your team! When it comes to creating reliable connections we’ve been in the race for decades. Education and innovation are key drivers for the future of our company – become one of our talents! We are looking forward networking with you at our tent this year. For us, every connection counts.

TE Connectivity freut sich Teil eures Teams zu sein, denn wenn es darum geht zuverlässige Verbindungen zu schaffen sind wir Jahrzehnte im Rennen. Bildung und Innovation treiben unser Unternehmen - werde Teil davon! Wir freuen uns darauf uns mit Euch an unserem Zelt in diesem Jahr zu vernetzen. Denn für uns zählt jede Verbindung.

ERIK DEMMLER
HR Director Giga Berlin, Human Resources

Tesla’s mission is to accelerate the world’s transition to sustainable energy. Tesla was founded in 2003 by a group of engineers who wanted to prove that people didn’t need to compromise to drive electric - that electric vehicles can be better, quicker and more fun to drive than gasoline cars. Today, Tesla builds not only all-electric vehicles but also infinitely scalable clean energy generation and storage products.

Tesla steht für eine Mission: Die Beschleunigung des Übergangs zu nachhaltiger Energie. Tesla wurde 2003 von einer Gruppe von Ingenieuren gegründet, die beweisen wollten, dass Elektrofahrzeuge keinen Kompromiss bedeuten, sondern mehr Leistung, Beschleunigung und Fahrspaß als Benziner bieten können. Heute baut Tesla neben reinen Elektrofahrzeugen auch unbegrenzt skalierbare Stromerzeugungs- und Stromspeicherprodukte.

DIPL.-ING. CHRISTOF KERKOFF
VDI-Society Automotive and Traffic Systems Technologies

VDI, the Association of German Engineers, is proud to be a partner and sponsor for Formula Student Germany since the very beginning. This competition is a model for other programs we run to stimulate interest in the engineering profession and to lend a hand to the future generation, and our members follow it keenly every year.

Der Verein Deutscher Ingenieure (VDI) ist stolz darauf, die Formula Student Germany seit Ihren Anfängen als ideeller Träger und Sponsor zu unterstützen. Dieser Wettbewerb ist ein Vorbild für andere Programme, mit denen wir das Interesse für Technikberufe wecken, den Nachwuchs fördern und er begeistert unsere Mitglieder jedes Jahr aufs Neue.

Vitesco TECHNOLOGIES

SUSANN BÖSL
Head of EB&TMOD Germany

#weareelectrified - at Vitesco Technologies! With our vision ELECTRIFIED. EMOTION. EVERYWHERE. we are shaping the future of mobility. We are inspired by drive technologies for sustainable mobility - clean, smart and electrified. We don't just talk about transformation - we are the transformation!

#weareelectrified – bei Vitesco Technologies! Mit unserer Vision ELECTRIFIED. EMOTION. EVERYWHERE. gestalten wir die Zukunft der Mobilität. Uns begeistern Antriebstechnologien für nachhaltige Mobilität - sauber, smart und elektrifiziert. Wir reden nicht nur über die Transformation - wir sind die Transformation!

DR. KARSTEN BENNEWITZ
Head of powertrain and energy system development, Volkswagen AG

The world's changing – and we're changing with it. We are always looking for ambitious and motivated talents with whom we will shape our development towards electromobility and smart mobility. At Formula Student Germany there is the chance to talk about your opportunities at Volkswagen. We are looking forward to getting in touch with you!

Die Welt verändert sich – wir verändern uns mit. Wir sind daher immer auf der Suche nach ambitionierten und engagierten Talenten, die unsere Entwicklung zu Elektromobilität und Smart Mobility mit vorantreiben. Bei der Formula Student habt ihr die Gelegenheit, mit uns zu euren Chancen bei Volkswagen ins Gespräch zu kommen. Wir freuen uns auf euch!

WÜRTH

DR. HEIKO ROSSKAMP
Head of Research and Development

As a leading manufacturer of fastening technology, Würth combines R&D, academic expertise, and experience in applications in its new Innovation Center. Our vision: more product and system innovation. We are looking for passionate and ambitious talents to help us achieve this vision, especially in the field of electronics and mechatronics!

Als führender Hersteller von Befestigungstechnik bringt Würth im Innovationszentrum Produktentwicklung, Hochschul-Know-how und Anwendungsexpertise zusammen. Das Ziel: Noch mehr Innovation bei Produkten und Systemen. Dafür suchen wir leidenschaftliche und ambitionierte Mitarbeitende – insbesondere auch mit Elektronik- und Mechatronik-Kenntnissen!

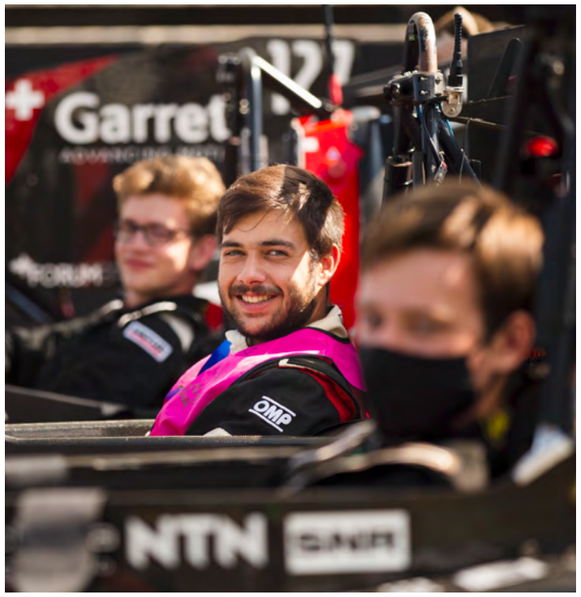
ZF

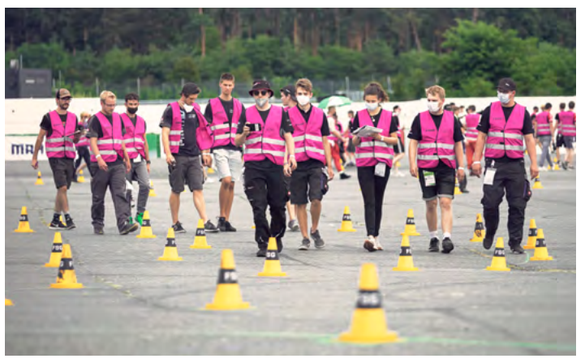
NATASCHA TENTEN
Senior Expert Employer Branding & Talent Attraction

ZF is a global technology company, enabling the next generation of mobility and offering integrated solutions for vehicle manufacturers, mobility providers and start-up companies in the fields of transportation and mobility. We support Formula Student to give the participants early insights in our activities that shape the future of mobility.

ZF ist ein weltweit aktiver Technologiekonzern. Mit seinem Technologieportfolio bietet ZF Lösungen für Automobilhersteller, Mobilitätsanbieter und neu entstehende Unternehmen im Bereich Transport und Mobilität. Bei der Formula Student engagieren wir uns, um den Teilnehmern Einblicke zu geben, wie wir die Mobilität der nächsten Generation gestalten.

Impressions



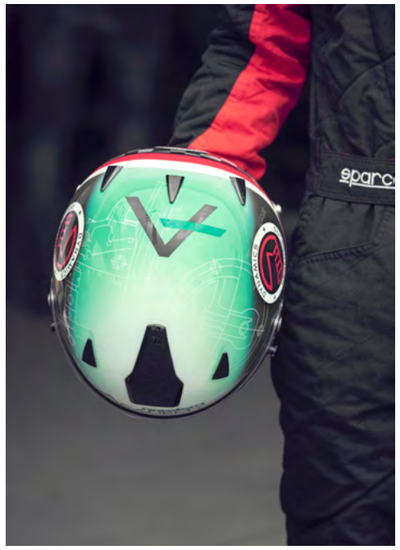


2021


RAVENOL
GEBHARDT
NEXT GENERATION
INTRALOGISTICS
RAVENOL
RAVENOL
HOTEL

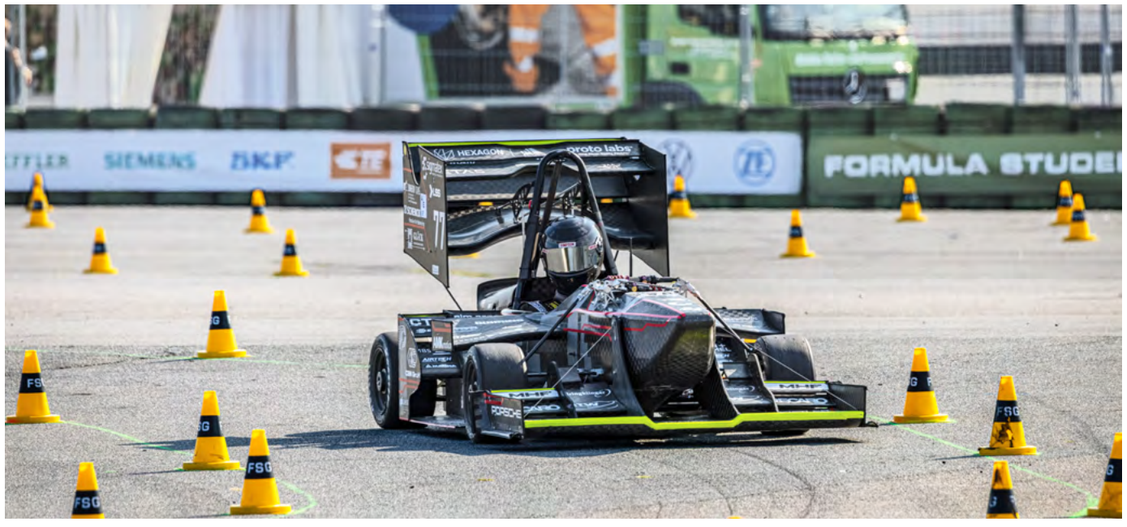

TU MÜNCHEN
BECKER CARBON
31


DYNAMIC AREA
FSG 2021




eSleek20


Julian Kolibaba
Driverless Steering Actuator

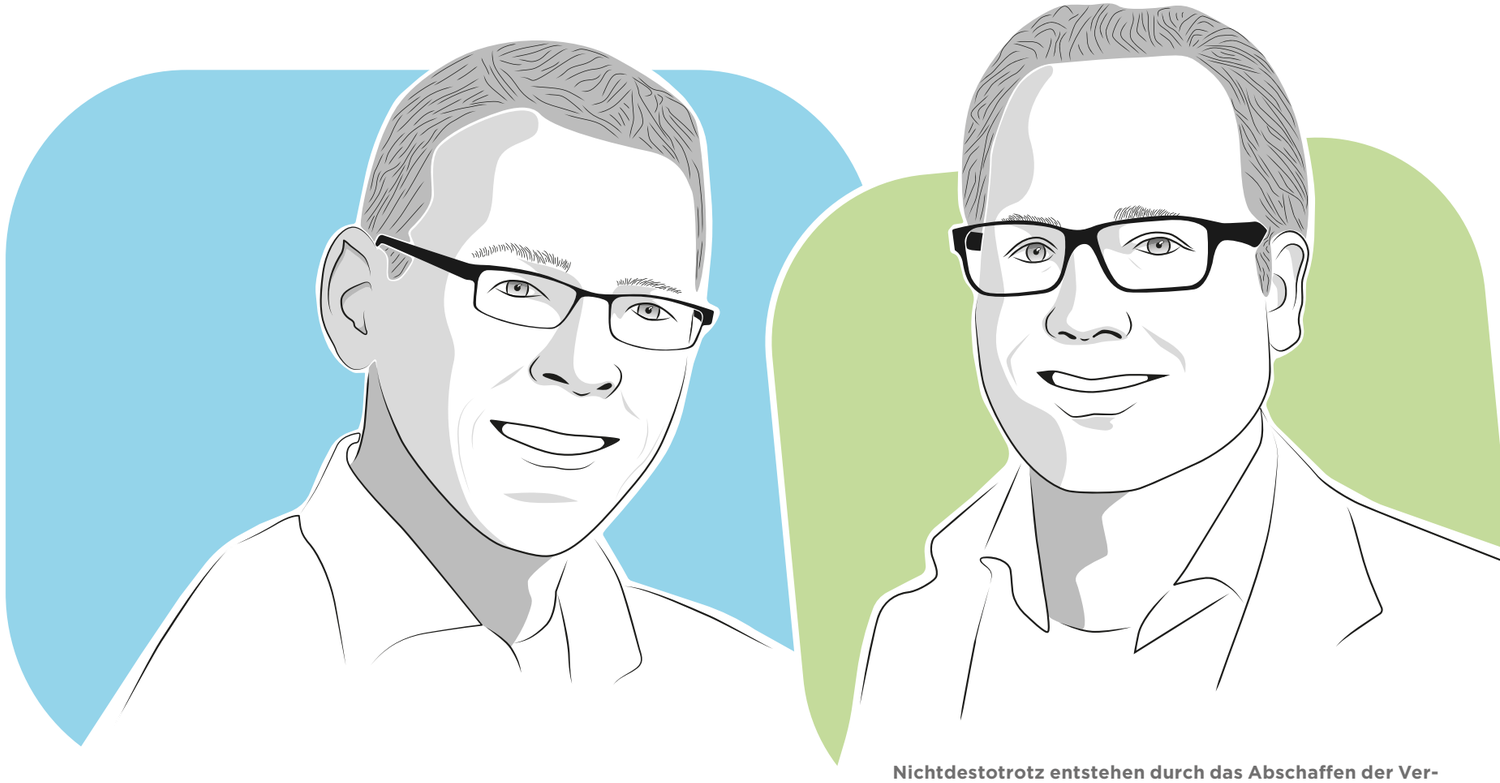

SIEMENS
FORMULA STUDE
FSG

Formula Student Germany in transition - background information of the strategic reorientation

Formula Student Germany im Wandel - Hintergründe zur strategischen Neuausrichtung

Written by Jennifer Stratmann & Julia Weber

An interview with /
Ein Interview mit
Johannes Kratzel
& Sebastian Hoppe



The phase out of the combustion class and the integration of autonomous driving are perceived as major changes by many team. Would smaller changes not be more in the teams' interest?

JK: To the first part of the question, I can say that the last major change to the rules was made to streamline and to create a basic order. With the introduction of the driverless category, we had the ambition to create something innovative, just as we did with the electric class in 2011. Also to create the incentive for the teams to deal with something new to be more competitive. You can see here that this has worked and that the current driverless vehicles are pushing the limits of physics.

SH: In fact, the major changes are mainly in the interest of the smaller teams, even if it does not seem that way at first glance. Major changes reshuffle the cards for everyone, giving even the smaller teams the chance to rethink some aspects from the beginning. With only small changes, the large teams with good knowledge management would always have the upper hand. Of course, even big changes cannot compensate for the fact that some teams have more resources, but that is just the nature of things, unfortunately we will not be able to regulate that. That's a challenge that even Formula 1 faces, despite budget restrictions and limits on simulator time, for example.

Das Abschaffen der Verbrennerklasse und die Integration des autonomen Fahrens werden von vielen Teams als große Änderungen wahrgenommen. Wären kleinere Veränderungen nicht eher im Interesse der Teams?

JK: Zum ersten Teil der Frage kann ich sagen, dass die letzte große Änderung des Regelwerks mit dem Ziel durchgeführt wurde, dieses zu Entschlanken und wieder eine neue Grundordnung zu schaffen. Mit dem Einführen der Driverless-Kategorie hatten wir, wie auch schon bei der Elektroklasse 2011, den Anspruch etwas Innovatives zu schaffen. Auch um die Teams anzuspornen sich mit etwas Neuem auseinandersetzen zu müssen, um wettbewerbsfähig zu sein. Man kann hier sehen, dass das funktioniert hat und die aktuellen Driverless-Fahrzeuge an die Grenzen der Physik stoßen.

SH: Tatsächlich sind die größeren Änderungen vor allem im Interesse der kleineren Teams, auch wenn es auf den ersten Blick nicht so erscheint. Durch größere Änderungen werden die Karten für alle neu gemischt. So haben dann auch die kleinen Teams die Chance manche Aspekte nochmal von Anfang an neu zu denken. Bei nur kleinen Änderungen würden die großen Teams mit einem gutem Wissensmanagement immer die Oberhand behalten. Natürlich können auch große Änderungen die Tatsache nicht ausgleichen, dass einige Teams über mehr Ressourcen verfügen. Das liegt jedoch in der Natur der Sache, das werden wir leider nicht reglementieren können. Das ist eine Herausforderung, mit dem selbst die Formel 1, trotz Budgetrestriktionen und z.B. Begrenzung der Simulatorzeit, zu kämpfen hat.

Nevertheless, the phase out of the internal-combustion class creates disadvantages for the former internal-combustion teams, because they have to start all over again. Could not a solution have been found, like for example the foundation of a new class that creates fair conditions for all teams?

SH: Basically, we made this new start by integrating the Driverless class. Of course, a team that has competed in the Driverless class before has more experience, but to undermine that we would have had to do something completely new. What has to be said clearly is that the step is bigger for the former CV teams, but even they do not start from scratch. The knowledge gained over the years about project management, technical fundamentals, e.g. vehicle dynamics, or generally how a vehicle is built, is available regardless of the powertrain technology.

JK: In addition, the number of students in the field of combustion engines is decreasing and more and more courses are being launched in the field of electric mobility. Therefore, it is also possible for the teams to find students who bring these new competencies.

SH: That's not the only thing that has changed: the content of traditional mechanical engineering courses has also changed. Anyone studying mechanical engineering today can no longer avoid the basics of electric mobility, and topics such as programming or machine learning are also being integrated into traditional mechanical engineering courses. This brings us back to the topic of driverless.

Nichtdestotrotz entstehen durch das Abschaffen der Verbrennerklasse Nachteile für die ehemaligen Verbrennerteams, da sie wieder ganz von vorne anfangen müssen. Hätte man nicht eine Lösung beispielsweise in Form einer neuen Klasse schaffen können, die faire Bedingungen für alle Teams schafft?

SH: Im Grunde haben wir diesen Neustart ja durch die Integration der Driverless Klasse gemacht. Natürlich hat ein Team, das vorher schon in der Driverlessklasse angetreten ist, mehr Erfahrung, aber um das auszuhebeln hätten wir etwas ganz Neues machen müssen. Was man ganz klar sagen muss ist, dass der Schritt für die ehemaligen CV-Teams größer ist, aber auch die fangen ja nicht von Null an. Das über die Jahre gesammelte Wissen über Projektmanagement, technische Grundlagen z.B. zur Fahrdynamik oder ganz allgemein, wie ein Fahrzeug gebaut wird, das ist unabhängig von der Antriebstechnologie vorhanden.

JK: Ergänzend ist es auch so, dass die Anzahl der Studierenden im Bereich der Verbrennungsmotoren abnimmt und immer mehr Studiengänge im Bereich Elektromobilität ins Leben gerufen werden. Daher ist es für die Teams auch möglich Studierende zu finden, die diese neuen Kompetenzen mitbringen.

SH: Nicht nur das, auch die Studieninhalte im klassischen Maschinenbau Studium haben sich verändert. Wer heutzutage Maschinebau studiert kommt auch um Grundlagen der Elektromobilität nicht mehr herum und auch was Themen wie Programmieren oder maschinelles Lernen angeht, werden diese auch in den klassischen Maschinenbaustudiengängen integriert. Hier sind wir dann wieder beim Thema Driverless.

The basic intention of Formula Student is still for teams to learn the basics that they can later apply in industry. With the integration of the driverless system the challenge is already big enough. If we would increase the complexity even further – for example, by having a hybrid powertrain – then we create even more potential sources of error for the teams.

Die Grundintention der Formula Student ist immer noch, dass die Teams die Basics lernen sollen, die sie später in der Industrie anwenden können. Mit der Integration des Driverless Systems ist die Herausfoderung bereits groß genug. Wenn wir diese Komplexität noch weiter erhöhen würden– beispielsweise durch einen hybriden Antriebsstrang – dann entstehen noch mehr potentielle Fehlerquellen für die Teams.

To manage the transition from combustion to electric more easily, some European competitions have introduced the hybrid class. Why did the FSG decide to not do the same?

SH: We also discussed the hybrid class for a long time and weighed up the possible pro and con arguments in order to make a decision. In the end, we came to the decision that we have already created enough complexity for the teams through the stronger integration of the Driverless class. The basic intention of Formula Student is still for teams to learn the basics that they can later apply in the industry. If we would increase that complexity even further – for example, by having a hybrid powertrain – then we create even more potential sources of error for the teams. Because if the car fails because the whole system is too complex, it will be difficult for the teams to compete at the front.

Um den Übergang von Verbrenner zu Elektro zu erleichtern haben einige europäische Wettbewerbe die Hybrid-Klasse eingeführt. Warum hat sich die FSG dagegen entschieden das auch zu machen?

SH: Wir haben die Hybrid Klasse ebenfalls lange diskutiert und die möglichen Pro- und Kontra Argumente abgewogen, um eine Entscheidung zu treffen. Schlussendlich sind wir zu der Entscheidung gekommen, dass wir durch die stärkere Integration der Driverless Klasse schon genug Komplexität für die Teams geschaffen haben. Die Grundintention der Formula Student ist immer noch, dass die Teams die Basics lernen sollen, die sie später in der Industrie anwenden können. Wenn wir diese Komplexität noch weiter erhöhen würden – beispielsweise durch einen hybriden Antriebsstrang – dann entstehen noch mehr potentielle Fehlerquellen für die Teams. Denn wenn das Auto ausfällt, weil das Ganze ein zu komplexes System ist, wird es schwer für die Teams vorne mitzumachen.

When the FSG was founded, the motivation was to enable all teams to participate, regardless of whether they came from a large university or a small college. What is your position on the fact that, due to the current reorientation, some smaller teams are now being excluded, for example those that do not have the resources and possibilities to build an electric racing car?

SH: Well, we certainly do not want to exclude anyone. I have also heard of one or two examples where teams are forbidden by the university to work with high voltage. I am very sorry about that, and of course it is certainly not what we want. However, as already mentioned, the design of degree programs is also changing. We truely believe that colleges and universities will change in this regard as well, even if some teams will face challenges for another year or two. However, we unfortunately cannot maintain a complete set of regulations for all exceptions. Regarding the driverless issue, component costs are of course always a point of discussion. However, we have also seen successful teams achieve good results with a simple car PC and a stereo camera solution which have not dramatically increased the budget. If you want to be at the top as a team, you might need more expensive components like a LiDAR sensor, but that's not required by the regulations. In order to accommodate smaller and newer teams here, we have designed the scoring in such a way that in autonomous driving, the arrival oft the car is rewarded much more than in the classic disciplines with a driver.

JK: What you also have to say is that especially in the autonomous area, the teams work together a lot. Initiatives like the ARWo Workshop in Hamburg, which was initiated by the teams, are of course supported by us on the organizational side with workshops and input. This way, new teams also have a point of reference and get some support to be able to tackle this new aspect of Formula Student better.

Bei der Gründung der FSG war die Motivation, allen Teams, egal ob von einer großen Uni oder einer kleinen Hochschule die Teilnahme zu ermöglichen. Wie positioniert ihr euch dazu, dass aufgrund der aktuellen Neuausrichtung nun teilweise kleinere Teams ausgeschlossen werden, die beispielsweise nicht die Ressourcen und Möglichkeiten haben einen Elektrorennwagen zu bauen?

SH: Also ausschließen wollen wir sicher niemanden. Ich habe auch von ein oder zwei Beispielen gehört, wo es Teams von der Hochschule verboten ist mit Hochvolt zu arbeiten. Das tut mir bzw. uns sehr leid und das ist sicher nicht in unserem Sinne. Wie schon angesprochen, wandelt sich auch die Gestaltung der Studiengänge. Wir glauben fest daran, dass die Hochschulen und Universitäten sich in dieser Hinsicht auch ändern werden, auch wenn manche Teams noch ein oder zwei Jahre mit diesen Herausforderungen konfrontiert sein werden. Wir können aber leider nicht ein komplettes Reglement für alle Ausnahmen aufrechterhalten. Bezüglich des Themas Driverless sind die Komponentenkosten natürlich immer Diskussionspunkt. Allerdings haben wir auch erfolgreiche Teams gesehen, die mit einem einfachen Car-PC und einer Stereokameralösung gute Resultate erzielt und das Budget nicht dramatisch erhöht haben. Wenn man ganz vorne mitmachen möchte als Team, dann werden vielleicht teurere Komponenten wie ein LiDAR Sensor benötigt, aber vom Reglement ist das nicht vorgeschrieben. Um hier kleineren und neueren Teams entgegenzukommen, haben wir die Punktevergabe so gestaltet, dass beim autonomen Fahren die Zielerreichung viel stärker belohnt wird als bei den klassischen Disziplinen mit Fahrer.

JK: Was man auch sagen muss, dass gerade im autonomen Bereich die Teams untereinander viel zusammenarbeiten. Initiativen wie der ARWo Workshop in Hamburg, der von den Teams organisiert wurde, unterstützen wir von der Organisationsseite natürlich gerne mit Workshops und Input. So haben auch neue Teams einen Anhaltspunkt und bekommen etwas den Rücken gestärt, um diesen neuen Aspekt der Formula Student besser angehen zu können.

The current, very progressive policy of the FSG is creating more and more separation from the other competitions. Does this have an impact on international cooperation and did you also take the team perspective into account when making that decision?

SH: Of course, we have always thought about what this means for the teams when we made our decisions regarding the rules. With the simplification of the FSG rules, I think we have made a good first step, even if it has moved a bit away from the FSAE rules. In addition, there is the Competition Handbook, on which base each event that uses the FSG rules can define its own regulation. You can also see that our rules have spread in Europe, except for FS UK. A compatibility with the FSAE regulations is still available, so that teams can still participate in competitions in the USA.

JK: Basically, we did not design the, I'll call it now, European rules alone, but always in cooperation with the colleagues from the other competitions. It also showed concerns at one point or another, why certain things should not be included in the rules, but better defined in the Competition Handbook.

SH: This international agreement takes place regularly in the form of an European forum. The goal is for the European events to work even more closely together and discuss topics such as the rules and regulations or the data loggers. There is no umbrella organization but at least the approach to work together to enable teams to participate everywhere - even if with small optional changes.

JK: Regarding compatibility, we as FSG would also like to encourage to design a modular concept. Because some competitions do not have a driverless category, but we require it. These modular systems are also of great interest in terms of the industry we want to prepare team members for. Also referring to the hybrid systems mentioned earlier, a modular concept with a base vehicle that is as similar as possible, but offers with different drivetrain components an exciting challenge for the teams. And fortunately, I have already seen some exciting concepts in this regard.

SH: All in all, we as FSG will try to keep going with the times, also in the future - or maybe even be one step ahead the times. But for now we are looking forward to seeing many teams on site in Hockenheim and wish them all good luck!

Thank you very much for the interview!

Durch die aktuelle, sehr progressive Politik der FSG entsteht eine immer größere Abgrenzung zu den anderen Wettbewerben. Hat das Auswirkungen auf die internationale Zusammenarbeit und habt ihr beim Treffen dieser Entscheidung auch die Teamperspektive mit berücksichtigt?

SH: Wir haben bei unseren Entscheidungen bezüglich des Regelwerks natürlich immer daran gedacht was das für die Teams bedeutet. Mit der Vereinfachung des FSG Reglements haben wir denke ich einen guten ersten Schritt gemacht, auch wenn es sich ein Stück von den FSAE Regeln entfernt hat. Zusätzlich gibt es ja noch das Competition Handbook, wo jedes Event, welches das FSG Reglement nutzt, noch eigene Sachen definieren kann. Man sieht auch, dass sich unser Reglement in Europa ausgebreitet hat. Eine Kompatibilität mit dem FSAE Reglement ist noch vorhanden, sodass Teams trotzdem noch an Wettbewerben in den USA teilnehmen können.

JK: Grundsätzlich haben wir das, ich nenne es jetzt mal, europäische Regelwerk, nicht alleine gestaltet sondern in Abstimmung mit den Kollegen und Kolleginnen der anderen Wettbewerbe. Diese haben dann auch an der ein oder anderen Stelle aufgezeigt, warum gewisse Dinge nicht ins Regelwerk mit aufgenommen werden sollten, sondern besser im Competition Handbook definiert werden.

SH: Diese internationale Absprache findet regelmäßig im Rahmen eines europäischen Forums statt. Ziel ist es, dass die europäischen Events noch enger zusammenarbeiten und Themen wie das Regelwerk oder die Data Logger etc. besprechen. Es gibt zwar keinen Dachverband, aber zumindest den Ansatz zusammenzuarbeiten, um es den Teams zu ermöglichen überall teilnehmen zu können - wenn auch mit kleinen optionalen Änderungen.

JK: Bezüglich der Kompatibilität, möchten wir als FSG auch dazu anregen ein modulares Konzept zu entwerfen. Denn manche Wettbewerbe haben keine Driverless Klasse, wir aber fordern diese. Diese modularen Systeme sind auch im Hinblick auf die Industrie, auf die wir die Teammitglieder vorbereiten wollen, von großem Interesse. Auch bezugnehmend auf die vorher schon angesprochenen hybriden Systeme bietet ein modulares Konzept mit einem möglichst gleichen Basisfahrzeug und verschiedenen Antriebskomponenten eine spannende Herausforderung für die Teams. Und erfreulicherweise habe ich diesbezüglich auch schon einige spannende Konzepte gesehen.

SH: Insgesamt versuchen wir als FSG auch in der Zukunft mit der Zeit zugehen – oder ihr vielleicht sogar einen Schritt voraus zu sein. Jetzt freuen wir uns aber erstmal wieder darauf viele Teams vor Ort in Hockenheim zu sehen und wünschen allen viel Erfolg!

The interview was conducted prior to the tragic lethal accident of Johannes. He was not only a proud member of the FSG Family but more importantly a close friend to all of us. He started in 2007 as a Red Shirt in the FSG Officials team. Since 2011 he was part of the Operative Team and took over the position as EC Member for Event Support & Control. Ever since Johannes played an important role in building the FSG Volunteer's community. He will remain in our memory, and we will always admire the dedication, the endurance and spirit with which he helped to build FSG. As a friend and team member he will be dearly missed.

Das Interview haben wir vor dem tragischen Unfall von Johannes geführt. Er war nicht nur ein stolzes Mitglied der FSG-Familie, sondern vor allem ein enger Freund für uns alle. 2007 startete er als Red Shirt im FSG Officials Team. Seit 2011 war er Teil des Operative Teams und übernahm die Position als EC Mitglied für Event Support & Control. Seitdem spielte Johannes eine wichtige Rolle beim Aufbau der FSG Volunteer's Community. Wir werden stets sein Engagement, seine Ausdauer und seinen Spirit bewundern, mit dem er die FSG jahrelang mit aufgebaut hat. Als Freund und Teammitglied werden wir ihn sehr vermissen.

People you might run into at Formula Student Germany...

Menschen, die Dir während der Formula Student Germany über den Weg laufen könnten...

Written by Theresa Stach

In order to put Formula Student on its feet year after year, active support is needed at all corners and ends. Some of the faces are well known to everyone, others run into us from time to time and others take care behind the scenes to make sure that we all have an unforgettable event. Behind every face there is an individual story. We would like to share a few of them with you, because these are the stories that make Formula Student Germany special for every one of us. Well, read for yourself – We cover quite different perspectives: From the family reunion at Formula Student Germany to the dream job.

Um Jahr für Jahr die Formula Student auf die Beine zu stellen, benötigt es an allen Ecken und Enden tatkräftige Unterstützung. Einige Gesichter sind jedem sicherlich wohl bekannt, andere laufen uns hier dort mal über den Weg und wiederum andere kümmern sich vor allem hinter den Kulissen darum, dass wir alle ein unvergessliches Event haben. Hinter jedem Gesicht verbirgt sich eine individuelle Geschichte. Ein paar von diesen wollen wir gerne mit Euch teilen, denn genau diese Geschichten machen die Formula Student Germany für jeden Einzelnen aus. Nun, lest selbst – wir zeigen euch ganz neue Perspektiven: vom Familientreffen auf der Formula Student Germany bis hin zum Traumjob.

Ky Nam Lilie

A family photo at the Hockenheimring is an open task /
Ein Familienfoto auf dem Hockenheimring steht noch aus

Marcel Peters

Family reunion at Formula Student Germany

For some years now, brothers Jannik and Marcel Peters meet annually at the Hockenheimring, but also their grandfather Peter Hofmann and his partner Ky Nam Lilie have been an integral part of the Formula Student family for years. Together they are represented in different volunteering areas at FSG. The initiator of the Formula Student Germany family is older brother Jannik, who himself joined the Formula Student Team DHBW Engineering in 2013. During his studies he got to know Dana Thalhäuser, who was already active as a volunteer at FSG at that time. She quickly convinced Jannik with her stories of being a FSG Official and so he also started in 2016 as an helper in the IT area (Black Shirts) before he later switched to the Red Shirts team. The stories from Jannik's first year as a FSG volunteer inspired his brother Marcel, who joined the Media Team as a videographer in 2017. Even though his first Formula Student Germany was very rainy, and he practically had wet feet for a week, this did not stop Marcel from coming back. In the meantime, Marcel is a regular at FSG and helps coordinate the video team throughout the year as well as during the event. Jannik's enthusiasm then also convinced his grandfather and his partner to become part of the FSG family as Red Shirts. Even if they do not remember which story finally convinced them, they caught fire for this extraordinary hobby from the very beginning. Among other things, the two help in the kitchen as well as with the set-up and dismantling of the event. Last year, our FSG family was united for the first time at the Hockenheimring for the family reunion, as Marcel could not participate in 2018 and 2019 due to the submission of his final papers. The family also wears the FSG T-shirt outside of the events and Marcel is very sure about the fact that he has seen his grandfather more often in a FSG T-shirt than in normal clothes.

Jannik Peters

Peter Hofmann

Familientreffen auf der Formula Student Germany

Alle Jahre wieder treffen sich nicht nur Freunde der Formula Student auf der FSG, sondern auch ganze Familien kommen in Hockenheim zusammen, um gemeinsam mit anzupacken. So auch die Familie von Jannik Peters.

Seit einigen Jahren treffen sich die Brüder Jannik und Marcel Peters jährlich auf dem Hockenheimring. Aber auch ihr Großvater Peter Hofmann und dessen Lebensgefährtin Ky Nam Lilie sind seit Jahren fester Bestandteil der Formula Student Familie. Gemeinsam sind sie in unterschiedlichen Volunteerbereichen auf der FSG vertreten. Der Initiator der Formula Student Germany Familie ist der ältere Bruder Jannik, der 2013 selbst beim Formula Student Team DHBW Engineering einstieg. Damals lernte er Dana Thalhäuser kennen, die selbst schon bei der FSG aktiv war und ihn sofort mit dem FSG Fieber ansteckte. So startete Jannik 2016 zum ersten Mal als Official im Bereich der IT (Black Shirts), bevor er zum Red Shirts Team wechselte. Sein Enthusiasmus und die Geschichten aus seiner Zeit als Official begeisterten auch seinen Bruder. Marcel schloss sich 2017 dem Media Team als Videograph an. Trotz sehr regnerischen Bedingungen und dem Fakt, dass er während seiner ersten FSG praktisch eine Woche lang nasse Füße hatte, war auch er direkt mit dem Formula Student Fieber infiziert. Janniks Begeisterung überzeugte jedoch nicht nur seinen Bruder, sondern schwappte auch auf seinen Großvater und dessen Lebensgefährtin über. Beide unterstützen nun in der Küche sowie beim Auf- und Abbau des Events. Auch wenn Peter und Ky Nam nicht mehr wissen, welche der vielen Geschichten sie schlussendlich zur Teilnahme überzeugt hat, waren sie doch ab Tag 1 in Hockenheim Feuer und Flamme. Letztes Jahr war unsere FSG-Familie zum ersten Mal am Hockenheimring zum Familientreffen vereint, da Marcel 2018 und 2019 aufgrund der Abgabe seiner Abschlussarbeiten nicht teilnehmen konnte. Aber nicht nur in Hockenheim lebt die Familie den FSG Spirit. Auch in der Freizeit tragen alle ihre FSG Shirts und Marcel ist überzeugt, dass er seinen Opa öfter im FSG T-Shirt als in normaler Kleidung sieht.

A dream job within Formula Student Germany

Almost everyone has probably already run into Esther Tromp on the event site or had contact with her, because Esther is always everywhere. Besides Daniel Mazur, she is the only permanent employee of Formula Student Germany since 2018. Originally Esther comes from the Netherlands and moved to Hannover because of a job change of her husband. With the move, she had to leave behind her own business, especially for (sports) events, but started looking for a new job in Germany in this direction as well. She was already working for an employment agency when she discovered the job offer from FSG. Immediately she knew that this job was made for her, and Esther luckily became part of the FSG family.

Esther is responsible for everything related to FSG event management, which includes organizing and managing the FSG partnerships, hosting the annual Main Academy, organizing the Academy on Site, FSG meetings, creating the site map, organizing the Academy on Site and the FSG meetings, creating the on-site or purchasing the FSG gear – the list goes on. The variety of topics, the freedom to take the initiative and the open work structure make this job special for Esther. The certain extra for her is the family feeling of FSG, because the event is supported every year by a large group of volunteers who give everything for the event with heart and soul.

Ein Traumjob innerhalb der Formula Student Germany

Wahrscheinlich ist der eine oder die andere Esther Tromp auf der Eventsite schon über den Weg gelaufen oder hatte Kontakt zu ihr, denn Esther ist eigentlich immer und überall. Neben Daniel Mazur ist sie seit 2018 die einzige Festangestellte der Formula Student Germany. Ursprünglich kommt Esther aus den Niederlanden und zog wegen eines Jobwechsels ihres Mannes nach Hannover. Mit dem Umzug musste sie unter anderem ihr eigenes Organisationsbüro, speziell für (Sport-)Veranstaltungen hinter sich lassen, begann aber auch in diese Richtung einen neuen Job in Deutschland zu suchen. Sie arbeitete bereits für eine Arbeitsagentur als sie das Stellenangebot der FSG entdeckte. Sofort wusste sie, dass diese Stelle wie für sie gemacht war und Esther wurde zum Glück Teil der FSG-Familie.

Esther ist für alles rund um das FSG-Eventmanagement zuständig. Dazu zählt die Organisation und Betreuung der FSG-Partner, die Ausrichtung der jährlichen Main Acadamy, die Organisation der Academy on Site, die FSG Meetings, die Erstellung des Lageplans, der Einkauf für die FSG-Utensilien – und so weiter - die Liste ist lang. Die Vielfalt der Themen, die Freiheit die Initiative zu ergreifen und die offene Arbeitsstruktur machen diesen Job für Esther besonders. Das gewisse Extra für sie ist, das Familiengefühl der FSG, denn das Event wird jedes Jahr von einer großen Gruppe Ehrenamtlichen getragen die mit Herz und Seele alles für das Event geben.

“The certain extra for me is that the organization and implementation are based on a family feeling.”
„Das gewisse Extra ist für mich, dass die Organisation und die Durchführung auf einem Familiengefühl basieren.“

Esther Tromp

Involved from the beginning

Matthias Brutschin probably has the longest FSG history in this article. He started in 2004 as the team founder of the wob-racing team. At that time there were only a few teams within Germany and no local competition yet. Through an article he became aware of the Lions Racing Team and thus made contact with Daniel Mazur. Since the wob-racing team did not have a vehicle itself in 2004, Matthias supported the organization of team-spanning test days in Aschersleben. Already at that time, among other things, he was responsible for bringing bread rolls for breakfast in the morning, a task he continued at FSG for at least a decade. When the pre-event in Leipzig took place in 2005, Matthias was already a wob-racing alumni and therefore not a team member but again on site as event support. From then on there was no FSG event where Matthias was not present. When the event took place in Hockenheim for the first time in 2006, he coordinated the Red Shirts, the external service providers, and the security. Until today Matthias is an expert for the coordination of the external service providers and in the last years, he still takes care of the security. For a long time, he took care of the key handover and drop-off for the Hockenheimring and was therefore the first and last person to enter and leave the event. He can leave his daily business completely behind while he is on the event site and is thrilled every time how much can be achieved together in such a short time. The motivation for Matthias to come back to FSG every year as a volunteer is: “If you want to work with professionals, go to Formula Student. It is working with great people who learn from each other every day and make the event work.” His highlight over the many years was the introduction of the electric class in 2011 and the Night Endurances that came with it. Of course, sometimes things go wrong or break: It happened that the floor of the Scrutineering tent was not made for the transport vehicle he was driving and collapsed. There is also a déjà vu every year - but Matthias is already prepared for that because experience has shown: The tent builder is never finished in time.

Von Anfang an dabei

Matthias Brutschin hat in diesem Artikel wohl die längste FSG-Historie. Er startete 2004 als Teamgründer des wob-racing Teams. Damals gab es nur wenige Teams innerhalb von Deutschland und noch keinen Wettbewerb vor Ort. Durch einen Artikel wurde er auf das Lions Racing Team aufmerksam und stellte so Kontakt zu Daniel Mazur her. Da das wob-racing Team 2004 selbst noch kein Fahrzeug hatte, unterstützte Matthias bei der Organisation von teamübergreifenenden Testtagen in Aschersleben. Schon damals war er neben zahlreichen anderen Tätigkeiten für das morgendliche Brötchen holen verantwortlich, was er auch später noch im Rahmen der FSG für mindestens ein Jahrzehnt übernahm. Als 2005 das Pre-Event in Leipzig stattfand, war Matthias bereits wob-racing-Alumni und somit nicht als Teammitglied aber wieder als Event Support vor Ort. Von da an gab es kein FSG-Event bei dem Matthias nicht dabei war. Als das Event 2006 zum ersten Mal in Hockenheim stattfand, koordinierte er die Red Shirts, die externen Dienstleister und die Security. Bis heute ist Matthias

Matthias Brutschin

Matthias at FSG 2007 /
Matthias beim Event 2007

Some years later at FSG 2014 /
Ein paar Jahre später beim Event 2014

Experte für die Koordination der externen Dienstleister und kümmert sich in den letzten Jahren auch wieder um die Security. Für lange Zeit übernahm er die Schlüsselentgegennahme und -abgabe gegenüber dem Hockenheimring und war somit der Erste und Letzte, der das Event betrat und verließ. Sein Daily Business kann er auf der FSG vollkommen hinter sich lassen und ist jedes Mal begeistert wie viel in so kurzer Zeit gemeinsam erreicht werden kann.

Die Motivation für Matthias, jedes Jahr wieder als Volontär bei der FSG dabei zu sein, ist: „Wenn du mit Profis zusammenarbeiten willst, gehst Du zur Formula Student. Es ist die Zusammenarbeit mit großartigen Menschen die täglich voneinander lernen und das Event zum Laufen bringen.“ Sein Highlight in den vielen Jahren war die Einführung der Elektroklasse 2011 und die damit verbundenen Night Endurances. Natürlich geht auch mal was schief oder kaputt: So passierte es, dass der Boden des Scrutizeltes für das von ihm gefahrene Transportfahrzeug nicht gemacht war und einbrach. Auch ein Déjà-vu gibt es in jedem Jahr – aber darauf ist Matthias schon vorbereitet, denn die Erfahrung hat gezeigt: Der Zeltbauer wird nie rechtzeitig fertig.

“If you want to work with professionals, go to Formula Student.”
„Wenn du mit Profis zusammenarbeiten willst, gehst Du zur Formula Student.“

You want to be a part of our FSG community? Find more information here!

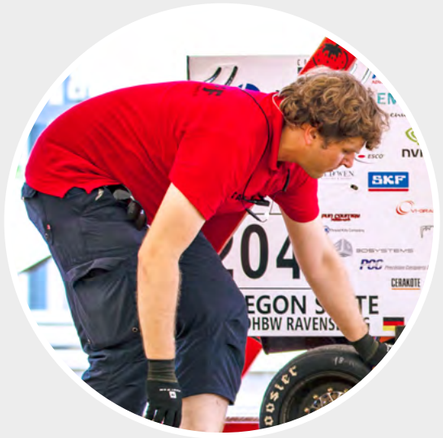
Du willst ein Teil unserer FSG Gemeinschaft werden? Weitere Infos gibt es hier!

“Master of the FSG Materials”

Timo Jeitner is one of the people who is probably less often visible to the teams, partners and guests during the event days, but who, like all volunteers, does an incredible amount in the background. Timo was studying aircraft construction at the University of Applied Sciences in Aachen when fellow students came up with the idea of founding a Formula Student team in 2007. When he heard about it, it was clear to him: “That's the best idea I've ever heard” – and he was already gripped by Formula Student fever. In 2008, the first vehicle from his university took part in Hockenheim, but unfortunately didn't drive a meter. After things went better in 2009, but it was discovered that glued driveshafts were simply not a good idea, the team at least managed six laps in Endurance in 2010 before the right front wheel suspension broke. Due to his thesis, Timo withdrew from the team's active activities in 2011. Nevertheless, he did not want to give up the event completely and thus registered for the first time as FSG Red Shirt. Since then, Timo is the “Master of the FSG materials”. For the realization of the event a large amount of different stock materials and new acquisitions are needed. Inventory materials, such as the signs that are hung throughout the event site, must be inventoried, and stored at the end of the event. Materials are then reordered accordingly before the next event. Over the years, it has become apparent that FSG's most important consumables are cable ties and tape. Before, during and after the event, Timo keeps track of the materials and supplies all volunteers with the necessary materials and tools, for example during the set-up. Once the set-up phase is complete, Timo works in regular event support and takes on tasks related to the event operations. This includes, for example, the operation of the “Strawberry basket” and the technical acceptance of the drivers’ clothing. From Thursday on, he already plans the dismantling of the event and prepares e.g. the maintenance of the storage boxes. The missing event in 2020 has shown Timo: “A year without a FSG event is possible, but I was just missing something” and therefore he was all the more happy to be able to participate again in 2021.

Der „Herr der FSG Materialien“

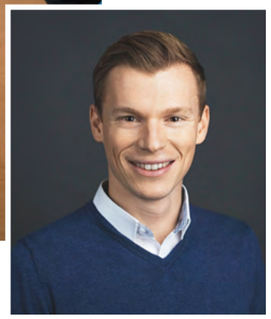
Timo Jeitner gehört zu den Personen, welche während der Eventtage wahrscheinlich weniger oft für die Teams, Partner und Gäste sichtbar ist aber dafür, wie alle Volunteers, im Hintergrund wahnsinnig viel leistet. Timo studierte Flugzeugbau an der Fachhochschule in Aachen als 2007 Kommilitonen auf die Idee kamen, ein Formula Student Team zu gründen. Als er davon hörte, stand für ihn fest: „Das ist die beste Idee, die ich je gehört habe“ – und schon hatte auch ihn das „Formula Student Fieber“ gepackt. 2008 nahm das erste Fahrzeug seiner Hochschule bereits in Hockenheim teil, fuhr nur leider keinen Meter. Nachdem es 2009 zwar besser lief, aber man feststellte, dass geklebte Antriebswellen einfach keine gute Idee waren, schaffte das Team 2010 immerhin sechs Runden im Endurance, bevor die rechte vordere Radaufhängung zerbrach. Aufgrund seiner Diplomarbeit zog sich Timo 2011 aus dem aktiven Geschehen des Teams zurück. Dennoch wollte er nicht ganz auf das Event verzichten und meldete sich somit erstmalig als FSG Red Shirt an. Seitdem ist Timo „Herr der FSG-Materialien“. Zur Durchführung des Events wird eine große Menge an unterschiedlichsten Bestandsmaterialien und Neuanschaffungen benötigt. Bestandsmaterialen, wie die Hinweisschilder, die über die gesamte Eventsite hinweg aufgehängt werden, müssen am Ende des Events inventarisiert und eingelagert werden. Vor dem nächsten Event werden dann entsprechend Materialien nachbestellt. Über die Jahre zeigte sich, das das wichtigste Verbrauchsmaterial der FSG Kabelbinder und Klebeband sind. Vor, während und nach dem Event behält Timo den Überblick über die Materialien und versorgt alle Volunteers mit den notwendigen Materialien und Werkzeugen, beispielsweise beim Aufbau. Ist die Aufbauphase abgeschlossen arbeitet Timo im regulären Eventsupport mit und übernimmt Aufgaben im operativen Eventbetrieb. Dazu gehört zum Beispiel der Betrieb des Erbeerkörbchens und die technische Abnahme der Fahrerbekleidung. Ab Donnerstag wird von ihm bereits der Abbau des Events durchgeplant und z.B. die Instandhaltung der Lagerkisten vorbereitet. Der Eventausfall 2020 hat Timo gezeigt: „Ein Jahr ohne FSG-Event ist zwar möglich, aber es fehlte mir einfach was“ und somit freute er sich 2021 umso mehr wieder dabei sein zu können.



“A year without a FSG event is possible, but I am clearly missing something.”
„Ein Jahr ohne FSG-Event ist zwar möglich, aber es fehlte mir einfach was.“

Timo Jeitner

2019 – Engineering Design Event in the event bay /
2019 – Engineering Design Event in der Event Bay



Robert Weingart
Formula Student Germany - OT Design Event

Engineering Design Competition –

Best practices to excel

Tipps für eine erfolgreiche Teilnahme

Formula Student Germany is an engineering design competition. At its core, there is the design judging event determining the best team of engineers among all participating universities. This article presents key elements of the judging itself and should help in your preparation for the next engineering design event (EDE).

The EDE is a crucial part of the overall competition by representing 15 %, and 25 % of the overall score for each vehicle category of CV & EV and DV respectively. The scoring is split into several engineering subcategories (see Figure 1), all of which are important areas of the Formula Student race car design. The scores differ for CV & EV vehicles, and the Driverless Cup. The engineering design event starts with the submission of the written engineering design report (check the rules, section S 3.2) prior to the event. It helps the judges getting a first impression of your work before heading into the EDE. But what does the judging process of the EDE look like?

Die Formula Student Germany ist ein Konstruktionswettbewerb für Ingenieure. Kern des ganzen ist das Engineering Design Event (EDE), bei welchem das beste Ingenieurteam aller teilnehmenden Hochschulen ermittelt wird. Dieser Artikel stellt die wichtigsten Elemente des Judgings (Bewertung durch Juroren) vor und soll euch bei der Vorbereitung helfen.

Das EDE ist ein entscheidender Teil des Formula Student Gesamtwettbewerbs und macht allein 15 % der Gesamtpunktzahl in den Fahrzeugkategorien CV & EV aus, bzw. 25 % in der Kategorie DV. Die Wertung ist in mehrere technischen Kategorien unterteilt (siehe Abbildung 1), welche die wichtigsten Bereiche der Formula Student Rennwagenkonstruktion darstellen. Die Punktzahlen unterscheiden sich dabei für CV & EV-Fahrzeuge und den Driverless Cup. Das Event selbst beginnt mit der Einreichung des schriftlichen Engineering Design Reports bereits vor dem Wettbewerb (siehe Rules, Abschnitt S 3.2). Das Dokument hilft den Juroren, sich einen ersten Eindruck von eurer Arbeit zu verschaffen, bevor ihr im EDE aufeinandertrefft. Wie sieht das Bewertungsverfahren selbst aus?

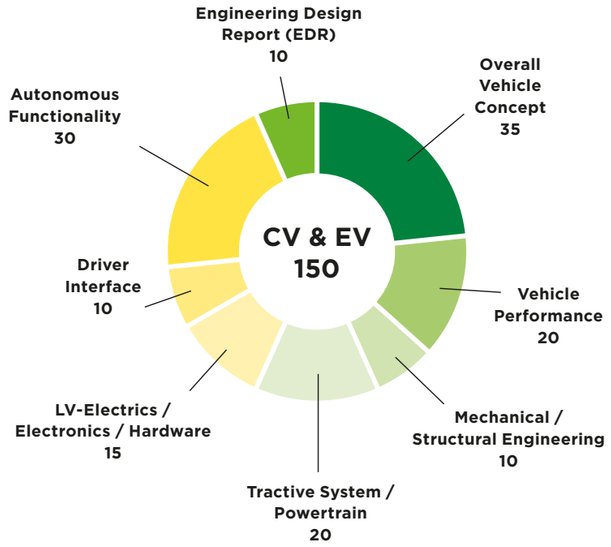


Figure 1: Classes, subcategories and their respective scores /
Abbildung 1: Fahrzeugklassen, technische Kategorien und die Punkteverteilung

Who Are the Judges (Blue Shirts)?

Formula Student Germany has a lot of partners and supporters from professional motorsports and automotive industry who volunteer their time and help judging. Judges are distributed across all EDE bays in a healthy mix of experienced and rookie judges covering all necessary topics of the respective competition class. Of course, judges bring their own specific area of expertise to the event, but their focus is the evaluation within the set categories. So how do we make sure it is a fair evaluation?

Since judging always remains a subjective matter and scores fluctuate between the bays, we have:

1. Set up tandems of rookie and experienced judges covering the same topics, so that rookie judges can adapt to the scoring.
2. One experienced head judge present at every bay leveling the overall team performances.
3. Chief judges (dark blue shirts) moving around and collecting impressions of the ongoing judging process at each bay.
4. FSG officials (white shirts) overlooking all raw scores, checking whether there is a need for balancing between the bays based on various scoring indicators.

By this process, we ensure a fair evaluation of team performances and grant scores based on how well teams have done compared to every competitor.

Wer sind die Judges (Blue Shirts)?

Die Formula Student Germany hat viele Partner und Unterstützer aus dem professionellen Motorsport und der Automobilbranche, die sich ehrenamtlich engagieren und bei der Bewertung helfen. Wir haben jedes Jahr eine gesunde Mischung an neuen und erfahrenen Juroren zur Verfügung. Alle Juroren sind gleichmäßig in den EDE-Bays verteilt und decken alle notwendigen Themen der jeweiligen Wettbewerbsklasse ab. Natürlich bringen die Juroren dabei ihre eigenen Fachkenntnisse ein, aber ihr Schwerpunkt beim EDE liegt auf der Bewertung innerhalb der festgelegten Kategorien. Wie stellen wir sicher, dass fair bewertet wird?

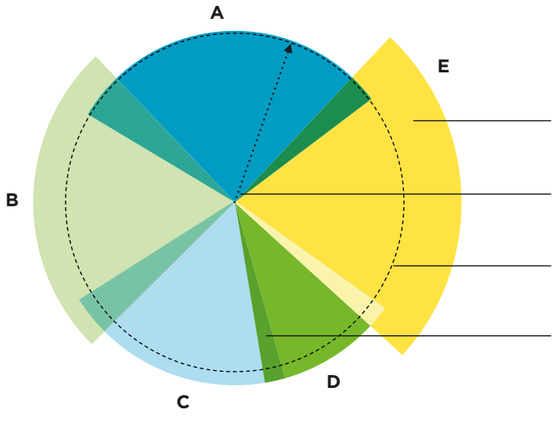
Da die Bewertung immer eine subjektive Angelegenheit bleibt und die Punktzahlen zwischen den Buchten schwanken, haben wir:

1. Tandems aus neuen und erfahrenen Juroren, welche dieselben Themen behandeln. Dadurch können sich neue Juroren an den Bewertungsmaßstab gewöhnen.
2. Erfahrene Head-Judges für jede Bay, welche die Gesamtleistung der Teams in Relation bringen.
3. Chief-Judges (dunkelblaue Hemden), welche sich zwischen den Bays bewegen und Eindrücke über den laufenden Bewertungsprozess sammeln.
4. FSG-Officials (weiße Hemden), welche alle Punktevergaben prüfen, ob auf der Grundlage verschiedener Wertungsindikatoren zwischen den Bays eine Angleichung der Punkte notwendig ist.

Auf diese Weise gewährleisten wir eine faire Bewertung der Teamleistungen und vergeben Gesamtpunkte in Abhängigkeit zu allen anderen Wettbewerbern.

How to Judge and Evaluate Teams?

For explanation purposes, there is the “Claude-Rouelle-Model” (see Figure 2) which represents the engineering knowledge by a pie chart (if you have not heard about Claude yet, watch his video “Claude Rouelle: Advice for SAE Teams” on Vimeo). The more knowledge a team has, the bigger the pie is in its overall area. However, the pie itself is not uniform in size. It is made from multiple pieces that symbolize the different engineering categories mentioned above. Also, the pie pieces overlap each other, representing the interface of knowledge between categories. As there are stronger and weaker areas of knowledge in a team, the pie looks like in the image shown below with some sections reaching further outwards than others.



How to read the pie chart? / Wie wird das Diagramm gelesen?

Shaded pieces = Different engineering categories (see above) /
Farbige Flächen = Verschiedene technische Kategorien (siehe oben)

Radius = Depth of focus / complexity /
Radius = Detailtiefe / Komplexität

Dotted circle = Usable impact on overall vehicle performance /
Punkte-Linie = Anwendbares Gesamtwissen am Fahrzeug

Overlap = Interdisciplinary synergies increase overall performance /
Überlappung = Schnittstellen und Synergien erhöhen die Performance

Figure 2: “Claude-Rouelle-Model” of Engineering Design /
Abbildung 2: „Claude-Rouelle-Modell“ vom Engineering Design Event

To make things more complicated, let us cluster the engineering knowledge in basic, intermediate, and advanced levels. During the EDE, judges focus on basic and intermediate levels, as well as the synergies between different engineering categories (e.g., aerodynamics and vehicle dynamics). Starting with general questions, judges quickly dig deeper during their assessment. Advanced knowledge, however, will be left for the finals to determine a winner. Hence, in order to being considered for finals you must score well in the basic and intermediate levels.

With every season, new knowledge is acquired. You can see the evolution of team’s knowledge over time in the chart above (Figure 3) representing 2006, 2010, and 2019 respectively. However, judges have noticed a paradox in EDE presentations during past seasons. Teams show up with comprehensive car designs implying a great understanding and knowledge level. Though, they miss crucial basics in key areas (e.g., excellent FEA analysis but poor explanation of suspension design, see piece D) or have a disconnection between the pieces of the pie (see D/E). The result is less common team knowledge which will end up in a lower team score and no chances for making it to the finals.

Wie werden die Teams beurteilt und bewertet?

Zur Erläuterung kann stellvertretend das „Claude-Rouelle-Modell“ (siehe Abbildung 2) herangezogen werden, welches das Ingenieurwissen im Team in einem Tortendiagramm darstellt (falls ihr noch nichts von Claude gehört habt, schaut sein Video „Claude Rouelle: Advice for SAE Teams“ auf Vimeo an). Je mehr Wissen ein Team hat, desto größer ist der Kuchen in seiner Gesamtfläche. Der Kuchen selbst ist jedoch nicht einheitlich groß. Er besteht aus mehreren Stücken, die die verschiedenen oben genannten technischen Kategorien symbolisieren. Außerdem überschneiden sich die Tortenstücke, was die Schnittstelle des Wissens zwischen den Kategorien darstellt. Da es in einem Team stärkere und schwächere Wissensbereiche gibt, sieht der Kuchen wie in der folgenden Abbildung aus.

Die technischen Kenntnisse werden nun in Grund-, erweitertes- und fortgeschrittenes Wissen unterteilt. Während des EDE konzentrieren sich die Juroren auf das Grund- und erweiterte Wissen sowie auf die Synergien zwischen verschiedenen technischen Kategorien (z. B. Aerodynamik und Fahrzeugdynamik). Die Juroren beginnen dabei mit allgemeinen Fragen und tauchen schnell ins Detail ab. Fortgeschrittenes Wissen wird jedoch erst im Finale abgefragt, um einen Sieger zu ermitteln. Um für das Finale in Frage zu kommen, müssen die Teams also vor allem im Grund- und erweiterten Wissen gut abschneiden.

In jeder Saison wird neues Wissen erworben. In der Grafik oben (Abbildung 3), welche die Jahre 2006, 2010 und 2019 darstellt, ist beispielhaft die Entwicklung des Wissensstandes der Teams im Laufe der Zeit sehen. Hierbei ist den Juroren in den vergangenen EDE Präsentationen eine denkwürdige Entwicklung aufgefallen: Einige Teams präsentieren durchdachte Fahrzeugkonzepte, welche auf ein großes Verständnis und einen hohen Wissensstand hindeuten. Allerdings lassen sie dabei entscheidende Grundlagen in Schlüsselbereichen vermissen (z. B. eine hervorragende FEA-Analyse, aber eine schlechte Erklärung der Aufhängungskonstruktion, siehe Teil D) oder sie haben keine Verbindung zwischen den einzelnen Teilen des Kuchens (siehe D/E). Das Ergebnis ist geringerer Gesamtwissensstand im Team, was konsequenterweise zu einer niedrigeren Bewertung führt und damit auch keine Chance mehr auf das Finale besteht.

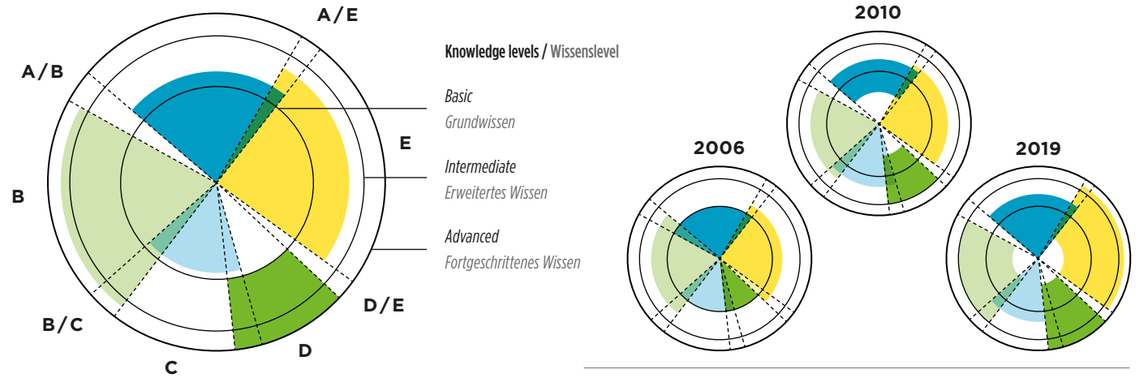


Figure 3: Knowledge levels, missing the basics at D, no synergy at D/E, and evolution over time /
Abbildung 3: Wissenslevel, kein Grundwissen bei D, fehlende Schnittstelle D/E, Entwicklung über die Jahre

How to Excel in Engineering Design Competition?

Often, we are asked what the ideal presentation looks like and what kind of documentation students need to bring. There are a few key elements to point out:

The team
At the beginning, one representative of your team will give a three-minute introduction stating goals, basic concept of the car, innovations you are proud of, individual specialties, and name responsible team members for the engineering categories. The intro is very important as it sets the tone for your presentation, and you should prepare it in advance. It helps judges getting a rough understanding of who you are, what you tried to achieve during design phase and how well it turned out. Technical goals that have been mentioned in the overall introduction should also be present throughout the sub system concepts and engineering of components. Select a team of engineers who have the specific knowledge, speak good English and are comfortable in presenting their own and the team’s work. Usually, your EDE bay consists of 5–8 judges focusing on a specific area of expertise, so ensure that your team is flexible enough to accommodate the judges. In case you registered for the Driverless Cup, there will be additional judges for a deep dive of autonomous functions.

We know that nervousness plays a big role when an entire season of work boils down to 30 minutes of presentation. Ask alumni or local partners if you can practice presenting and answering questions ahead of competition so you can get more comfortable. You should be very proud of all your efforts. Judges appreciate your work and spirit. In case you cannot answer a question, try to bring in one of your colleagues that can. Most importantly, if you do not know the answer, do not lie. It is better to admit to the design judge then pretend you know. Move on to the next topic where you have more knowledge and convince the judge that you understood the underlying principles.

Wie kann ich mich im Engineering Design Event hervorheben?

Oft werden wir gefragt, wie die ideale Präsentation aussieht und welche Art von Unterlagen die Studierenden mitbringen müssen. Es gibt einige Kernthemen, auf die wir hinweisen möchten:

Das Team
Zu Beginn gibt ein Vertreter des Teams eine dreiminütige Einleitung, in welcher die Ziele, das Grundkonzept des Fahrzeugs, die Innovationen, die einzelnen Spezialgebiete und die Namen der für die technischen Kategorien zuständigen Teammitglieder genannt werden. Die Einleitung ist sehr wichtig, da sie den ersten Eindruck vom Team prägt. Daher sollte sie im Voraus vorbereitet und geübt werden. Außerdem hilft sie den Juroren, sich ein grobes Bild vom Fahrzeug zu machen, wer ihr seid, was ihr während der Design-Phase versucht habt zu erreichen und wie gut es gelungen ist. Die technischen Ziele, die in der allgemeinen Einleitung genannt wurden, sollten sich in den Konzepten der Baugruppen und der Konstruktion der Komponenten widerspiegeln sein. Wählt für den weiteren Verlauf ein Team von Ingenieuren aus, die über die entsprechenden Kenntnisse verfügen, gut Englisch sprechen und ihre eigene Arbeit sowie die des Teams gut präsentieren können. In der Regel besteht eure EDE-Bay aus 5–8 Juroren, die sich jeweils auf ein bestimmtes Fachgebiet konzentrieren. Stellt sicher, dass das Team flexibel genug ist, um allen Juroren Fragen beantworten zu können. Falls ihr euch für den Driverless Cup angemeldet habt, werden zusätzliche Juroren anwesend sein, welche sich intensiv mit den autonomen Funktionen beschäftigen.

Uns ist bewusst, dass Nervosität eine große Rolle spielt, wenn sich die Arbeit einer ganzen Saison auf eine 30-minütige Präsentation reduziert. Fragt Ehemalige oder Partner vor Ort, ob ihr die Präsentation und Fragen vor dem Wettbewerb üben können, damit ihr sicherer werdet und Schwachstellen aufdeckt. Die Juroren wissen eure Arbeit und euren Kampfgeist zu schätzen. Falls ihr mal eine Frage nicht beantworten können, versucht jemand anderes hinzuzuziehen, der die Antwort kennt. Ganz wichtig: Wenn keiner die Antwort weiß, dann lügt nicht. Es ist besser, es dem Juror gegenüber zuzugeben, als nur so zu tun. Geht zum nächsten Thema über, bei welchem ihr mehr wisst, und überzeugt den Juror, dass ihr die zugrunde liegenden Prinzipien verstanden habt.

2019 Autonomous Design Finals – Judges will test the limit of your knowledge /
2019 Autonomous Design Finals – Die Juroren werden euch alles an Wissen abverlangen

The documentation

Having a well-prepared documentation will help your presentation immensely. Utilizing posters to provide general information and highlight key areas of development help judges get a quick understanding of the overall vehicle. Tablets or binders (no preference, use what you can work best with) with organized data in the form of charts or engineering analysis will help you support your presentation and answer any questions the judge has about your decisions and work. Prototypes of parts or other physical exhibits can help provide tangible examples of how you developed the car or learned hard lessons.

The most important part is that you and your team must know what all of your presenting material is, so that you can deliver it efficiently to the judges as it is requested. Do not bring materials that have been created seasons ago and you do not fully understand. Also ensure that you appropriately display and label all of your material (refer to academic standards). By avoiding spending time looking for or explaining your supporting evidence, you will be able to spend more time telling the judge about your engineering process and designs. The judges can only score each system on what they hear from you and your team members. They can not make inferences based off of information that was not presented or what they imagine your processes must have been.

Die Dokumentation

Eine gut vorbereitete Dokumentation hilft der Präsentation ungemein. Plakate, die allgemeine Informationen liefern und die wichtigsten Entwicklungsbereiche hervorheben, helfen den Juroren, sich schnell ein Bild vom Gesamtfahrzeug zu machen. Tablets oder Ordner (keine Präferenz, verwendet das, womit ihr am besten arbeiten könnt) mit organisierten Daten in Form von Diagrammen oder technischen Analysen helfen euch, die Präsentation zu unterstützen und alle Fragen zu beantworten, die der Juror zu euren Entscheidungen und eurer Konstruktion hat. Prototypen von Teilen oder andere physische Exponate können helfen, greifbare Beispiele dafür zu liefern, wie ihr das Auto entwickelt oder schwierige Lektionen gelernt habt.

Das Wichtigste ist, dass Ihr das gesamte Präsentationsmaterial kennt und ihr es den Juroren auf effiziente Weise zeigen könnt, wenn danach gefragt wird. Bringt keine Unterlagen mit, die schon vor Jahren erstellt wurden und die ihr nicht vollständig versteht. Vergewissert euch, dass das gesamte Material ordentlich aufgebaut und beschriftet ist (nach akademischen Standards). Wenn ihr weniger Zeit für die Suche oder die Erklärung von Unterlagen aufwenden müsst, könnt ihr mehr Zeit damit verbringen, dem Juror eure Konstruktionen zu erläutern. Die Juroren können jedes System nur danach bewerten, was sie von euch gehört haben. Sie können keine Rückschlüsse auf Informationen ziehen, die nicht präsentiert wurden.

The car

While judges are there to evaluate your knowledge and not your car specifically, a well-prepared and clean car can be one of your strongest assets in the presentation. It is the best proof of your knowledge applied in real life. Judges understand that teams have a tight schedule during the event and not everything will always go as planned. But do everything you can to get it there and have it looking good.

A good-looking car does not have to be the one with the fanciest tech or the most carbon fiber. Attention to detail regardless of the material or processes involved will show a lot about your team's engineering capabilities and will impress the judges as you show them specific design decisions or problem areas. Be prepared for the judges to ask for your team to remove items like nose cone and wheels, so they can see more of your designs. Also be prepared to have one or more judges sit in your car to evaluate driver ergonomics and ease of adjustment.

To summarize, you can view the engineering design event like an exam. Prepare yourself, study your material, know why you took decisions in your design process and the reasons behind, practice presentation skills, and be proud to present your work to experienced professionals.

Der Rennwagen

Auch wenn die Juroren euer Wissen und nicht euer Auto bewerten, kann ein gut vorbereitetes und sauberes Auto einer eurer besten Trümpfe bei der Präsentation sein. Es ist der beste Beweis dafür, dass ihr euer theoretisches Wissen angewandt und in der Praxis umgesetzt habt. Die Juroren haben Verständnis dafür, dass die Teams während der gesamten FSG-Veranstaltung einen engen Zeitplan haben und nicht immer alles wie geplant abläuft. Stellt aber in jedem Fall sicher, dass ihr euer Auto mitbringt und dass es glänzt.

Ein gutaussehendes Auto muss nicht unbedingt das mit der ausgefallensten Technik oder den meisten Karbon-Teilen sein. Die Liebe zum Detail, unabhängig von den verwendeten Materialien oder Prozessen, zeigt viel über die technischen Fähigkeiten eures Teams und wird die Juroren beeindrucken, wenn ihr ihnen bestimmte Konstruktionsentscheidungen oder Problembereiche zeigt. Seid darauf vorbereitet, dass die Juroren danach fragen werden, ob Verkleidungsteile oder die Räder entfern werden können, damit sie mehr von den Komponenten darunter sehen. Stellt euch auch darauf ein, dass sich ein oder mehrere Juroren ins Auto setzen möchten, um die Ergonomie und die Einstellmöglichkeiten für den Fahrer zu beurteilen.

Zusammenfassend kann man sagen, dass das Engineering Design Event wie eine Prüfung betrachtet werden kann. Bereiten euch vor, studiert eure Unterlagen, kennt die Entscheidungen in der Konzept- und Konstruktionsphase und welche Gründe es dafür gab, übt die Präsentationsfähigkeiten und seid stolz darauf, eure harte Arbeit erfahrenen Fachleuten präsentieren zu können.

2019 FSC Engineering Design Finals – Evaluation of driver ergonomnics and adjustability /
2019 FSC Engineering Design Finals – Bewertung der Fahrer-Ergonomie und Einstellbarkeit

What else would you like to hear more about? Let us know and we will cover it in a future article.

Worüber möchtet ihr noch mehr erfahren? Lasst es uns wissen und wir werden es in einem zukünftigen Artikel aufgreifen.

Participating Formula Student Combustion TEAMS 2022

Teams

https://fsg.one/cv22

Car	City/University	Country	Pit	Page
212	Puerto Real UCA	Spain	T-59	101
214	Castellón de la Plana UJI	Spain	06-B	96
218	Sevilla U	Spain	07-C	102
222	Napoli UNINA	Italy	10-B	100
225	Manresa EPSEM	Spain	T-56	100
229	Stuttgart U	Germany	10-A	102
240	Rzeszów TU	Poland	04-C	101
249	Krefeld HSNR	Germany	06-A	99
250	Lübeck TH	Germany	07-B	99
251	Rijeka U	Croatia	T-57	101
270	Coburg UAS	Germany	07-A	96
271	Khulna KUET	Bangladesh	T-62	98
275	Cambridge U	United Kingdom	06-C	95

Car	City/University	Country	Pit	Page
277	Volos U	Greece	T-60	103
279	Győr U	Hungary	04-B	97
284	Hannover UAS	Germany	09-A	98
294	Esslingen UAS	Germany	10-C	97
296	Manipal U	India	T-50	100
299	Bari PT	Italy	T-51	95
318	Aalborg U	Denmark	T-52	94
326	Dortmund UAS	Germany	T-58	96
369	Białystok TU	Poland	T-55	95
372	Hamburg HSU	Germany	T-54	97
373	Leganés UC3M	Spain	T-53	99
395	València UPV	Spain	09-B	102
399	Karlsruhe UAS	Germany	04-A	98

STATUS/STAND: 21.07.2022

Participating Formula Student Electric TEAMS 2022

Teams

https://fsg.one/ev22

Car	City/University	Country	Pit	Page
12	Wrocław TU	Poland	25-C	125
13	Berlin TU	Germany	26-C	106
14	Budapest TU	Hungary	26-A	107
15	Madrid TU	Spain	31-A	115
16	Winterthur ZHAW	Switzerland	40-A	124
21	Terrassa ESEIAAT	Spain	23-B	122
23	Amberg OTH	Germany	44-A	103
24	Darmstadt TU	Germany	16-C	108
25	Athens TU	Greece	37-A	104
26	Stuttgart U	Germany	12-A	121
27	Mumbai Somaiya	India	40-C	117
28	Kassel U	Germany	41-C	113
29	Bayreuth U	Germany	17-A	105
30	Kempten UAS	Germany	34-B	113
31	München TU	Germany	20-A	117
33	Zürich ETH	Switzerland	16-A	125
34	Ingolstadt UAS	Germany	46-C	113
35	Wolfenbüttel UAS Ostfalia	Germany	12-B	125
36	Chemnitz TU	Germany	23-C	107
39	Biel UAS	Switzerland	40-B	106
40	Eindhoven TU	Netherlands	22-A	110
41	Wien TU	Austria	20-B	124
43	Konstanz UAS	Germany	34-C	114
44	Ulm UAS	Germany	28-A	123
45	Sankt Augustin UAS	Germany	37-B	120
46	Turin PT	Italy	28-C	123
47	Corvallis OSU	United States	19-B	108
48	Bochum U	Germany	29-A	106
49	Erlangen U	Germany	19-A	110
50	Lisboa IST	Portugal	25-A	115
51	Sevilla U	Spain	09-C	120
54	Barcelona UPC	Spain	22-C	104
55	Be'er Sheva BGU	Israel	29-B	105
58	Paderborn U	Germany	38-C	118
59	Dresden TU	Germany	14-B	109
60	Weingarten UAS	Germany	37-C	123
62	Regensburg OTH	Germany	14-A	119
63	Trondheim NTNU	Norway	26-B	122
65	Wiesbaden UAS	Germany	29-C	124
66	Nürnberg GSO UAS	Germany	38-B	118
67	Prague CTU	Czech Republic	28-B	119
68	Hsinchu NTHU	Taiwan	32-B	112
69	Mannheim DHBW	Germany	22-B	116
76	Freiberg TU	Germany	35-A	111
77	Diepholz UAS	Germany	43-C	109
78	Hamburg TU	Germany	14-C	111
79	Pforzheim U	Germany	41-A	119
85	Delft TU	Netherlands	17-B	108
90	Milano PT	Italy	19-C	116
91	Braunschweig TU	Germany	25-B	107
94	Esslingen UAS	Germany	12-C	110
97	Schweinfurt UAS	Germany	38-A	120
98	Helsinki UAS	Finland	44-C	112
99	Aachen RWTH	Germany	17-C	103
110	Augsburg UAS	Germany	23-A	104
111	Trento U	Italy	35-C	122
113	München UAS	Germany	34-A	117
124	Tallinn TU UAS	Estonia	44-B	121
127	Lausanne EPFL	Switzerland	32-C	114
135	Belgrade U	Serbia	31-B	105
153	Kiel UAS	Germany	32-A	114
159	Ljubljana U	Slovenia	43-A	115
161	Göttingen HAWK	Germany	20-C	111
167	Osnabrück UAS	Germany	46-A	118
168	Mannheim UAS	Germany	41-B	116
169	Hamburg UAS	Germany	31-C	112
172	Dortmund TU	Germany	35-B	109
177	Stuttgart DHBW	Germany	16-B	121

STATUS/STAND: 21.07.2022

Formula Student
Team profiles

23 nations
2642 students

24 teams Combustion
2 teams Driverless Combustions

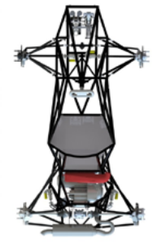
40 teams Electric
30 teams Driverless Electric

AALBORG

Aalborg University

Car 318 **Pit T-52** **WRL 430** Denmark

AAU Racing is Denmarks oldest formula student team and started back in 2001. The teams first generation car G1 competed in Australia in 2003 and the team has sinced produced 8 cars. The team has no education regarding automobiles and are therefore self-taught in this discipline. G9 is designed for realiability and is also expected to be the teams last combustion vehicle before the team shifts to fully electric. The teams first electric car is set to compete in its first competition in 2023



COMBUSTION

FRAME CONSTRUCTION Steel space frame
MATERIAL Mild steel E235 tubing
OVERALL L / W / H 2571mm / 1395mm / 1134mm
WHEELBASE / TRACK (Fr / Rr) 1599mm / 1225mm / 1171mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 142kg / 146kg
SUSPENSION Double unequal lenght non parallel A-arm. Pull rod acuated laterally
TYRES (Fr / Rr) Hoosier 205/470 R13 C20 Radial / Hoosier 205/470 R13 C20 Radial
WHEELS (Fr / Rr) 7x13, 30mm offset, OZ Racing magnesium rim / 7x13, 30mm offset, OZ Racing magnesium rim

ENGINE Modified Honda CBR 600RR PC37
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.5:1
FUEL SYSTEM Custom semi-direct electronic fuel injection.
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9500 rpm/ 7000rpm
DRIVE TYPE 520mm chain drive and modified gearbox
DIFFERENTIAL Drexler limited slip differential, custom lenght drriveshaft with drexler tripod joints.
COOLING Side angle-mounted single pass radiator with 6 Noctua NF-F12 CPU fans, custom CFRP cooling duct
BRAKE SYSTEM 4-Disk system with ISR calibers, adjustable brakebalance and AP Racing mastercylinders
ELECTRONICS Electronic gearshift, injectors, throttle body. AIM Dashboard and sensors. Custom ECU.

BARI

Polytechnic University of Bari

Car 299 **Pit T-51** **WRL 445** Italy

We are Poliba Corse, the Formula Student team of the Polytechnic University of Bari, Italy. Since 2006, we have designed and built one-seater cars to compete for FSAE events all over Europe. Year after year, we always look for new technical solutions, facing budget and rules limitations. The introduction of the hybrid carbon-fibre/steel chassis was one of the latest upgrades. After overcoming many difficulties, we finally bounce back in this season. We look forward to meeting you in Hockenheim!

COMBUSTION

FRAME CONSTRUCTION Hybrid Structure: Front Composite Monocoque and Rear Tubular Steel
MATERIAL Composite Structure: Balsaflex Core and prepreg carbon fiber; Tubular frame: AISI 4130
OVERALL L / W / H 2983mm / 1440mm / 1145mm
WHEELBASE / TRACK (Fr / Rr) 1580mm / 1250mm / 1230mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 123kg / 185kg
SUSPENSION Double A-ARMS(upper and lower) with springs and dampers, pull-rod front and push-rod rear
TYRES (Fr / Rr) 407x166 R10 , Avon Crossply Slick A94 / 407x166 R10 , Avon Crossply Slick A94
WHEELS (Fr / Rr) 7.0x10.0 , 22mm offset , 3pcd Mg / 7.0x10.0 , 22mm offset , 3pcd Mg
ENGINE Modified Honda 2004 CBR600 RR PC-37E
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12,0:1
FUEL SYSTEM Student designed and built, phased
FUEL 95 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 11900 rpm/ 9500rpm
DRIVE TYPE 30mm x 15mm chain belt
DIFFERENTIAL DREXLER clutch pack limited slip, 25 Nm preload
COOLING Water pump, thermostatic valve, side pod mounted single radiator with fan
BRAKE SYSTEM 4-Disk system, self developed rotors with 180mm diameter, adjustable brake balance
ELECTRONICS Multifuctional Steering Wheel, datalogger, wiring PVC protection, Electroactuated Shifter

BIAŁYSTOK

Białystok University of Technology

Car 369 **Pit T-55** **WRL 156** Poland

Built in one year by 29 members team. The eighth vehicle was an evolution of its predecessor. To improve overall performance and reliability we introduced changes in aerodynamics package, monocoque, electronics and engine department. With our eight car CMS-08 for the third time in history of our team we will proudly represent Bialystok University of Technology.

COMBUSTION

FRAME CONSTRUCTION Hybrid construction - sandwich composite monocoque and rear steel frame
MATERIAL Honeycomb
OVERALL L / W / H 2999mm / 1486mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1200mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 139kg / 139kg
SUSPENSION Double A-arm, Push-rod to upper wishbone, 2 coil springs with helper springs, adjustable U
TYRES (Fr / Rr) Hoosier 16x7,5-10
WHEELS (Fr / Rr) Hoosier 16x7,5-10
ENGINE Honda
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 13,1:1
FUEL SYSTEM Self design aluminium fuel rail, Honda OEM fuel pressure regulator, Honda CBR 600rr PC40 i
FUEL RON 98
MAX POWER/TORQUE DESIGN 59,5 rpm/ 57rpm
DRIVE TYPE Chain drive
DIFFERENTIAL LSD
COOLING Two radiators
BRAKE SYSTEM dia. 180mm, 5mm steel, fully floating, vented
ELECTRONICS Launch control, bias bar, LCD on dashboard, paddle shifters, drag reduction system, tracti

CAMBRIDGE

University of Cambridge

Car 275 **Pit 06-C** **WRL 451** United Kingdom

The University of Cambridge's TTP Full Blue Racing is making their return to in-person competition after the pandemic this year. This marks the first time that the team has attended FSG in a decade. The team's 2022 car uses an improved chassis with better suspension characteristics. The new dashboard provides the driver with better access to sensor data, and a pneumatic paddle shifter system enhances driveability.
The team would like to thank their sponsors for their support this year.

COMBUSTION

FRAME CONSTRUCTION Steel spaceframe
MATERIAL Cold drawn seamless steel tubing
OVERALL L / W / H 2837mm / 1382mm / 1015mm
WHEELBASE / TRACK (Fr / Rr) 1150mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 134kg / 164kg
SUSPENSION Double unequal A-Arm, Coil-over strut suspension
TYRES (Fr / Rr) 7.2/20.0-13 Avon A92
WHEELS (Fr / Rr) Bain Sturace Monoblock 6
ENGINE Yamaha R6 5SL
BORE / STROKE / CYLINDERS / DISPLACEMENT 65,5mm / 44,5mm / 4 cylinders / 600cc
COMPRESSION RATIO 12.4:1
FUEL SYSTEM Yamaha R6 stock fuel rail and injectors
FUEL 95/98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 12000 rpm/ 8200rpm
DRIVE TYPE Chain Drive
DIFFERENTIAL Drexler LSD 120mm
COOLING 2 sidepod-mounted single core radiators,1000cfm fan mounted to rear of radiators
BRAKE SYSTEM 4-Disk system, 248mm rotors, Wilwood calipers
ELECTRONICS Big loom, wheel with display electropneumatic shifting system, local data acquisition

CASTELLÓN DE LA PLANA

Universitat Jaume I

Car 214 **Pit 06-B** **WRL 467** Spain

We are the UJI Motorsport team, a group formed by students of the Universitat Jaume I of Castellón. In our team you will find a group of students involved in all areas of work; we seek a common goal through young talent, innovation, technology, and effort. Every year we work hard to develop a Formula Student car like this year. The biggest step we have taken this year has been to make the monocoque out of carbon fibre.

COMBUSTION

FRAME CONSTRUCTION Monocoque (composite panel) with tubular secondary structure
MATERIAL Composite panel - CFRP with aluminum honeycomb or PVC foam core
OVERALL L / W / H 3152mm / 1289mm / 1226mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1120mm / 1000mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 110kg / 140kg
SUSPENSION Double unequal length A-Arm. Push rod, spring-damper adjustable compression and rebound.
TYRES (Fr / Rr) 20.5x7.0 R13, Hoosier R20 / 20.5x7.0 R13, Hoosier R20
WHEELS (Fr / Rr) OZ racing 13' Aluminum 7x13, 22mm offset / OZ racing 13' Aluminum 7x13, 22mm offset
ENGINE Yamaha MT-07 (CP2 Engine) 2019
BORE / STROKE / CYLINDERS / DISPLACEMENT 80mm / 68,6mm / 2 cylinders / 689cc
COMPRESSION RATIO 11.5:1
FUEL SYSTEM Yamaha YCC-T, fuel injection
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9000 rpm/ 6600rpm
DRIVE TYPE 20x10 mm transmission chain
DIFFERENTIAL none
COOLING Rear single radiator mounted with thermostatic controlled dual-electric fans
BRAKE SYSTEM 3-Disk system, Floating rotors 222mm outer diam, adjustable brake balance
ELECTRONICS Custom data logger, 6 analog, 6 digital ch, CAN, Unidirectional data streaming esp-now

COBURG

University of Applied Sciences Coburg

Car 270 **Pit 07-A** **WRL 144** Germany

The margay (Leopardus wiedii) is a small wild cat native to Central and South America. This incredible cat is able to jump up to 3.7 m horizontally. After 15 years of CAT-Racing we built our 14th car, the C-22 Margay. This season the car features Hoosier 16x7,5-10 LCO tires and a CFRP monocoque paired with a steeltube rearframe, powered by a 4-cylinder Yamaha R6 engine. On top of that our C-22 has a completely new aero package. We are looking forward to a successful season with our agile Margay.

COMBUSTION

FRAME CONSTRUCTION hybrid chassis; rear spaceframe decoupled from main structure, front monocoque
MATERIAL 200g/m² twill weave carbon fiber, 173g/m² twill weave aramid fiber, mild steel E355/S235 JR +C
OVERALL L / W / H 2980mm / 1490mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1230mm / 1220mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 110kg / 133kg
SUSPENSION Double unequal length A-Arm/Pull rod actuated spring and damper / adjustable u-shape ARB
TYRES (Fr / Rr) Hoosier 16x7,5-10 LC0
WHEELS (Fr / Rr) custom alumnium center/ CFK shell, 10x7
ENGINE Yamaha YZF-R6 RJ05
BORE / STROKE / CYLINDERS / DISPLACEMENT 65,5mm / 44,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 17.1:1
FUEL SYSTEM Multipoint fuel injection with Bosch EV14 and Bosch MS6
FUEL RON 95
MAX POWER/TORQUE DESIGN 10300 rpm/ 8500rpm
DRIVE TYPE 520 Roller-Chain Drive
DIFFERENTIAL Drexler Slip Differential with reworked Locks; preload 30Nm - TBR = 4.00
COOLING two sidepod mounted 0,045m² core radiators, student designed fan
BRAKE SYSTEM 4-Disk system, self developed rotors, adjustable brake balance, fixed caliper
ELECTRONICS Selfdeveloped Live-telemetry, PDB and dashboard for driver information

DORTMUND

University of Applied Sciences Dortmund

Car 326 **Pit T-58** Germany

The Race-Ing. Team of UAS Dortmund is a group of engaged students of different fields of study. Beside our study we develop racecars to take part in the Formula Student competition. The project should give us the possibility to apply theoretical knowledge from the studies practically. We set ourselves the target to produce a racecar with high raceing-performance and durability. We wish all participants, officials, visitors and all red shirts an amazing and above all an accident free competition.

COMBUSTION

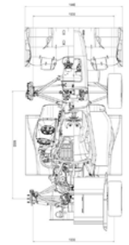
FRAME CONSTRUCTION cfrp monocoque with removable Aluminum rear frame
MATERIAL cfrp prepreg, 200 g/m² with aramid honeycomb core
OVERALL L / W / H 2821mm / 1395mm / 1116mm
WHEELBASE / TRACK (Fr / Rr) 1630mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 134kg / 164kg
SUSPENSION Double unequalized length Wishbone with Push- / Pullrods ?
TYRES (Fr / Rr) 205/470R13 CONTI FSAE
WHEELS (Fr / Rr) OZ Magnesium, 7x13 Offset 30, 4x100
ENGINE Honda, PC35, 4 cylinder, in-line
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12,0:1
FUEL SYSTEM modified multi port fuel injection
FUEL RON98
MAX POWER/TORQUE DESIGN 11200 rpm/ 9800rpm
DRIVE TYPE chain drive Norm: 520, Honda original ge
DIFFERENTIAL Drexler F-Student slip differential, max. Torque 1200Nm, preload: 10Nm0
COOLING side pod mounted radiator with ECU regulated fan speed
BRAKE SYSTEM 4 Piston FA / 2 Piston RA Brake calipers with Balance bar for optimal Brake balance bar
ELECTRONICS Vector GL1000, 500K Baud HighSpeed Can, Trijekt, CanChecked MFD28, electromechanic shifter

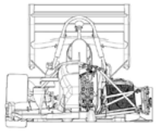
ESSLINGEN

University of Applied Sciences Esslingen

Car 294 **Pit 10-C** **WRL 25** Germany

For the 15th time the Rennstall Esslingen will participate at FSG. A new team has formed around the Stallardo '22. Eager to improve the car, we defined our key goals of driveability, reliability, and performance. All these goals are exentuated with a clear view towards the future. We developed a new CFRP rear frame, optmized our aerodynamic packaging and reinvented our front wheels. Our team is eager to show the full potential of the Stallardo '22 at the event. You're invited to visit us!





COMBUSTION

FRAME CONSTRUCTION Partial Monocoque; CFRP monocoque with CFRP rear frame
MATERIAL UD & fabric fibres (HM;HT)/AL honeycomb/ Rohacell
OVERALL L / W / H 3025mm / 1440mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1218mm / 1218mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 127kg / 141kg
SUSPENSION pushrod actuated SLA, KW FS heave damper, self-made roll damper and heave air spring
TYRES (Fr / Rr) 20x7-13, Goodyear FSAE / 20x7-13, Goodyear FSAE
WHEELS (Fr / Rr) 7x13, -2mm, self designed CFRP / 7x13, -30mm, self designed CFRP, 4 spoke
ENGINE KTM Duke 790 / LC8c
BORE / STROKE / CYLINDERS / DISPLACEMENT 88mm / 58mm / 2 cylinders / 706cc
COMPRESSION RATIO 13,4:1
FUEL SYSTEM stock injectors and rail, Walbro GSL392
FUEL E85
MAX POWER/TORQUE DESIGN 9000 rpm/ 5000rpm
DRIVE TYPE Chain: DID ERT 520
DIFFERENTIAL Drexler FS2016: limited slip clutch pack, adjustable preload and bias ratio
COOLING left sidepod mounted 1 core u-flow radiator, 825 cfm fan mounted to radiator
BRAKE SYSTEM perimeter brake system with self-developed front Calipers with adjustable brake balance
ELECTRONICS Selfdeveloped RTOS - StallardOS, STM32 based ECU's, Electrical Shifting System

GYŐR

Széchenyi István University Györ

Car 279 **Pit 04-B** **WRL 71** Hungary

Established in 2014, the Arrabona Racing Team represents the University of Györ. Our team won their second competition, the Formula Student Russia, afterward we were third in Formula Student East 2019. This year we participate in FSA, FS East, and FSG. The ART_09 is the second car, with CFRP monocoque, the lightweight, and optimized descendant of ART_08, with SZEngine-22 engine, CFRP wheels, and A-Arms. Our goal is to reach podium places in every competition.

COMBUSTION

FRAME CONSTRUCTION Full monocoque
MATERIAL Prepreg CFRP with aluminum honeycomb
OVERALL L / W / H 2920mm / 1525mm / 1170mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 127kg / 131kg
SUSPENSION Double unequal length A-Arm, Pullrod actuated spring and damper
TYRES (Fr / Rr) Hoosier 16.0x7.0-10 R20
WHEELS (Fr / Rr) 10" Carbon fiber rim shell with aluminum 3D printed center
ENGINE Szengine-22
BORE / STROKE / CYLINDERS / DISPLACEMENT 105mm / 80mm / 1 cylinder / 693cc
COMPRESSION RATIO 12.7:1
FUEL SYSTEM HP-Tech fuel pump, Systec fuel pressure regulator and filter, KTM Injector
FUEL RON98
MAX POWER/TORQUE DESIGN 8500 rpm/ 6720rpm
DRIVE TYPE 428 chain drive
DIFFERENTIAL Drexler limited slip differential, 35 Nm preload, adjustable ramp angles
COOLING Frame mounted radiator, with thermostatic controlled electric fans
BRAKE SYSTEM 4-disk system, self-developed floating rotors, custom caliper, e-balancebar
ELECTRONICS MaxxECU Pro,custom Power Distribution Unit, Motec C125 dash, Live-Telemetry

HAMBURG

Helmut Schmidt University of Federal Armed Forces Hamburg

Car 372 **Pit T-54** **WRL 534** Germany

EOS Racing is happy to come back to FSG after our engine blow up last year. The team consists of 20 men and women that are active military personnel and share the passion of building race cars. Our time at the University is strictly bound to four years, including both bachelor's and master's degrees. To manage that we work in a trimester system with an exam period every three months. The RUSH22 is our tenth Formula Student race Car. Let's give our last FSC vehicle a worthy ending!

COMBUSTION

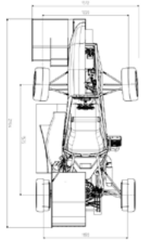
FRAME CONSTRUCTION Tubular space frame
MATERIAL E235+C
OVERALL L / W / H 2708mm / 1470mm / 1045mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1250mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 125kg / 153kg
SUSPENSION Double unequal length A-Arm. Direct actuated spring and damper
TYRES (Fr / Rr) Double unequal length A-Arm. Direct actuated spring and damper
WHEELS (Fr / Rr) 7x13, 22mm offset, 1pc Al Rim / 7x13, 22mm offset, 1pc Al Rim
ENGINE 2014 Yamaha MT-07
BORE / STROKE / CYLINDERS / DISPLACEMENT 80mm / 68,6mm / 2 cylinders / 690cc
COMPRESSION RATIO 11,5:1
FUEL SYSTEM Student design/built, fuel injection, sequential
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9000 rpm/ 6500rpm
DRIVE TYPE 520 chain
DIFFERENTIAL clutch pack limited slip, 35Nm preload
COOLING Side mounted radiator and 120mm electric fan
BRAKE SYSTEM 4-Disk system, self developed rotors with 220mm diameter, adjustable brake balance
ELECTRONICS Dashboard with shift light and gear indicator, electromagnetic shifting system

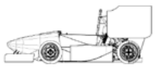
HANNOVER

University of Applied Sciences Hannover

Car 284 **Pit 09-A** **WRL 266** Germany

Campus Motorsport Hanover – We are a team of 40 young motivated people, newbies and experienced team members, engineers and business (wo)men. Our home is the UAS Hanover, Germany. The team was established in 2007 and our first Formula Student experience were at FS Germany with our first ever race car Pegasus 09. Since then, we all contribute our innovative ideas and expand our knowledge. This year´s car – our Pegasus 22 – is a visual representation of our combined strengths.





COMBUSTION

FRAME CONSTRUCTION tubular space frame
MATERIAL E355
OVERALL L / W / H 2964mm / 1512mm / 1163mm
WHEELBASE / TRACK (Fr / Rr) 1575mm / 1220mm / 1190mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 153kg / 125kg
SUSPENSION Double unequal length A-Arms, Push-rod actuated spring and damper
TYRES (Fr / Rr) 470x205 R13 Continental 6J6N/ 470x205 R13 Continental 6J6N
WHEELS (Fr / Rr) 13x7, 30 mm offset, Mg cast/ 13x7, 30 mm offset, Mg cast
ENGINE Turbocharged KTM LC4
BORE / STROKE / CYLINDERS / DISPLACEMENT 102mm / 84,5mm / 1 cylinder / 690cc
COMPRESSION RATIO 12,6:1
FUEL SYSTEM 10 bar fuel pump, single BOSCH 980ccm injector
FUEL E85 ethanol
MAX POWER/TORQUE DESIGN 6800 rpm/ 5600rpm
DRIVE TYPE chain drive, oem gear box
DIFFERENTIAL Drexler Formula SAE Limited Slip (40°/50°, 41Nm preload)
COOLING dual side mounted 195x180x35mm radiators, controlled brushles motor
BRAKE SYSTEM 4-Disk system, rotors with 220mm /210mm diameter, adjustable brake balance, 4/2 calipers
ELECTRONICS wiring harness, multifunctional steering wheel, electropneumatic shifting and clutch

KARLSRUHE

University of Applied Sciences Karlsruhe

Car 399 **Pit 04-A** **WRL 21** Germany

High Speed Karlsruhe is entering its 16th season in the Formula Student combustion competition. Around 55 team members are working together to build the new race car called F-116, which has a monocoque with new layup and a modified aero package. The F-116 features a shark fin, a revised cooling system and a new steering wheel. We manufacture most of our car ourselves. Team members programme and operate CNC machines, laminate the CFRP parts and assemble the electronic boards themselves.

COMBUSTION

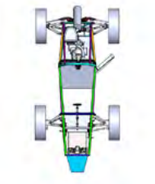
FRAME CONSTRUCTION Full CFRP monocoque
MATERIAL Carbon fibre with aluminium honeycomb core
OVERALL L / W / H 2855mm / 1524mm / 1177mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1220mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 111kg / 119kg
SUSPENSION Unequal length double-wishbone, pushrod actuated dampers, U-type anti-roll-bars
TYRES (Fr / Rr) 16.0 x 7.5 - 10.0 Hoosier R20 / 16.0 x 7.5 - 10.0 Hoosier R20
WHEELS (Fr / Rr) 7.0 x 10.0, 4.0 mm rim offset, 2 pc CFRP rim with AL7075 rimstar (Front and Rear)
ENGINE Modified Suzuki RMX 405, 2011
BORE / STROKE / CYLINDERS / DISPLACEMENT 100mm / 62,1mm / 1 cylinder / 488cc
COMPRESSION RATIO 17:1
FUEL SYSTEM system with fuel injection and spark ignition
FUEL E85
MAX POWER/TORQUE DESIGN 9000 rpm/ 7500rpm
DRIVE TYPE Chain drive
DIFFERENTIAL Clutch pack limited slip, 10Nm preload, adjustable ratios
COOLING Two Radiators behind Drive Axle
BRAKE SYSTEM 4-Disk system, self designed 4 piston calipers (Fr). 2 piston calipers (Rr)
ELECTRONICS 11 self-developed control and sensor units, electropneumatic shifting

KHULNA

Khulna University of Engineering & Technology

Car 271 **Pit T-62** Bangladesh

For the first time in history, a team from Bangladesh is going to attend the tarmac in Hockenheim. One goal, one mission; to construct a Formula Student racecar, tirelessly working since 2018. Economical design with sustainability is what we targeted, used Natural fiber composite structure in our body. Ever have plans to visit the largest mangrove forest in the world, the Sundarbans? Call us before you leave.



COMBUSTION

FRAME CONSTRUCTION Steel Spaceframe
MATERIAL Mild Steel (Class A), produced according to the British standard i.e., BS-1387.
OVERALL L / W / H 2855mm / 1415mm / 1230mm
WHEELBASE / TRACK (Fr / Rr) 1580mm / 1240mm / 1215mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 175kg / 175kg
SUSPENSION Independent, Double unequal wishbone, Unparallel, Push Rod, Compression spring
TYRES (Fr / Rr) 175x70 R13, Dunlop ECO EC 201/ 175x70 R13, Dunlop ECO EC 201
WHEELS (Fr / Rr) Aluminum alloy rim
ENGINE KTM Duke 390cc
BORE / STROKE / CYLINDERS / DISPLACEMENT 89mm / 60mm / 1 cylinder / 390cc
COMPRESSION RATIO 12.6:1
FUEL SYSTEM Bosch, Port fuel Injection
FUEL 98 RON
MAX POWER/TORQUE DESIGN 9000 rpm/ 7000rpm
DRIVE TYPE Chain driven, Chain: Size 520 (Pitch)
DIFFERENTIAL Open Differential, Configuration: 2 side gears, 2 planet gears.
COOLING Single left side pod mounted KTM Duke 390 cc radiator with direct line electric fan.
BRAKE SYSTEM Fixed disc steel rotor of 239.2mm diameter, adjustable brake balance, duel piston caliper.
ELECTRONICS Digital Dashboard.

KREFELD

Hochschule Niederrhein

Car 249 **Pit 06-A** **WRL 244** Germany

"Team up. Build up. Speed up." After a break of two years due to the pandemic, we are proud to say our slogan again and to present the RS-22C as our latest and greatest competing racecar. The HSNR Racing Team is celebrating its 10th anniversary in 2022, which makes this FS Season even more special to us. As always, while developing the RS-22C we focused on a lightweight design, reliability and sustainability to ensure high performance as well as good economic value.

COMBUSTION

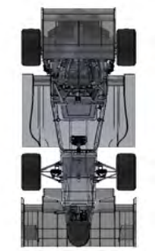
FRAME CONSTRUCTION Front and rear tubular space frame
MATERIAL E235 steel round tubing, 20mm to 30mm dia
OVERALL L / W / H 2845mm / 1540mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1250mm / 1210mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 104kg / 124kg
SUSPENSION Double Wishbone push-rod
TYRES (Fr / Rr) 16.0x7.5-10 LCO Hoosier / 16.0x7.5-10 LCO Hoosier
WHEELS (Fr / Rr) 10x7, 1 pc Magnesium Rim / 10x7, 1 pc Magnesium Rim
ENGINE 2019 KTM 500 EXC-F
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 72mm / 1 cylinder / 511cc
COMPRESSION RATIO 11.9:1
FUEL SYSTEM self-developed injection system, single Bosch EV14ESxT injector w/v-shaped jets
FUEL 98 octane
MAX POWER/TORQUE DESIGN 9000 rpm/ 6500rpm
DRIVE TYPE DID 520 ERT2 chain drive
DIFFERENTIAL Mechanical limited slip differential, adjustable preload
COOLING Twin side pod mounted radiators with thermostatic controlled electric fans
BRAKE SYSTEM 4-Disk system, floating steel rotors, master cylinders and calipers from AP Racing
ELECTRONICS Electropneumatic Shifting System, selfdesigned controllers for auxiliary systems

LEGANÉS

University Carlos III of Madrid

Car 373 **Pit T-53** **WRL 462** Spain

We are a group of students who have united our personal goals to make something special happen, together. In the process, we want to push ourselves to the limit and we want to self-improve and improve as a team. During the pandemic, we decided to rebrand our team changing our name, logo and, most importantly, our mindset. We are designing our new car considering the four values that determine what MAD Formula Team is: Original-practical thinking, dedication, organization, and love.



COMBUSTION

FRAME CONSTRUCTION CFRP Integral Monocoque
MATERIAL Gurit CFRP (twill and unidirectional) with aluminium honeycomb
OVERALL L / W / H 2950mm / 1416mm / 1160mm
WHEELBASE / TRACK (Fr / Rr) 1545mm / 1170mm / 1170mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 132kg / 161kg
SUSPENSION Double unequal length A-Arm Pull rod actuated spring and damper.
TYRES (Fr / Rr) 18x7-8, Hoosier R20
WHEELS (Fr / Rr) 10x7.5 Braid Sturace Mg rim
ENGINE Honda CBR600 F4i
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12
FUEL SYSTEM Inline fuel pump with direct injection
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 10200 rpm/ 6800rpm
DRIVE TYPE Rear wheel drive by a 520 chain
DIFFERENTIAL Limited Slip differential
COOLING Diffuser mounted radiator
BRAKE SYSTEM 4 disk system with self developed steel rotors
ELECTRONICS Self-made wiring, CAN Bus communication protocol with electronic clutch and shifter.

LÜBECK

Technische Hochschule Lübeck

Car 250 **Pit 07-B** **WRL 508** Germany

Presenting our 3rd overall race car we, the Seagulls Luebeck, are very proud of our youngest hatchling, the SG-03. Featuring full aero and way more carbon than ever before we managed to make a lighter, more refined and faster car than both of it's predecessors.

COMBUSTION

FRAME CONSTRUCTION Steel Tube space Frame
MATERIAL 1.0045, 1.0308, 1.0580 steel round tubing 25mm to 30mm dia.
OVERALL L / W / H 2745mm / 1400mm / 1300mm
WHEELBASE / TRACK (Fr / Rr) 1580mm / 1150mm / 1105mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 139kg / 171kg
SUSPENSION double unequal lenght A-arm Pull-(Fr) Push(Re)- rod actuated horiz. oriented spring+damper
TYRES (Fr / Rr) 205x55 R13, Continental C19 Front and Rear
WHEELS (Fr / Rr) 7x13, 30mm offset, 1pc Magnesium Rim
ENGINE 2005/2006 Kawasaki ZX-636 C 4 Cylinder
BORE / STROKE / CYLINDERS / DISPLACEMENT 68mm / 43,8mm / 4 cylinders / 636cc
COMPRESSION RATIO 12.9:1
FUEL SYSTEM Full Sequential Prim. Inj., Batched Secondary Inj.
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9000 rpm/ 8000rpm
DRIVE TYPE OEM Sequential 5 Speed Gearbox
DIFFERENTIAL Drexler FS 2010 Differential, clutch pack limited slip, 45Nm preload
COOLING Twin side pod radiators with thermostatic controlled electric fans
BRAKE SYSTEM 4 Disk Floating , self developed rotors, 1.4034 ,hub mounted, vented
ELECTRONICS CAN2.0A, Custom GPS Assisted Data Logger, Electronic Shifting System

MANIPAL

Manipal Academy of Higher Education

Car 296 **Pit T-50** **WRL 181** India

With 15 years of experience, 11 cars, and over 30 awards, Formula Manipal, the official FSAE team of MAHE, Manipal is one of the top-performing teams in India. FMXX1, our redesigned and intricately manufactured Combustion Vehicle is here with a bang. Incorporating a newly designed suspension geometry for maximizing mechanical grip and an aero-package using inverse design, a high lift airfoil along with a custom-designed Electro-pneumatic circuit for clutching and shifting.

COMBUSTION

FRAME CONSTRUCTION Tubular Spaceframe
MATERIAL AISI 1018 Mild Steel
OVERALL L / W / H 3004mm / 1512mm / 1201mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1220mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 142kg / 158kg
SUSPENSION Double non-parallel unequal wishbone, pullrod actuated (front), pushrod actuated (rear)
TYRES (Fr / Rr) Hoosier 18x7.5-10 R25B / 18x7.5-10 R25B
WHEELS (Fr / Rr) 7.0x10, 3 pc Al, 100 mm offset / 7.0x10, 3 pc Al, 75 mm offset
ENGINE 2006 Honda CBR 600RR PC37 4 cylinder
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12:1
FUEL SYSTEM Student designed, single stage multi port fuel Injection, sequential
FUEL 98RON Gasoline
MAX POWER/TORQUE DESIGN 12000 rpm/ 10500rpm
DRIVE TYPE Chain drive DID 520 ERV3 X-ring chain
DIFFERENTIAL Drexler clutch type limited slip differential (preload 31Nm)
COOLING Sidepod mounted single core dual pass radiator, 2400 cfm fan mounted to shroud
BRAKE SYSTEM Self developed 4-Disk system, floating rotors, ISR CP 22-048 (front), CP4226-2S0 (rear)
ELECTRONICS Wiring harness sealed to IP66, Electropneumatic shifting , custom data acquisition system

MANRESA

Escola Politècnica Superior d'Enginyeria de Manresa

Car 225 **Pit T-56** **WRL 455** Spain

Dynamics UPC Manresa is a 7 year old team formed by students from Escola Politècnica Superior d'Enginyers de Manresa which are very proud to be a part of FSG for the first time. With its foundation back in 2015 and a total of 6 combustion vehicles built ever since, it is a young team fueled by passion and will to improve. The biggest achievement for the team has been a podium back in FSN 2018 during the DYN-03's tremendous performance.This will to improve inspires revolutionary projects.

COMBUSTION

FRAME CONSTRUCTION Steel tubular
MATERIAL Steel tubular E355
OVERALL L / W / H 2925mm / 1460mm / 1153mm
WHEELBASE / TRACK (Fr / Rr) 1560mm / 1220mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 147kg / 156kg
SUSPENSION Double unequal lenght A-Arm. Front pull rod and rear push rod actuated spring dampers.
TYRES (Fr / Rr) 185x40 R13, Pirelli FS front and rear
WHEELS (Fr / Rr) 7.0x13 OZ Formula Student Magnesium 4H wheel front and rear
ENGINE Modified KTM 690 LC4 2018
BORE / STROKE / CYLINDERS / DISPLACEMENT 105mm / 80mm / 1 cylinder / 693cc
COMPRESSION RATIO 12,7:1
FUEL SYSTEM Sigle point. Direct spark via double spark and coils firing at the same timming.
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 8000 rpm/ 5900rpm
DRIVE TYPE Sprocket, Crown and chain with tensioner
DIFFERENTIAL Drexler Limited Slip Differential FS 4 RAG Ramp 60º/45º
COOLING 2 mounted aluminium core 351cm2 radiator inside sidepods, 382 cfm fan mounted to radiator.
BRAKE SYSTEM 4-Disk system, self developed rotors 220mm front 200mm rear, adjustable brake balance.
ELECTRONICS wiring harness, Multifunctional Steering Wheel, Electronic Shifting System, Live Telemetry

NAPOLI

Università degli Studi di Napoli Federico II

Car 222 **Pit 10-B** **WRL 208** Italy

UniNa Corse is the official racing team of the Federico II University of Naples born in 2010. This Year the team designed and produced the driverless racecar "AZZURRA". It is equipped with a Honda CB600F 4-cylinder in-line engine, 599cc displacement, with a total weight of 270 kg, a wheelbase of 1565 mm and front and rear track widths of 1200 mm and 1190 mm respectively. The chassis is made of AISI 4130 tubular steel frame. A self-made aerodynamic kit made of CFRP has been developed.

DRIVERLESS COMBUSTION

FRAME CONSTRUCTION Tubular steel space frame
MATERIAL AISI 4130 steel round tubing of 25,4mm and 28,57mm outer diameter
OVERALL L / W / H 3147mm / 1430mm / 1174mm
WHEELBASE / TRACK (Fr / Rr) 1565mm / 1200mm / 1190mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 187kg / 155kg
ENGINE Honda Hornet CB600F 2007
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mmmm / 42,5mm / 4 cylinders / 599cc
BRAKE SYSTEM 4-Steel floating drilled disks ϕ218 OD, adj. brake balance, AP racing brake calipers
PROCESSING UNITS STM32f446RE, Jetson TX2 (ARM cortex-A57)
PERFORMANCE OF PUs 1330 GFLOPS
POWER CONSUMPTION OF PUs 17 W
CAMERAS one ZED 2, 110°H x 70°V, stereoscopic camera, motion sensor, position sensor
RADAR N/A
LIDAR N/A
OTHER SENSORS IMU (MTi-G-710), giroscope, sensor fusion, accelerometer, magnometer, GNSS, Barometer
HIGHLIGHTS OF THE DV SYSTEM Steering and braking system actuated by DC48V servomotor (RMD-X series)

PUERTO REAL

University of Cadiz

Car 212 **Pit T-59** **WRL 567** Spain

Hello! We are Formula Gades the Formula Student team from the south of Spain, living in Cadiz. We know that we are late to the FS game, because it is our second single-seater, but we didn't want to miss out. This season we wanted to create a breaking point and finally consolidate our team and we are going to put all of our effort to make Formula Gades a strong one in the FS family. G22 "Melkart" is meant to set the bases for the future of Formula Gades in the competition. See you on the track.

COMBUSTION

FRAME CONSTRUCTION Tubular Steel structure with an Aluminum Honeycomb impact attenuator
MATERIAL Steel E355
OVERALL L / W / H 2962mm / 1410mm / 1129mm
WHEELBASE / TRACK (Fr / Rr) 1580mm / 1220mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 148kg
SUSPENSION Direct Acting Suspension System - Cane Creek DB Coil IL
TYRES (Fr / Rr) Continental C19 205/470 R13 / Continental C19 205/470 R13
WHEELS (Fr / Rr) Braid Sturace 7
ENGINE Honda CBR 600 RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12:1
FUEL SYSTEM OEM EFI (Indirect sequential injection)
FUEL RON 98
MAX POWER/TORQUE DESIGN 10250 rpm/ 7750rpm
DRIVE TYPE Chain
DIFFERENTIAL Drexler Automotive Mechanical Limited Slip Differential, Version 2
COOLING Aluminum Mishimoto Radiator with a 350mm diameter electric fan
BRAKE SYSTEM 4 Floating NG Brakes Disc, 195mm outer diam and 147 inner diam mounting on the hubs.
ELECTRONICS Telemetry: Arduino Nano, ECU Li,Solo2 DL Lap Timer GP ; HighSpeed CAN Baudrate: 256Kbits/s

RIJEKA

University of Rijeka

Car 251 **Pit T-57** **WRL 273** Croatia

Riteh Racing Team consists of 45 team members that represent a broad range of expertise from 4 constituents of University of Rijeka. For this season the team focused primarily on decreasing the level of complexity in the car in search of an increase in reliability, reduction of manufacturing time and improved serviceability. This decision was made due to decrease in the number of team members, decrease in resources and rise in manufacturing difficulties following the global Covid pandemic.

COMBUSTION

FRAME CONSTRUCTION Steel space frame
MATERIAL 25CrMo4
OVERALL L / W / H 2997mm / 1498mm / 1166mm
WHEELBASE / TRACK (Fr / Rr) 1580mm / 1250mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 129kg / 158kg
SUSPENSION Double unequal length A-Arm, push rod, transversely mounted 4 way adjustable coilovers
TYRES (Fr / Rr) 205/470 R13 Hoosier FSAE Slick and Wet
WHEELS (Fr / Rr) 7x13 OZ Racing Formula Student Magnesium 4H
ENGINE Modified Yamaha R6
BORE / STROKE / CYLINDERS / DISPLACEMENT 65,5mm / 44,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12,4:1
FUEL SYSTEM multi-point port fuel injection
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 11000 rpm/ 9000rpm
DRIVE TYPE 4 speed pneumaticaly actuated sequential
DIFFERENTIAL Two way Salisbury type with preload adjustment
COOLING Water cooled with two bespoke side mounted radiators
BRAKE SYSTEM 4-disk system with bespoke rotors
ELECTRONICS Motec ECU, wiring harness sealed to IP67, Electropneumatic Shifting, Clutch by wire

RZESZÓW

Rzeszów University of Technology

Car 240 **Pit 04-C** **WRL 351** Poland

Founded in 2013, PRz Racing Team now has 100 students who present a new formula student car every year. The 2021 season brought us many great wins in FS competitions with our PMT-03. This year, while building the PMT-04, we focused on a hybrid chassis consisting of a composite monocoque and steel rear frame, as well as increasing the reliability of our vehicle and improving driver ergonomics. Groundbreaking projects in the PMT-04 is our proprietary TelemetryBox providing live data.

COMBUSTION

FRAME CONSTRUCTION Hybrid frame (carbon fiber composite monocoque and tubular frame)
MATERIAL CFRP and 4130 Stell Round Tubing
OVERALL L / W / H 3171mm / 1407mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 140kg / 146kg
SUSPENSION Double length A-Arms. Pull-rod for ft axle. Push-rod for rr axle. TTX25 dampers. Adj ARB.
TYRES (Fr / Rr) 16.0 x 7.5 - 10 R25B Hoosier
WHEELS (Fr / Rr) OZ 10"x7
ENGINE Modified Triumph Street Triple 675
BORE / STROKE / CYLINDERS / DISPLACEMENT 74mm / 52,3mm / 3 cylinders / 675cc
COMPRESSION RATIO 12,85:1
FUEL SYSTEM Triumph OEM
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9500 rpm/ 8000rpm
DRIVE TYPE 5speed sequential pneumatic transmission
DIFFERENTIAL Drexler limited slip
COOLING Both side mounted single core aluminum radiator, 150mm fan mounted to an air duct behind the radiato
BRAKE SYSTEM 4-disk system, adj brake balance, self-designed rotors, custom ft axle brake calipers
ELECTRONICS Multifunctional Steering Wheel, electropneumatic shifting and clutch actuation, telemetry

SEVILLA

University of Seville

Car 218 **Pit 07-C** **WRL 239** Spain

Since its founding in 2012, being the first team from Andalusia, in southern Spain, ARUS has manufactured 8 combustion and 4 electric cars. After demonstrating a high reliability last season (4/4 endurance) and establishing as the best team in the business event, our goal this season is achieving top 10 in all competitions, always keeping that spirit and that joy that makes us be remembered by everyone who happens to share a moment with us. FORZA ARUS!

COMBUSTION

FRAME CONSTRUCTION Tubular steel space frame
MATERIAL Steel E355 (St52)
OVERALL L / W / H 2977mm / 1506mm / 1177mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1250mm / 1175mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 145kg / 144kg
SUSPENSION Double unequal length A-Arm. Pull rod actuated spring and adjustable damper, anti-roll bar
TYRES (Fr / Rr) 18x6.0-10, Hoosier R20
WHEELS (Fr / Rr) 7x10, 3 pc Al Rim, 19mm offset
ENGINE Modified 2003 Honda CBR 600 RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 69mm / 42,5mm / 4 cylinders / 635cc
COMPRESSION RATIO 13.8:1
FUEL SYSTEM Fuel injectors DENSO 6 AT
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9800 rpm/ 8600rpm
DRIVE TYPE Chain/Sprocket
DIFFERENTIAL Drexler, clutch packed limited slip
COOLING Side mounted 386x275 core Al radiator 55º inclined. 0.59 cfm electrical fan
BRAKE SYSTEM 4-Disk, Toolox33, 4 mm thick, hub mounted, 200mm frt diam, 162 rear, adjustable balance
ELECTRONICS Electromechanical Shifting System, selfdesigned Live-Telemetry System

STUTTGART

University of Stuttgart

Car 229 **Pit 10-A** **WRL 59** Germany

We - the Rennteam Uni Stuttgart - are very proud to be part of the Formula Student Germany for the sixteenth time now. After just missing the podium last year we are more eager than ever to succeed again this year! To prevail against the strong competition we focused on our overall package with attention on reliability and manufacturing quality and a well rounded and extensively tested vehicle setup. Complete - Finish - Win!

COMBUSTION

FRAME CONSTRUCTION singlepiece carbon fibre monocoque with tubular rearframe
MATERIAL CFRP sandwich monocoque with aluminum honeycomb, steel (15CdV6) rearframe
OVERALL L / W / H 3075mm / 1435mm / 1195mm
WHEELBASE / TRACK (Fr / Rr) 1630mm / 1212mm / 1192mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 135kg / 125kg
SUSPENSION double unequal length A-Arm, pushrod actuated KW dampers, adjustable U-ARB
TYRES (Fr / Rr) 16.0 x 7.5 x 10 Hoosier R20 (front and rear)
WHEELS (Fr / Rr) CFRP student designed and built rims with aluminum star
ENGINE modified Yamaha YZF-R6 (RJ03)
BORE / STROKE / CYLINDERS / DISPLACEMENT 65,5mm / 44,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 14.87:1
FUEL SYSTEM student built fuel injection system using MoTec, CFRP fuel tank
FUEL E85
MAX POWER/TORQUE DESIGN 9000 rpm/ 7500rpm
DRIVE TYPE self developed sequential 4speed gearbox
DIFFERENTIAL Drexler limited slip differential
COOLING side mounted core dual radiator and rear mounted oil radiator, fans mounted on each radiator
BRAKE SYSTEM 4-disk system with self-designed rotors, adjustable brake balance, coated disks rear axle
ELECTRONICS digital multifunctional steering wheel, live-telemetry, electropneumatic shift and clutch

VALÉNCIA

Universitat Politécnica de Valéncia

Car 395 **Pit 09-B** **WRL 3** Spain

We, the FSUPV Team, are a 9th year team with a strong philosophy based on setting self-challenging season goals that demand an efficient Team and resources management to make the most out of the car. This need for continuous improvement has taken us to be the 2nd in Europe and 3rd in the Formula Student World Ranking. Embracing the challenge of building an autonomous racing system while keeping track performance, our main goal for the season is to be Top 1 in every competition.

DRIVERLESS COMBUSTION

FRAME CONSTRUCTION Monocoque
MATERIAL Pre-impregnated carbon fiber and aluminium honeycomb core
OVERALL L / W / H 3061mm / 1496mm / 1196mm
WHEELBASE / TRACK (Fr / Rr) 1585mm / 1200mm / 1170mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 123kg / 157kg
ENGINE Modified 2005 Honda CBR 600 RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 68mm / 42,5mm / 4 cylinders / 617cc
BRAKE SYSTEM 4-Disk system, self developed rotors with 200 mm OD, adjustable bias
PROCESSING UNITS Intel Core i7-9700k
PERFORMANCE OF PUs Unknown GFLOPS
POWER CONSUMPTION OF PUs 165 W
CAMERAS none
RADAR none
LIDAR ×1 Velodyne VLP-16 HiRes
OTHER SENSORS WSS, 1 gnss/ins, 1 IMU
HIGHLIGHTS OF THE DV SYSTEM Self-developed AS with Lidar-based cone perception and fully sensor redundant odometry estimation. Known-track localization by means of particle filter and simple control principles for path tracking

VOLOS

University of Thessaly

Car 277 **Pit T-60** **WRL 205** Greece

Centaurus Racing Team was founded in 2009 from students of the Department of Mechanical Engineering of University of Thessaly. Since then the team has designed and manufactured 6 race cars, with its last Amphion, being the end result of all this experience. Main objective behind the team's design procedure is to minimize the divergence between simulation-reality and to eliminate the need of trail&error during construction. General team goal is to try and lower the cost of non critical components.

COMBUSTION

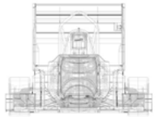
FRAME CONSTRUCTION Tubular spaceframe, Welded
MATERIAL 4130 steel with 304L hoops
OVERALL L / W / H 2895mm / 1360mm / 1213mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1180mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 140kg / 158kg
SUSPENSION Double unequal converging A-Arm, Push rod actuated decoupled damping system
TYRES (Fr / Rr) 185/40 R13, Pirelli /185/40 R13, Pirelli
WHEELS (Fr / Rr) 13" (Diameter), 7" (Width), OZ magnesium
ENGINE Honda CBR600RR 2007-2008
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 43mm / 4 cylinders / 606cc
COMPRESSION RATIO 12,2:1
FUEL SYSTEM Oem fuel injection rail, 4 injectors, Denso 178cc each
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 10300 rpm/ 8000rpm
DRIVE TYPE Chain driven, #520 chain, 7075-T6 Al rea
DIFFERENTIAL Adjustable limited slip diff, Clutch style, 42% acc, 60% dec, 35Nm preload
COOLING 1 radiator located at the left sidepod, 45 mm Al core water to air radiator
BRAKE SYSTEM 4 semi floating disk system,adjustable brake balance,4piston caliper (fr) and 2piston (re)
ELECTRONICS electropneumatic shifting sys,analog sensors PCB,GPS,custom fusebox PCB and Telemetry sys

AACHEN

RWTH Aachen University

Car 99 **Pit 17-C** **WRL 25** Germany

The eax01 is the first vehicle in the 23-year history of the team from RWTH Aachen University that combines the performance of an easy-to drive, lightweight and highly aerodynamically optimized EV-class vehicle with the technology and functionality necessary to perform autonomously at the very mechanical limit of the car.



DRIVERLESS ELECTRIC

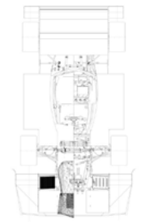
FRAME CONSTRUCTION CFRP Sandwich Monocoque
MATERIAL Carbon Fibre Prepreg (Woven & UD), Aluminium Honeycomb & Foam Core, CFRP and Aluminium Inserts
OVERALL L / W / H 3005mm / 1541mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1250mm / 1250mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 115kg / 116kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Wheel hub mounted / 35.37kW per motor
COMBINED ACCUMULATOR CAPACITY 6.82 kWh
BRAKE SYSTEM Grinded X46Cr13 disks attached via 6 floaters to wheel hub
PROCESSING UNITS AMD Ryzen 9 5900HX; Nvidia RTX 3080m; NXP RT1060
PERFORMANCE OF PUs GFLOPS
POWER CONSUMPTION OF PUs 150 W
CAMERAS 2, Basler daA1920-160uc
RADAR
LIDAR 1, Ouster OS1-32 Below Horizon
OTHER SENSORS IMU, GPS and Gyroscopes
HIGHLIGHTS OF THE DV SYSTEM DV System designed to be at the limit even from the first lap on an unknown track: - 400g Sensor Package / - 45m pylon detection range / - YOLOV5s trained with custom dataset / - GraphSLAM with scan-matching data association with 10ms runtime / - 1st Lap curvature minimization, 2nd time-optimal racing line / - Full MPC for optimal control at vehicles l

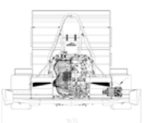
AMBERG

Ostbayerische Technische Hochschule Amberg-Weiden (OTH)

Car 23 **Pit 44-A** **WRL 57** Germany

The Running Snail Racing Team was established in August 2004 at the OTH Amberg-Weiden in eastern Bavaria. After building eight combustion cars, the „RS22" is our ninth generation electric powered racecar. With further weight reduction, a completely redesigned suspension, a fundermentaly different chassis geometry, improved aerodynamics alongside many more small enhancements we are looking forward to surpass last year's results.





ELECTRIC

FRAME CONSTRUCTION CFRP / aluminium honeycomb Monocoque
MATERIAL CFRP prepreg (Twill, UD), aluminium honeycomb
OVERALL L / W / H 2891mm / 1674mm / 1183mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1230mm / 1210mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 114kg / 134kg
SUSPENSION Double unequal length A-Arm. Pushrod actuated one heave and two corner spring and damper
TYRES (Fr / Rr) 7.5x16 R10 Hoosier LC0 / 7.5x16 R10 Hoosier LC0
WHEELS (Fr / Rr) 7.0x10, OZ Racing Magnesium Rim / 7.0x10, OZ Racing Magnesium Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / FL, FR, RL, RR / 35.3 kW per Motor
MOTOR TYPE Fischer Elektromotoren TI085-052-070
MAX MOTOR RPM 20000
MOTOR CONTROLLER Bucher Drives MOBILE DCU
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 8.23kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:12.67 / n/a
DRIVE TYPE planetary Gear
DIFFERENTIAL n/a
COOLING twin front mounted radiators
BRAKE SYSTEM 4-Disk system, semi-floating, hub mounted, 175mm diameter, ISR 22-048 piston Al caliper
ELECTRONICS Torque vectoring, traction control

ATHENS

National Technical University of Athens

Car 25 **Pit 37-A** Greece

Prom Racing of NTU Athens is ready for a new challenge in FSG. This year, our team has focused on creating the ultimate single motor electric FS race car. P22 is our second electric vehicle, and the fastest, most efficient and most reliable car we have ever created. We have worked restlessly this past year to conceive, design & manufacture our most evolved racecar yet. We can't wait to see the greek white racing car back on track. It is #madewithpa22ion.

ELECTRIC

FRAME CONSTRUCTION Single Piece Molded CFRP Monocoque
MATERIAL CFRP Standard Modulus skins with aluminum honeycomb 5052 core
OVERALL L / W / H 2944mm / 1490mm / 1163mm
WHEELBASE / TRACK (Fr / Rr) 1650mm / 1240mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 113kg / 137kg
SUSPENSION Double unequal length A-Arms, Push rod actuated roll-heave decoupled system in front
TYRES (Fr / Rr) 16x7.5-10
WHEELS (Fr / Rr) 10
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Center Rear / 120kW
MOTOR TYPE Emrax 228 HV CC
MAX MOTOR RPM 6500
MOTOR CONTROLLER Bamocar Inverter PG-D3 700V
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 9,1
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:3.9 / 1:1
DRIVE TYPE Chain Drive
DIFFERENTIAL FSAE Drexler LSD Differential
COOLING Water cooled motor/inverter with rear mounted radiator, air cooled accumulator with side ducts
BRAKE SYSTEM 4-Disk system with 4-piston calipers Front, 2-piston calipers rear. Rear axle regeneration
ELECTRONICS Custom ECU, Custom RF PCB and telemetry receiver, server based software with loggin

AUGSBURG

University of Applied Sciences Augsburg

Car 110 **Pit 23-A** **WRL 99** Germany

Taking one step further was a crucial part of the 2022 season. The starting signal was given for the new development of our wheel assembly, planned as a 2-year project. The system for the 2022 vehicle was developed as an evolution of the 2021 vehicle, by optimizations and error elimination from the previous season. On top, the autonomous software was revised, intensively tested and the challenge to integrate the autonomous system into our manual vehicle within one year was mastered.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION One piece composite monocoque with rollbar structures
MATERIAL Carbon Fiber with honeycomb/ S355 steel tubing rollbars 25mm diam. /ENAW-6061
OVERALL L / W / H 2920mm / 1460mm / 1210mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 625mm / 600mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 118kg / 150kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / FR, FL, RR, RL / 32kW
COMBINED ACCUMULATOR CAPACITY 7,98kWh
BRAKE SYSTEM 4-Disk system, adjustable brake balance, recuperation, traction control
PROCESSING UNITS Zotac MAGNUS EN72080V
PERFORMANCE OF PUs 5734 GFLOPS
POWER CONSUMPTION OF PUs 330 W
CAMERAS Basler dart daA 1600-60uc
RADAR n/a
LIDAR Hesai Pandar 40P
OTHER SENSORS Kistler SF-Race
HIGHLIGHTS OF THE DV SYSTEM Optimized, compressed steering / Faster, more resource-efficient path planning algorithm. / YOLOv5 neural network / Newly developed Key-Point-Detection with Depth Detection / Diagnostic tool for error analysis

BARCELONA

PT University of Catalonia - Engineering School of Barcelona

Car 54 **Pit 22-C** **WRL 29** Spain

BCN eMotorsport is the new era of ETSEIB Motorsport, one of the oldest Formula Student Teams founded in 2007. After building four combustion cars, the team decided to change to the EV category, creating ten electric cars since 2011. In 2019, we joined the DV category, finishing all the dynamic events. This year, we bring our CAT14x up to the table, the fusion of both our 2021 cars, being the first car designed to race on both driverless and manual events. We are excited to come back to FSG!

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Single-piece CFRP Monocoque + Fully laminated Al FH + Inside-Cockpit MH
MATERIAL Toray T800 & M40JB fibers, 5052 Aluminium Core, 6063 T6 FH, S355 Steel MH
OVERALL L / W / H 2965mm / 1402mm / 1174mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1150mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 147kg / 147kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / 4WD / 35.4kW
COMBINED ACCUMULATOR CAPACITY 7.14kWh
BRAKE SYSTEM 4-disk system, self-developed steel rotos-with 182.5mm diameter, adjustable brake balance
PROCESSING UNITS Intel Core i9-10900 2.8 GHz, Nvidia Jetson AGX XAVIER
PERFORMANCE OF PUs 3,074 GFLOPS
POWER CONSUMPTION OF PUs 37 W
CAMERAS Two DFK33UX252. Global shutter, USB 3.0, 640x480 to 2048x1536 pixels
RADAR n/a
LIDAR Velodyne VLP-32C
OTHER SENSORS INSS + 2 GNSS (Vectornav VN-300 and SBG Ellipse)
HIGHLIGHTS OF THE DV SYSTEM Localization using LiDAR Inertial Odometry. Improved cone detection range and stability via accumulated LiDAR frames. Polynomial interpolated track limits using sensor-fused cam-LiDAR data. Trackdrive map-based localization and offline full vehicle state optimization to obtain optimal trajectory. Curvature-based dynamic bicycle model MPC with TV.

BAYREUTH

University of Bayreuth

Car 29 **Pit 17-A** **WRL 45** Germany

Founded in 2004, our team Elefant Racing from the University of Bayreuth is one of the oldest Formula Student Teams in Germany. In 2011 we changed from CV to EV; since 2019 we are using 4WD and since 2020 our team also competes in driverless competitions. We are proud to present our brand new car - the FR22 Thor. The FR22 features a fully integrated DV system, a highly improved torque vectoring and traction control systems. We are looking forward to exciting days at FSG 2022.

DRIVERLESS ELECTRIC

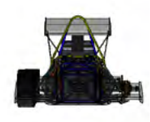
FRAME CONSTRUCTION CFRP Sandwich monocoque (aluminium honeycomb)
MATERIAL Carbon Fibre Prepreg (Woven, Biax & UD), Al-honeycomb, balsa and abachi wood hardpoints
OVERALL L / W / H 2848mm / 1400mm / 1168mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 131kg / 147kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / 4 x wheelhub / 35kW per Motor
COMBINED ACCUMULATOR CAPACITY 6,84
BRAKE SYSTEM 4-Disk system, self developed 42CrMo4 rotors, adjustable brake balance
PROCESSING UNITS AMD Ryzen 3700x, RTX 2070 SUPER
PERFORMANCE OF PUs 9500 GFLOPS
POWER CONSUMPTION OF PUs 450 W
CAMERAS 2 x mono nearfield camera, 60° HFOV, 9m range; 1 x stereo camera, 40° HFOV, 18m range
RADAR -
LIDAR 1 x Lidar, 100° HFOV, 10m range
OTHER SENSORS Kistler speed sensor
HIGHLIGHTS OF THE DV SYSTEM Simple but reliable system (KISS=keep it simple, stupid). The different software components, i.e. perception, state estimation, localization and track-planning & control are decoupled. The parts provide either a basic or more sophistaced solution for the problem they face, allowing for a faster development and more robust vehicle behavior.

BE'ER SHEVA

Ben-Gurion University of the Negev

Car 55 **Pit 29-B** **WRL 138** Israel

The „BGRacing" team is the longest active FSAE team in Israel. We come from Ben-Gurion University, which is located in the Israeli Negev desert, and present the fourth electric vehicle we developed. There are 70 students in our team who are all in different stages of doing their B.Sc degrees. The vehicle we present has two Emrax 208 engines and is powered by Samsung 40T batteries. The vehicle design was made in collaboration with students in the Israeli academy of arts „Bezalel".



ELECTRIC

FRAME CONSTRUCTION Steel tube chassis and roll bars
MATERIAL Chromaly 4130 steel
OVERALL L / W / H 2860mm / 1469mm / 1177mm
WHEELBASE / TRACK (Fr / Rr) 1630mm / 1260mm / 1220mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 135kg / 190kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) Hoosier 6
WHEELS (Fr / Rr) Hoosier 6
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right and Rear Left / 40kW, 40kW
MOTOR TYPE RR, RL: Emrax 208HV LC
MAX MOTOR RPM RR, RL: 6.000
MOTOR CONTROLLER UniTek Bamocar D3 00-160
MAX SYSTEM VOLTAGE 554V
ELECTRODE MATERIALS NMC: LiNiMnCoO2 - graphite
COMBINED ACCUMULATOR CAPACITY 8,87kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:3,7 / N.A
DRIVE TYPE D.I.D 520 VO chain and sprockets
DIFFERENTIAL electronic differential
COOLING Rear mounted 1470cc Mini radiator and 432.5mm electric fan
BRAKE SYSTEM 4-Disk, EBC md6187cx O.D 185 mm, adjustable brake balance, Wilwood PS1 25.4mm calipers
ELECTRONICS Driver Monitor, 2x CAN buses, Self Developed data logging system, 4G LTE telemetry

BELGRADE

University of Belgrade (Универзитет у Београду)

Car 135 **Pit 31-B** Serbia

Road Arrow was founded in 2010. in Belgrade. In our history, we have built 9 ICE vehicles, and this will be our first year competing as an electric team. Our team consist of 70 students from 6 faculties within the University of Belgrade. As this will be our first year as an electric team we hope to learn as much as possible and to make our race car as reliable as possible. Some special features of our vehicle are our first-ever carbon monocoque chassis which is also asymmetrical.

ELECTRIC

FRAME CONSTRUCTION CFRP full monocoque
MATERIAL Carbon fiber reinforced composite; Rigid polyurethane closed cell foam
OVERALL L / W / H 2875mm / 1472mm / 1108mm
WHEELBASE / TRACK (Fr / Rr) 1580mm / 1180mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 154kg / 154kg
SUSPENSION Double wishbone unequal length A-Arms, direct acting
TYRES (Fr / Rr) Avon 7/16-10, Compund A92
WHEELS (Fr / Rr) Force Racing 10" two piece rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / In-wheel drive / 12.3kW each
MOTOR TYPE AMK/DD5-14-10-POW
MAX MOTOR RPM 20000
MOTOR CONTROLLER Inverter / AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 588V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 5,18
TRANSMISSION RATIO (PRIMARY / SECONDARY) 11 / /
DRIVE TYPE Planetary gear box at each wheel
DIFFERENTIAL /
COOLING Radiators with thermostatic controlled electric fans are mounted on both sides
BRAKE SYSTEM 4-Disk system, self developed rotors with 194/140 diameter. Adjustable brake balance
ELECTRONICS Live telemetry, cooling control, dashboard with info, SD card logging, ECU with custom TV

BERLIN

Technische Universität Berlin

Car 13 **Pit 26-C** **WRL 108** Germany

For the FT22 we started with a clean sheet of paper and came up with a new drivetrain and battery concept. Two Emrax 188 synchronous motors propel the car and are connected via a chain drive to the rear axle. Having won the Tesla design challenge for a cylindrical cell accumulator concept our battery has been completely redesigned from last year's car. Additionally we further developed our driverless components from last year's car and fully integrated them into the design of the FT22.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Steel Tube Spaceframe
MATERIAL Docol R8
OVERALL L / W / H 2899mm / 1400mm / 1232mm
WHEELBASE / TRACK (Fr / Rr)
1575mm / 1200mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 52kg / 55kg
NUMBER OF MOTORS / LOCATION / MAX POWER
2 / Rear Right, Rear Left / 52kW
COMBINED ACCUMULATOR CAPACITY 8,3
BRAKE SYSTEM 4-Disk System, adjustable brake balance, 4 pistons front, 2 pistons rear
PROCESSING UNITS Nvidia Jetson AGX Xavier
PERFORMANCE OF PUs 30 000 GFLOPS
POWER CONSUMPTION OF PUs W
CAMERAS 2x Allied Visio Alvium 1800 C-319 MIPI Cameras
RADAR
LIDAR Livox Horizon
OTHER SENSORS Xsens MIT-670 GMSS/INS IMU
HIGHLIGHTS OF THE DV SYSTEM

BIEL

Bern University of Applied Sciences

Car 39 **Pit 40-B** **WRL 120** Switzerland

The Bern Formula Student was founded in 2014 by a group of students to gain practical experience during the studies. This season, our team has 46 active members from various courses of studies. The main goal in building our 6th car is the upgrade to four-wheel drive. In addition to that, we developed a new tractive system accumulator with pouch cells and integrated our motors and gearbox in the topology-optimized wheel hubs. What defines our group is the bilingual spirit of the city Biel.

ELECTRIC

FRAME CONSTRUCTION Tubular Space Frame
MATERIAL E235+C
OVERALL L / W / H 2991mm / 1457mm / 1171mm
WHEELBASE / TRACK (Fr / Rr)
1535mm / 1200mm / 1185mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 150kg / 150kg
SUSPENSION Double unequal length A-Arm. Front: Direct coil over, Rear: Push rod actuated
TYRES (Fr / Rr) Hoosier 16.0x7.5-10 R20
WHEELS (Fr / Rr) 7.0x10, 36.2mm offset, 2pc. Al rim
NUMBER OF MOTORS / LOCATION / MAX POWER
4 / All-wheel drive / 35.366 per Motor
MOTOR TYPE Fischer TI085-052-070-04B7S-07S04BE2
MAX MOTOR RPM 20
MOTOR CONTROLLER Lenze EMDAG2603603U00010
MAX SYSTEM VOLTAGE 550V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 6.379kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY)
1:12.45 / N/A
DRIVE TYPE self-developed planetary gearbox
DIFFERENTIAL electronic
COOLING Sidepod mounted Radiators
BRAKE SYSTEM 4-Disk system, 193mm Rotoes, adjustable brake balance
ELECTRONICS 2x CAN, Data logging and Telemetry

BOCHUM

Ruhr University Bochum

Car 48 **Pit 29-A** Germany

The beginning of a new dawn! With the 2022 season we venture into a new chapter for RUB Motorsport as we build our first electrically powered car. Since the RUB22e is designed from the ground up it no longer represents an evolution of its predecessor but a completely new car. While low weight has been in our car's DNA for the past years, focus has shifted primarily to reliability for 2022. We aim to have our all-new charger running and want to thank our sponsors and partners for their support.

ELECTRIC

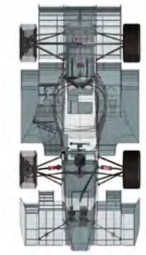
FRAME CONSTRUCTION Aluminium honeycomb sandwich panel manufactured by vaccum infusion and pressing
MATERIAL EuroComposites Aluminium honeycomb 20, 15 and 10mm thickness
OVERALL L / W / H 2909mm / 1511mm / 1173mm
WHEELBASE / TRACK (Fr / Rr)
1650mm / 1235mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 125kg / 153kg
SUSPENSION double wishbone suspension, push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) 4x 16x6-10 Hoosier R20
WHEELS (Fr / Rr) OZ 10 Inch Centerlock
NUMBER OF MOTORS / LOCATION / MAX POWER
1 / rear center / 109 kW
MOTOR TYPE Emrax 228 MV LC PMSM
MAX MOTOR RPM 6500
MOTOR CONTROLLER Bamocar PG-D3 700-400
MAX SYSTEM VOLTAGE 554V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7,39
TRANSMISSION RATIO (PRIMARY / SECONDARY)
1:3,92 / n/a
DRIVE TYPE Chain drive
DIFFERENTIAL Drexler LSD
COOLING 2x rear side mounted AKG-Coolers
BRAKE SYSTEM 4 disk system, self developed rotors, adjustable brake balance
ELECTRONICS self developed BMS

BRAUNSCHWEIG

Technische Universität Braunschweig

Car 91 **Pit 25-B** **WRL 122** Germany

Founded in 2000, the Lions Racing Team is one of Germany's oldest Formula Student teams. The LR22 is our 20th car and our first car designed for manual and autonomous driving. It marks a new page in our team history with monocoque, suspension and steering, aerodynamic devices, accumulator and the entire electrical system being designed from scratch with a focus on weight reduction, aerodynamic performance and full integration of autonomous systems. We are excited to meet you at the FSG!



DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Carbon fibre composite single piece Monocoque
MATERIAL Carbon fibre, Aluminium Honeycomb
OVERALL L / W / H 2956mm / 1460mm / 1159mm
WHEELBASE / TRACK (Fr / Rr)
1530mm / 1225mm / 1225mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 127kg / 127kg
NUMBER OF MOTORS / LOCATION / MAX POWER
4 / FR, FL, RR, RL / FR, FL, RR, RL: 40kW
COMBINED ACCUMULATOR CAPACITY 7.03kWh
BRAKE SYSTEM Calipers ISR, 4 Disc System, self developed rotors (201mm dia), self turned Titan bushings
PROCESSING UNITS STM32G474 family, Nvidia Jetson AGX Xavier
PERFORMANCE OF PUs 1410 GFLOPS
POWER CONSUMPTION OF PUs 60 W
CAMERAS 2, 20m, 120°, Stereolabs ZED 2i stereocamera
RADAR -
LIDAR 1, 120m, 360°, Ouster OS1 mid-range surround lidar
OTHER SENSORS -
HIGHLIGHTS OF THE DV SYSTEM - VectorNav VN300 INS, multi GNSS antenna setup for centimeter precision / - 5 class neural net for different cone sizes / - mission selection via voice controll

BUDAPEST

Budapest University of Technology and Economics

Car 14 **Pit 26-A** **WRL 44** Hungary

BME Formula Racing Team is the pioneer of the hungarian FS teams. At the beginning, we made cars powered by gasoline, but in 2011 we were the first team in the country to switch to the more innovative electric category. The successful 2021 season - where we achieved our best overall score so far - built a great foundation for this year. This year we built an EV/DV car to compete fully under the FSG ruleset, to be able to race against the very bests and to collect throphies instead of cones.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Single piece CFRP monocoque
MATERIAL Sandwich panel: prepreg layers with Al honeycomb and CFRP inserts
OVERALL L / W / H 2871mm / 1440mm / 1110mm
WHEELBASE / TRACK (Fr / Rr)
1540mm / 1200mm / 1160mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 123kg / 137kg
NUMBER OF MOTORS / LOCATION / MAX POWER
4 / 4 outboard motors / 35 kW / motor
COMBINED ACCUMULATOR CAPACITY 7.03kWh
BRAKE SYSTEM 4-disk system, self developed rotors with 154 mm diameter, adjustable brake balance
PROCESSING UNITS NVIDIA Jetson AGX Xavier, TI TMS-570LS1227
PERFORMANCE OF PUs 705 GFLOPS
POWER CONSUMPTION OF PUs 30 W
CAMERAS 1x Basler acA2040-120uc
RADAR -
LIDAR 1x Ouster OS1-32, vertical FOV: 29°, horizontal FOV used: 180°, 100 m range
OTHER SENSORS 1x Vectornav VN-300 DUAL GNSS/INS, used for velocity estimation and positioning
HIGHLIGHTS OF THE DV SYSTEM Robust perception pipeline based on a Camera-LiDAR sensor fusion algorithm using a motion compensated and ground filtered point-cloud. A particle filter based FastSLAM algorithm with GraphSLAM optimization upon loop closure. Online trajectory planning and velocity profile fitting with a non linear control system using the Hoffmann-Stanley algorithm.

CHEMNITZ

Technische Universität Chemnitz

Car 36 **Pit 23-C** **WRL 131** Germany

The Mkx.IV, the newest addition to the Formula Student Team Chemnitz family! With the fourth vehicle in our history we want to show how a relatively simple drive concept can perform optimally on the tracks of the Formula Student. This year´s extensive focus has been on scoring dynamic points and the implementation of our first autonomous system. With Mkx.IV we, about 60 students of the TU Chemnitz, show how optimal installation space can be used. Check out our package.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION tubular steel frame
MATERIAL E235 & E355
OVERALL L / W / H 2790mm / 1450mm / 1080mm
WHEELBASE / TRACK (Fr / Rr)
1530mm / 1250mm / 1255mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 154kg / 154kg
NUMBER OF MOTORS / LOCATION / MAX POWER
1 / Rear / 120kW
COMBINED ACCUMULATOR CAPACITY 7,2kWh
BRAKE SYSTEM
PROCESSING UNITS Raspberry Pi4, STM
PERFORMANCE OF PUs 1420 GFLOPS
POWER CONSUMPTION OF PUs 50 W
CAMERAS 2 Cameras, 97°, Svpro Cmos-sensors
RADAR N/A
LIDAR N/A
OTHER SENSORS N/A
HIGHLIGHTS OF THE DV SYSTEM

CORVALLIS

Oregon State University

Car 47 | **Pit 19-B** | **WRL 31** | United States

We are Global Formula Racing, an international collaboration between Oregon State University and DHBW Ravensburg. Each year we design, build and test two identical electric race cars which can be equipped with driverless systems. Design, production and assembly is carried out simultaneously at both locations, despite the nine hours time difference and 8,770 kilometers distance. For the past 12 years this cooperation has helped grow all members of the team personally and as engineers. We are GFR!

DRIVERLESS ELECTRIC

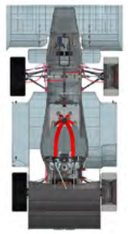
FRAME CONSTRUCTION Aluminium sandwich panel box structure with tubular steel roll bars
MATERIAL CFRP/aluminum honeycomb sandwich panel
OVERALL L / W / H 2854mm / 1351mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1145mm / 1145mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 120kg / 132kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / All corners / 28 kW, each
COMBINED ACCUMULATOR CAPACITY 6.5kWh
BRAKE SYSTEM 4 Disk system, self developed rotors, adjustable brake balance
PROCESSING UNITS Speedgoat Real-Time Unit, Nvidia Jetson AGX Xavier
PERFORMANCE OF PUs GFLOPS
POWER CONSUMPTION OF PUs 30 W
CAMERAS
RADAR --
LIDAR
OTHER SENSORS
HIGHLIGHTS OF THE DV SYSTEM

DARMSTADT

Technische Universität Darmstadt

Car 24 | **Pit 16-C** | **WRL 68** | Germany

The TU Darmstadt Racing Team e.V. (DART Racing) has participated in Formula Student Germany every year since 2006. Starting with a combustion engine, DART Racing has been building a fully electric racing car since 2011 and has been developing an autonomous system since 2017. This year, 50 students are working on the omikron2022. This year's special feature is the first implementation of self-developed electric motors, a completely redesigned aero package and the design of new kinematics.



DRIVERLESS ELECTRIC

FRAME CONSTRUCTION One-piece monocoque
MATERIAL CFRP prepreg and aluminum honeycomb
OVERALL L / W / H 3056mm / 1549mm / 1193mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1240mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 132kg / 136kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / wheel hub-integrated / 42 kW each
COMBINED ACCUMULATOR CAPACITY 8.22 kWh
BRAKE SYSTEM Self-developed rotors with 220 mm diameter, AP Racing 4-piston and 2-piston calipers
PROCESSING UNITS self-developed VCU
PERFORMANCE OF PUs 13740 GFLOPS
POWER CONSUMPTION OF PUs 380 W W
CAMERAS 2, 15m (colors 30m), H: 66°, V: 51° Matrix Vision mvBlueFOX3-2032aC-1112
RADAR n/a
LIDAR 1, 28m, H: 115°, V: 25°, Innoviz One
OTHER SENSORS Vectornav VN300, MSO Speed Wedge
HIGHLIGHTS OF THE DV SYSTEM Fully parallel processing pipelines for camera and lidar for redundant and failsafe operation; complete time synchronisation with integrated dead time compensation in the vehicle control module

DELFT

Delft University of Technology

Car 85 | **Pit 17-B** | **WRL 18** | Netherlands

The DUT22 is the 21st car built by our team. We have done driverless before but for the first time, the car is designed to work with and without a driver. We have emphasized consistency by focusing on reliability and drivability. The autonomous systems are packaged so as not to inhibit the drivers' ability to extract performance and we have continued development of our self-designed motor controllers to make them as reliable as possible.

DRIVERLESS ELECTRIC

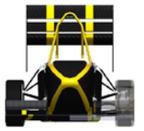
FRAME CONSTRUCTION Composite monocoque
MATERIAL CFRP with aluminium honeycomb core
OVERALL L / W / H 2892mm / 1604mm / 1059mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1250mm / 1250mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 120kg / 119kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Innerwheel mounted / 35kW
COMBINED ACCUMULATOR CAPACITY 7
BRAKE SYSTEM 4-Disk system, Floating in hub rotors with 161mm diameter, adjustable brake balance
PROCESSING UNITS Raspberry Pi, Lenovo P350 tiny PC Intel Core i5-11500
PERFORMANCE OF PUs 667 GFLOPS
POWER CONSUMPTION OF PUs 150 W
CAMERAS 0
RADAR 0
LIDAR 1, 200m, 120°, Velodyne
OTHER SENSORS Xsens MTi-670G, GPS and IMU
HIGHLIGHTS OF THE DV SYSTEM This year's DUT22 driverless system is built from scratch and is entirely optimized for the acceleration and skidpad events. From sensing to steering actuation, our total latency is less than 100ms with the system weighing in at only 4kg. The DUT22 driverless system maximizes the potential points scored and minimizes impact on car performance.

DIEPHOLZ

University of Applied Sciences Diepholz/Oldenburg/Vechta

Car 77 | **Pit 43-C** | **WRL 86** | Germany

We are Deefholt Dynamics, the racing team of the PHWT from Diepholz. We've been part of the FS-Community since 2006. The special thing about us: our car is built every year by a first year team within only six months. This season 60 students joined the project with one goal: To build a competitive car one step at a time as fast as no one else can. Year after year. Our main goal this year? Being as light as we can. Following the DD21e the DD22e saved over 20kg this season. (yeah buddy!)



ELECTRIC

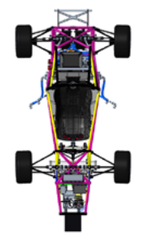
FRAME CONSTRUCTION CFRP Monocoque
MATERIAL CFRP/AFRP aluminium honeycomb sandwich
OVERALL L / W / H 3050mm / 1420mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1560mm / 1230mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 140kg / 140kg
SUSPENSION Double-wishbone suspension with pushrod system
TYRES (Fr / Rr) 205/470R13 Continental
WHEELS (Fr / Rr) OZ Formula Student Magnesium 4H wheel
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear / 52
MOTOR TYPE EMRAX 188
MAX MOTOR RPM 8000
MOTOR CONTROLLER emDrive H300
MAX SYSTEM VOLTAGE 400V
ELECTRODE MATERIALS LiPo
COMBINED ACCUMULATOR CAPACITY 8,4672
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4 / n/a
DRIVE TYPE Motor - Clutch - Planetary gear
DIFFERENTIAL electrical
COOLING two rear mounted radiator each for one Motor/ Contoller
BRAKE SYSTEM 4-Disk system 42CrMo4 steel, o.d.: 220mm, i.d.:166mm
ELECTRONICS Multifunctional Steering Wheel, Live-Telemetry System, self build wiring harness

DORTMUND

Technical University of Dortmund

Car 172 | **Pit 35-B** | Germany

We are the team GET racing, located at the TU Dortmund in Germany. This season our first electrical vehicle will compete in the the formula student. The change from a combustion to an electric car has presented us with unexpected issues, so this car took us two seasons to complete. But rather than giving up, we met the conceptual changes with an agile development, perseverance and a team willing to help outside of their department whenever needed. Thus, we are happy to present the FS221 this season.



ELECTRIC

FRAME CONSTRUCTION Steel space frame
MATERIAL 10.083 Steel
OVERALL L / W / H 2855mm / 1401mm / 1177mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1205mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 153kg / 187kg
SUSPENSION double unequal length A-arm, push rod actuated spring and damper
TYRES (Fr / Rr) 16x6 R10, Hoosier/16x6 R10, Hoosier
WHEELS (Fr / Rr) 10x7 1pc Mg Rim/10x7 1pc Mg Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 53kW, 52kW
MOTOR TYPE RR, RL: Emrax 188 HV LC
MAX MOTOR RPM 6500
MOTOR CONTROLLER BAMOCAR-PG-D3-700-160
MAX SYSTEM VOLTAGE 403V
ELECTRODE MATERIALS LiPo
COMBINED ACCUMULATOR CAPACITY 8,47kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4,5 / n/a
DRIVE TYPE 2 planetary gearboxes located on rear ax
DIFFERENTIAL Electrical (individual driven wheels)
COOLING One radiator mounted in each side pod, equipped with electric fans
BRAKE SYSTEM 4-Disk system, self developed rotors with 172mm diameter
ELECTRONICS Multifunctional Steering Wheel and Dashboard, 360 Degree TSAL with custom casing

DRESDEN

Technische Universität Dresden

Car 59 | **Pit 14-B** | **WRL 17** | Germany

With HerminE, our 14th car, we made a huge step in technical development. Over two years about 80 students designed a hybrid (EV/DV) racecar with a new aerodynamic package which is more agressive. At the drivetrain we switched to 10 inch CFRP rims and designed a smaller wheel package. To have a better connection between the wheel and the monocoque we decided to develop a hydraulic decoupled suspension system. We are excited to be back at the Hockenheimring!

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Full Size CFRP Monocoque
MATERIAL CFRP with aramid honeycomb core and alumnium honeycomb core
OVERALL L / W / H 2889mm / 1453mm / 1200mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1200mm / 1150mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 114kg / 124kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Wheel Hubs FL FR RR RL / 35,3 kW
COMBINED ACCUMULATOR CAPACITY 7,35
BRAKE SYSTEM 4-Disk system, selfmade printed calipers
PROCESSING UNITS Ryzen 7 5800H
PERFORMANCE OF PUs GFLOPS
POWER CONSUMPTION OF PUs W
CAMERAS
RADAR
LIDAR Blickfeld
OTHER SENSORS Cameras
HIGHLIGHTS OF THE DV SYSTEM

EINDHOVEN

Eindhoven University of Technology

Car 40 | **Pit 22-A** | **WRL 12** | Netherlands

University racing Eindhoven (URE) latest car, the URE16, is the first 'with a flip of a switch' hybrid car, which means it can change from EV to DV in just a few seconds. The URE16 will compete in the Driverless Cup, with a newly designed chassis, its completely newly designed powertrain, including four in-wheel electric motors, a full aerodynamic package and custom Vredestein tires. With the help of extra sensors, it can drive fully autonomously around the racetrack.

DRIVERLESS ELECTRIC

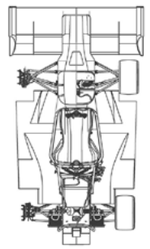
FRAME CONSTRUCTION CRFP sandwich full monocoque
MATERIAL Textreme M30SC/CPV4 prepreg. Gurit EP137 UD, Bi- & Triaxial prepregCore: Al 5056
OVERALL L / W / H 2916mm / 1417mm / 1061mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1220mm / 1220mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 136kg / 136kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Four hub motors / 35
COMBINED ACCUMULATOR CAPACITY 6,6
BRAKE SYSTEM Floating, steel hub mounted, 182x3 mm, vented custom designed rotors
PROCESSING UNITS NVIDEA drive PX2, Dspace, Raspberry Pi
PERFORMANCE OF PUs 16 FP16 TF GFLOPS
POWER CONSUMPTION OF PUs 80 W
CAMERAS 2 sekonixs
RADAR -
LIDAR Ouster OS1-32
OTHER SENSORS -
HIGHLIGHTS OF THE DV SYSTEM With our new LiDAR, the car can more accurately detect cones at a further distance. With a neural network using the cameras, we can highly accurate detect the colour of the cones. Our self-written FastSLAM2.0 allows the car to make a good map of the track, which allows the car to optimize lap times.

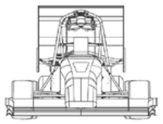
ERLANGEN

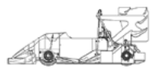
Friedrich-Alexander-Universität Erlangen-Nürnberg

Car 49 | **Pit 19-A** | Germany

After creating combustion vehicles since 2007, we are very happy to present our second electric vehicle FAUmax omikron. Our team decided to focus on the following design principles: Efficient and Reliable Powertrain, Lightweight Design, Aerodynamic Efficiency and Integration of DV Components. Let's see what the electric future brings for High-Octane Motorsports.







DRIVERLESS ELECTRIC

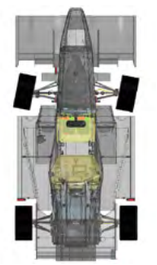
FRAME CONSTRUCTION CFRP monocoque
MATERIAL CFRP sandwich structure
OVERALL L / W / H 2880mm / 1708mm / 1193mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1240mm / 1150mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 117kg / 126kg
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right and Left / 70kW
COMBINED ACCUMULATOR CAPACITY 6,696
BRAKE SYSTEM 4-Disk system, self developed rotors, adjustable brake balance
PROCESSING UNITS 3 Raspberry Pi CM4 modules on custom PCBs, 2 Intel Myriad X VPUs integrated in cameras
PERFORMANCE OF PUs 2800 GFLOPS
POWER CONSUMPTION OF PUs 25 W
CAMERAS two sets of stereo cameras with 69° FOV and 35m depth-sensing capabilities
RADAR /
LIDAR one 64-layer LiDAR with 60m range and 104° VFOV
OTHER SENSORS /
HIGHLIGHTS OF THE DV SYSTEM The DV system of the FAUmax omikron is designed with compactness and power efficiency in mind. NN inference directly takes place on the camera modules. All other algorithms like the LiDAR cone-detector, SLAM, pathfinder and MPC run on three CM4s. Sensor data and CAN-Bus logs are written to a NVMe SSD.

ESSLINGEN

University of Applied Sciences Esslingen

Car 94 | **Pit 12-C** | **WRL 77** | Germany

The E.Stall Esslingen was founded in 2012 and is the electric team of the UAS Esslingen, located at the Campus in Göppingen. Our new car, EVE 22, is an evolution of EVE 20. Goals for this years car were mainly reliability and ergonomics while driving and maintaining, and further reducing weight. Other technical highlights are our >20kg high stiffness monocoque, DRS system and driver adjustable Torque Vectoring. After six years of FSG absence we are excited to once again compete at Hockenheim.



ELECTRIC

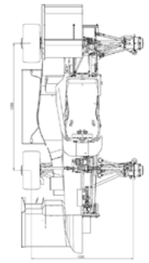
FRAME CONSTRUCTION CFRP one-piece Monocoque
MATERIAL CFRP-Aramid honeycomb sandwich
OVERALL L / W / H 2863mm / 1400mm / 1195mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1196mm / 1210mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 124kg / 124kg
SUSPENSION double unequal length A-Arm, Push rod actuated rocker to kw damper, sword-type ARB
TYRES (Fr / Rr) 16x7.5 Hoosier R20
WHEELS (Fr / Rr) 8x10, self designed cast aluminum rims
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Wheelhub / 36kW
MOTOR TYPE PMSM, water cooled, AMK DT5
MAX MOTOR RPM 20000
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7,6
TRANSMISSION RATIO (PRIMARY / SECONDARY) 12,3 / -
DRIVE TYPE Planetary Gearbox
DIFFERENTIAL individually driven wheels, software controlled
COOLING sidepod mounted radiators, single open loop with compensation tank
BRAKE SYSTEM 192mm self developed floating disks, 4 piston front caliper, 2 piston rear calipe
ELECTRONICS decentralized topology with all self developed PCBs, fully self developed software

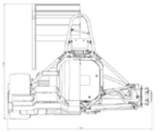
FREIBERG

TU Bergakademie Freiberg

Car 76 | **Pit 35-A** | **WRL 4** | Germany

Racetech Racing Team was founded in 2005. After a small hiatus, we will compete with our 14th car this year. After an era of rear-wheel drive cars, the RT14's key design changes are the switch to all-wheel drive and an increased focus on aerodynamics. This resulted in big changes throughout the car's layout and components, which we are proud to show off at this year's events. The RT14 will take on the competition in the Netherlands and Germany. We are looking forward to meeting you in the pits!





ELECTRIC

FRAME CONSTRUCTION Hybrid: F/R: aluminium monocoque, M: CFRP monocoque
MATERIAL F/R: 2017/6082 Al-sheets+ Al-Honeycomb, M: CFRP, Al-Honeycomb/Airex rigid foam; Mg/Al Inlays
OVERALL L / W / H 3000mm / 1472mm / 1170mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1220mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 135kg / 140kg
SUSPENSION Double unequal length A-arms, Pushrod actuated Heave/Roll decoupled dampers
TYRES (Fr / Rr) 205/470 R13, C20 Continental
WHEELS (Fr / Rr) 7x13, Hybrid rim: CFRP shell, Al center
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / FR, FL, RR, RL / 37,1 kW
MOTOR TYPE self-developed Racetech M1-VZG
MAX MOTOR RPM 19200
MOTOR CONTROLLER Lenze-Schmidhauser Mobile DCU
MAX SYSTEM VOLTAGE 596V
ELECTRODE MATERIALS LiCoO2, pouch cells
COMBINED ACCUMULATOR CAPACITY 6,935kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:14,24 / -
DRIVE TYPE 1,5 stage planetary gear
DIFFERENTIAL wheels driven independently, torque vectoring
COOLING 2 independent circuits for motors and inverters, Sidewing mounted radiators
BRAKE SYSTEM 4-Disc system, self developed DSLM Aluminium calipers, adj. brake balance
ELECTRONICS self developed vehicle dynamics control module, Live Telemetry system

GÖTTINGEN

Hochschule für angewandte Wissenschaft und Kunst Hildesheim/ Holzminden/Göttingen

Car 161 | **Pit 20-C** | **WRL 69** | Germany

We are Blue Flash Mobility Concepts from Göttingen. We are 45 Students driven by the motivation to get involved beyond our studies and to gain experience that no lecture can offer. At our sixth consecutive FSG Event we compete with the E_HAWK22, our sixth racecar overall and the first with autonomous capabilities. With our new Roll-Heave decoupled Suspension we extend the limits of our previously used concepts. We are not just any student project - we turn Students into Engineers!

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION tubular space frame
MATERIAL S235+C
OVERALL L / W / H 2664mm / 1495mm / 1163mm
WHEELBASE / TRACK (Fr / Rr) 1650mm / 1280mm / 1280mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 130kg / 130kg
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / rear center / 80kW
COMBINED ACCUMULATOR CAPACITY 7.67kWh
BRAKE SYSTEM 4-Disk system, self dev. rotors with 207/207mm (f/r) diameter, adjustable brake balance
PROCESSING UNITS
PERFORMANCE OF PUs GFLOPS
POWER CONSUMPTION OF PUs W
CAMERAS
RADAR
LIDAR Velodyne VLP32-C
OTHER SENSORS
HIGHLIGHTS OF THE DV SYSTEM

HAMBURG

Technische Universität Hamburg

Car 78 | **Pit 14-C** | **WRL 47** | Germany

e-gnition Hamburg participates in the formula student since 2012. All-time EV-Team and pioneers in the DV category! The experience gained, after having built their first combined EV-DV vehicle last season, was used to introduce the egn22. A highly integrated DV actuation, completely reworked monocoque shape and a new 10" wheel assembly are just a few of the innovations the egn22 features - and that's just what's visible from the outside!

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION single-piece CFRP monocoque with aluminium honeycomb core
MATERIAL prepreg fibers, aluminium honeycomb core of various thickness
OVERALL L / W / H 2889mm / 1480mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1230mm / 1230mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 135kg / 152kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / hub motors at each wheel / 35kW each
COMBINED ACCUMULATOR CAPACITY 6,216kWh
BRAKE SYSTEM self developed rotors 210mm diameter, self-designed laser sintered brake calipers
PROCESSING UNITS Intel Core i7-6700K, NVIDIA Jetson TX2 module
PERFORMANCE OF PUs 460,8 GFLOPS
POWER CONSUMPTION OF PUs 90 W
CAMERAS n/a
RADAR n/a
LIDAR 3 sensors, 85° central working range, ibeo LUX 2010
OTHER SENSORS cooling temperature sensors in cooling loop / ground speed sensor
HIGHLIGHTS OF THE DV SYSTEM Sophisticated LiDAR Perception, newly developed Drive Control Unit able to run the autonomous system, self-developed radar ground speed sensor

HAMBURG

University of Applied Sciences Hamburg

Car 169 **Pit 31-C** Germany

HAWKS Racing, known as one of the loudest combustion teams in FS history, has now been silenced. FSG hoped they wouldn´t have to clean up any more of our oil leaks on the track. But you know what? We won´t let anyone tell us what to do. With a completely new designed, liquid cooled HV-Accumulator and Tractive System, we are prepared to flood the hearts of every electric racing enthusiast. We proudly present: HAAVKE

ELECTRIC

FRAME CONSTRUCTION Hybrid monocoque and tubular rear frame
MATERIAL CFRP Monocoque with aluminium honeycomp, steel rear frame
OVERALL L / W / H 3129mm / 1430mm / 1188mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1170mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 136kg / 167kg
SUSPENSION short arm long arm (SLA) with push rods, roll and heave decoupled
TYRES (Fr / Rr) 205x96 R13 Continental C-20
WHEELS (Fr / Rr) 7x13-22mm offset, OZ
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Center Rear / 109kW
MOTOR TYPE Emrax 228 MV LC
MAX MOTOR RPM 5500
MOTOR CONTROLLER Bamocar D3 700/400
MAX SYSTEM VOLTAGE 500V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 8.06 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4.5 / -
DRIVE TYPE self designed spur gear drive
DIFFERENTIAL limited slip differential (Drexler)
COOLING twin side radiators, electric water pump and electric fans
BRAKE SYSTEM 4-Disk-system, self-designed, rotors with 250mm diameter, adjustable bias bar
ELECTRONICS self developed AMS, Powerhub w/ electronic and hardware fuses, distributed data collection

HELSINKI

Helsinki Metropolia University of Applied Sciences

Car 98 **Pit 44-C** **WRL 34** Finland

Metropolia Motorsport was found at the start of the decade and made the move from FSC to FSE in 2013. Now the team is proud to participate in FS competitions after 2 years of not being able to compete. HPF021 is Metropolia Motorsports first vehicle to introduce AWD and torque vectoring after developing RWD vehicles for 6 years. Metropolia Motorsports prototypes can have up to 80% of the components manufactured by team members since Metropolia provides great manufacturing capabilities.

ELECTRIC

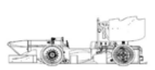
FRAME CONSTRUCTION Tubular space frame with composite SIS and floor
MATERIAL SSAB form 220 Steel tubing for the hoops and Docol 800-1200 for the other tubes
OVERALL L / W / H 2863mm / 1408mm / 1184mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 139kg / 139kg
SUSPENSION Double wishbone pushrod actuated with coil springs
TYRES (Fr / Rr) 16x7,5 R10 Hoosier LC0
WHEELS (Fr / Rr) 7x10, 22mm offset, OZ magnesium FS wheels
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Every corner / 35kW
MOTOR TYPE Fischer PMSM
MAX MOTOR RPM 20000
MOTOR CONTROLLER Lenze DCU 60/60
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiPo
COMBINED ACCUMULATOR CAPACITY 7,8kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:12,34 / N/A
DRIVE TYPE AWD
DIFFERENTIAL N/A
COOLING Dual water cooling circuit for inverters and motors
BRAKE SYSTEM Self developed 4-disk rotor system with Tilton master cylinders and ISR calipers
ELECTRONICS Self designed telemetry system

HSINCHU

National Tsing Hua University

Car 68 **Pit 32-B** **WRL 21** Taiwan

We are NTHU Racing, a formula student racing team from Taiwan. Founded in 2015, our team is pending the 7th season of FSAE races! Being the first time competing in European races, our newly designed electric race car, TH06, is a 4WD vehicle with aluminum mono and a full aero package, also equipped with first self-developed SiC-inverter, for a more powerful powertrain. After two years of suspension due to the COVID-19 pandemic, we are truly excited to make our debut in this year's FSG!



ELECTRIC

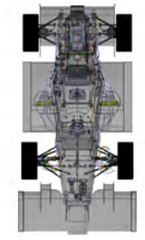
FRAME CONSTRUCTION Aluminium sandwich panel box structure with tubular steel roll bars
MATERIAL Aluminium honeycomb sandwich panels
OVERALL L / W / H 3036mm / 1454mm / 1137mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1265mm / 1215mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 150kg / 170kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and dampers
TYRES (Fr / Rr) Goodyear 20.0x7.0 R13/Goodyear 20.0x7.0 R13
WHEELS (Fr / Rr) 7.0x13, 51.9mm offset, 3 pc Al Rim/7.0x13, 30mm offset, Magnesium Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Integrated in the wheels / 35kW, 35kW, 35kW, 35kW
MOTOR TYPE PMSM
MAX MOTOR RPM 20000
MOTOR CONTROLLER Self-Developed
MAX SYSTEM VOLTAGE 528
ELECTRODE MATERIALS LiNiCoAlO2
COMBINED ACCUMULATOR CAPACITY 9.31kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:11.46 / n/a
DRIVE TYPE Planetary Gearbox
DIFFERENTIAL Electronic Torque vectoring
COOLING active air cooling and water cooling
BRAKE SYSTEM 4-Disk system, self developed rotors, adjustable brake balance
ELECTRONICS self-designed system electronics

INGOLSTADT

Technische Hochschule Ingolstadt

Car 34 **Pit 46-C** **WRL 98** Germany

Since its foundation in 2010, Schanzer Racing Electric e.V. has been constructing race cars and is participating in the Formula Student Electric. We are part of the university of applied sciences Ingolstadt, which is located in Bavaria. This season we will compete with our fourth consecutive all-wheel-drive and ninth overall vehicle called SRe22. The car was constructed, built and tested by a team of 70 prospective engineers who are looking forward to presenting our vehicle at the events.



ELECTRIC

FRAME CONSTRUCTION Full Monocoque
MATERIAL CFRP with Aluminium Honeycomp core
OVERALL L / W / H 2879mm / 1470mm / 1197mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1200mm / 1164mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 136kg / 147kg
SUSPENSION Double unequal length A-Arm, Push rod actuated at upper A-Arm
TYRES (Fr / Rr) 205x470 R13, Continental C20 / 205x470 R13, Continental C20
WHEELS (Fr / Rr) 7x13, 30mm offset, 1pc Mg / 7x13, 30mm offset, 1pc Mg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / outboard wheelhub motors / 35 kW
MOTOR TYPE AMK / DD5-14-10-POW-18600-B5
MAX MOTOR RPM 20000
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS NCA
COMBINED ACCUMULATOR CAPACITY 7,78
TRANSMISSION RATIO (PRIMARY / SECONDARY) 16,5 / n/a
DRIVE TYPE 1,5-stage planetary gearbox
DIFFERENTIAL n/a
COOLING air cooled accumulator, water cooled inverters
BRAKE SYSTEM 4-Disk system, self developed rotors with 224mm, 4 piston front, 2 piston rear
ELECTRONICS Display, live-telemetry system, torque vectoring, recuperation system

KASSEL

University of Kassel

Car 28 **Pit 41-C** **WRL 126** Germany

We are the original ones with the wooden wings. In 2019 we switched to the EV category. We have the first running car after 3 years. 3Years-2Teams-1Car-ZERO EXPERIENCE

ELECTRIC

FRAME CONSTRUCTION Monocoque
MATERIAL Carbon fiber sandwich with Aluminium Honeycomp
OVERALL L / W / H 2949mm / 1396mm / 1200mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 138kg / 149kg
SUSPENSION double A-Arm system with anti-features; directly actuated two damper system
TYRES (Fr / Rr) Continental 205/470 R13
WHEELS (Fr / Rr) 7x13 OZ Magnesium Rim, CL 30mm offset
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / near each wheel / 4x35kW
MOTOR TYPE PMSM
MAX MOTOR RPM 20
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS Lilon (INR/NMC are synonymous)
COMBINED ACCUMULATOR CAPACITY 6,7kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 13,7 / -
DRIVE TYPE planetary gear, close-coupled motors
DIFFERENTIAL -
COOLING 2 Radiator for the Motors and one for the Inverter
BRAKE SYSTEM Four piston, 220mm Disk
ELECTRONICS Multifunctional Steering Wheel, programmable display, Sensor data over CAN

KEMPTEN

UAS Kempten

Car 30 **Pit 34-B** Germany

Infinity Racing performs fascinating motorsport from design to track. You will recognize our car by the two colors: red for our passion and blue for our never ending spirit. Silicia 1, the first electric racecar in our family was created to inspire. We are over 60 talented individuals and since 2007 we build an incredible team using our motivation to represent the top of the mountains and the source of Infinity - the University of Applied Sciences in Kempten.

ELECTRIC

FRAME CONSTRUCTION Full Monocoque with aluminum cores
MATERIAL Prepreg Carbon Fibre
OVERALL L / W / H 2941mm / 1384mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1140mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 145kg / 145kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) Hoosier 43164; 20.5 x 7.0-13, R25B
WHEELS (Fr / Rr) OZ 4H 7x13 1 pc Magnesium
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Hub-Motors / 4x 31.2
MOTOR TYPE permanent excitated watercooled synchronous
MAX MOTOR RPM 20000
MOTOR CONTROLLER self-made
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS NCM
COMBINED ACCUMULATOR CAPACITY 7.8kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 14:1 / n/a
DRIVE TYPE Planetary gearbox in wheel hub
DIFFERENTIAL n/a
COOLING Twin Side mounted radiator with electronic controlled fans
BRAKE SYSTEM 4 fully floating discs with 4 and 2 pistion calipers
ELECTRONICS Intelligent Driver Interface; decentralized, CAN-based sensor monitoring system

KIEL

University of Applied Sciences Kiel

Car 153 **Pit 32-A** **WRL 83** Germany

We are Raceyard E, the northernmost German team. Since our foundation in 2005, we raced 15 cars all over Europe. The 16th is now heading for FSG and we are super excited to compete once again! 54 fearless students once again took the challenge to design, manufacture and race a entirely new racecar in less than 1 year. With experience from previous years, teams, cars and concepts the decisionmaking was easy: Put even more of a racecar into less space and push it to the limit!

ELECTRIC

FRAME CONSTRUCTION Carbon fiber monocoque, main-hoop from high strength steel, fronthoop Al7020-T6
MATERIAL CFRP prepreg sandwich with 15/20mm honey-comb core(AL5056)
OVERALL L / W / H 2970mm / 1417mm / 1196mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 108kg / 131kg
SUSPENSION double unequal length wishbone; Push rod actuated separated heave-/roll spring and damper
TYRES (Fr / Rr) Hoosier 16.0x7.5-10 LC0
WHEELS (Fr / Rr) 1piece CFRP Rim 7.5x10,37.6mm Offset
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / inside all wheelhubs / 4x35,3kW
MOTOR TYPE 4x Fischer TI-085 PMSM
MAX MOTOR RPM 20000
MOTOR CONTROLLER Bucher Hydraulics DCU30/30
MAX SYSTEM VOLTAGE 598V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7,28kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:12,75 / n/a
DRIVE TYPE 1,5 staged planetary gearbox
DIFFERENTIAL Simulink based torque vectoring
COOLING 2 rear mounted AKG Radiators with 80W Fans, additional Airscoops for Rear-end cooling
BRAKE SYSTEM 4 Disk System with self developed rotors and SLM manufactured, topologyoptimized calipers
ELECTRONICS Recuperation, Live-Telemetry, self developed system electronics, driver adapted 5inch HMI

KONSTANZ

University of Applied Sciences Konstanz

Car 43 **Pit 34-C** Germany

This year we present our second electric vehicle which is the 16th car in our team history. Learning from the first steps our electrical IItis took at last year's FSG, we are proud to release our new and improved IItis22E. Working towards a big technical breakthrough next year new manufacturing methods were used (e.g. 3D-printing of metal/endless carbon fiber reinforced onyx polymer) in order to save weight and improve the familiar 2WD concept further to maximize the potential it has to offer.

ELECTRIC

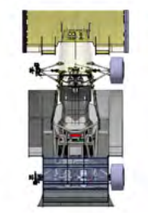
FRAME CONSTRUCTION Tubular steel frame
MATERIAL 25CrMo4
OVERALL L / W / H 2840mm / 1460mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1210mm / 1170mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 113kg / 169kg
SUSPENSION Double unequal length A-Arm, Pull rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) 205/470 R13, Continental 34M
WHEELS (Fr / Rr) wheels 7x13, 30mm off set, Mg rim, OZ S.p.A
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear right, rear left / 68kW each
MOTOR TYPE EMRAX 208
MAX MOTOR RPM 6000
MOTOR CONTROLLER Lenze DCU 6060
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiPo-graphite
COMBINED ACCUMULATOR CAPACITY 7,5 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4,41 / n/a
DRIVE TYPE custom build single stage transmission
DIFFERENTIAL Eletronic by motor controller
COOLING Water cooled system with Twin side pod mounted radiators
BRAKE SYSTEM self devel. fl oating rotors with 225mm OD, adj. brake bias, 4- and 2-piston ISR calipers
ELECTRONICS Steering Wheel with integrated display, self-designed PDM

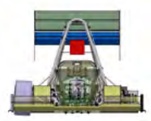
LAUSANNE

École Polytechnique Fédérale de Lausanne

Car 127 **Pit 32-C** **WRL 151** Switzerland

The EPFL Racing Team is back with our third car, Artemis, for the 2022 FS season! After the 2020 season was cancelled due to covid, last summer taught us to listen, to rethink and to remake! We will compete with our first hybrid monocoque chassis this year: Artemis, which is geared to optimise the designs of the team's previous cars. All divisions working on Artemis took the feedback from 2021 in stride, and we will be back stronger than ever!





ELECTRIC

FRAME CONSTRUCTION CFRP skin aluminium honeycomb core front monocoque. Tubular steel from main hoop
MATERIAL Corex aluminium honeycomb sandwich panel (1mm skins)
OVERALL L / W / H 2986mm / 1551mm / 1169mm
WHEELBASE / TRACK (Fr / Rr) 1570mm / 1371mm / 1403mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 122kg / 149kg
SUSPENSION Double unequal length A-Arm. Adjustable Z style ARB. Rear push rod, front pull rod actued
TYRES (Fr / Rr) Hoosier R25B 160*75
WHEELS (Fr / Rr) 7x10, 22mm offset, 1pc magnesium rim
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / rear right, rear left / 52 Kw
MOTOR TYPE Emrax 188
MAX MOTOR RPM 8000
MOTOR CONTROLLER Unitek Bamocar D3
MAX SYSTEM VOLTAGE 430
ELECTRODE MATERIALS LiPo
COMBINED ACCUMULATOR CAPACITY 6,8
TRANSMISSION RATIO (PRIMARY / SECONDARY) 4,5 / 1
DRIVE TYPE Tripod
DIFFERENTIAL electronic
COOLING 2 radiators mounted in sidepods without fans. 880cc. Dedicated to battery and to power module
BRAKE SYSTEM 4-Disk system, self developed rotors with 175mm diameter, adjustable brake balance
ELECTRONICS self designed telemetry, multifunctional steering wheel, touchscreen dashboard

LISBOA

Universidade de Lisboa - Instituto Superior Técnico

Car 50 **Pit 25-A** **WRL 54** Portugal

FST Lisboa is the Formula Student team from University of Lisbon. It was established in 2001 and currently consists of 55 members. This year, the team presents its 11th prototype, the FST11, specifically designed to include autonomous capabilities while maintaining high electric performance. This year's focus was the autonomous integration, as well as solving previous reliability issues. Weight reduction and aerodynamic performance were also priorities in the FST11's design.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION CFRP sandwich single-piece monocoque
MATERIAL Prepreg Carbon Fiber layup with aluminum honeycomb and 3D Core
OVERALL L / W / H 2912mm / 1465mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 141kg / 152kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / AWD (FL,FR,RL,RL) / 35kW
COMBINED ACCUMULATOR CAPACITY 7.67kWh
BRAKE SYSTEM 4-Disk system, AISI 420 rotors, 220mm diam,dual opposing (fr) and opposing (rr) piston
PROCESSING UNITS Intel Core i5-10600, ETAS ES910, Raspberry Pi, Microchip DSPIC33
PERFORMANCE OF PUs 461 GFLOPS
POWER CONSUMPTION OF PUs 160 W
CAMERAS N/A
RADAR N/A
LIDAR 1, 200m, 360ºhorizontal 40º vertical, description: Hesai Pandar40P
OTHER SENSORS Xsens GNSS/INS MTi-670
HIGHLIGHTS OF THE DV SYSTEM A single LiDAR sensor and a robust perception module allow the vehicle to detect cones in a range of over 30 meters. A very accurate graph-based SLAM enables the use of a Learning-MPC algorithm to generate optimal controls for the vehicle. This algorithm employs machine learning techniques to improve performance in real-time.

LJUBLJANA

University of Ljubljana

Car 159 **Pit 43-A** **WRL 35** Slovenia

Superior engineering is a formula student team from University of Ljubljana. We have built our first formula student race car in 2015 and have presented 4 others since. This year, we are competing with our third electric car. The two electric motors power the rear axles and draw current from the battery which is mounted from underneath the car. The design is a bit of a revolution as we apply some new design concepts to our racecar.

ELECTRIC

FRAME CONSTRUCTION Monocoque
MATERIAL Carbon fiber sandwich with aramid honeycomb
OVERALL L / W / H 2895mm / 1583mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1238mm / 1238mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 132kg / 132kg
SUSPENSION Double A-arms with push rod actuated decoupled damping adjustable in heave and roll.
TYRES (Fr / Rr) 16x10x7.5 Hoosier LC0
WHEELS (Fr / Rr) 8.5 x 10 self made carbon rims with aluminium centers
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear left and rear right / 70kW
MOTOR TYPE Emrax 188
MAX MOTOR RPM 6500
MOTOR CONTROLLER TDI 500
MAX SYSTEM VOLTAGE 588V
ELECTRODE MATERIALS
COMBINED ACCUMULATOR CAPACITY
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:3.8 / /
DRIVE TYPE Planetary gearbox
DIFFERENTIAL /
COOLING Rear mounted double Mahle AH188000P heat exchangers without fans
BRAKE SYSTEM 4 disc from Inox 420 steel. 200mm outer diameter. Adjustable brake balance.
ELECTRONICS

MADRID

Technical University of Madrid (UPM)

Car 15 **Pit 31-A** **WRL 90** Spain

Founded in 2003, UPM Racing is the first Spanish FS team, made up of 60 engineering students of the Universidad Politécnica de Madrid. In 2018, we moved on from combustion and changed our philosophy, switching to our first carbon fibre monocoque, 4 in-wheel-drive electric system to create the most revolutionary car of our history. This season we have optimized that concept to extract its maximum potential, now embodied in the UPM04e, which will fly with us to FSG boosting us to do our best!

ELECTRIC

FRAME CONSTRUCTION Composite sandwich monocoque chassis / Attached MH and encapsulated FH
MATERIAL CFRP and aramid epoxy prepreg + hexagonal aluminium and aramid honeycomb
OVERALL L / W / H 3001mm / 1430mm / 1212mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 143kg / 175kg
SUSPENSION Double unequal wishbone, actuated by push rod on the upper a-arm, with bellcrank
TYRES (Fr / Rr) Hoosier 18.0x6.0-10 R25B / Hoosier 18.0x6.0-10 R25B
WHEELS (Fr / Rr) 6.0x10, -5 mm offset, Aluminium alloy / 6.0x10, -5 mm offset, Aluminium alloy
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Front&Rear, Right&Left / 14.4kW per motor
MOTOR TYPE AMK DD5-14-10-POW-18600-B5
MAX MOTOR RPM 14,4
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 580V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 8.11kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 13,176 / n/a
DRIVE TYPE Compound planetary gear with locked ring
DIFFERENTIAL n/a
COOLING 3 independent water-cooling systems for inverters and motors. Air forced convection battery cooling
BRAKE SYSTEM 4-disk, adjustable brake balance system with self-developed 188mm rotors
ELECTRONICS Self-Designed BMS, Telemetry & Data Acquisition System and Power Distribution with LV BMS

MANNHEIM

Duale Hochschule Baden-Württemberg - Mannheim

Car 69 **Pit 22-B** **WRL 134** Germany

This year we proudly present our new vehicle CM-22xThe fifth vehicle in our team history will again compete as a combined EV and DV team this season. With our renewed suspension, enhanced aerodynamics, the CFRP accumulator container, the first self-developed transmission and the newly implemented Lidar, we will attack the successes of last year. We are looking forward to meeting you!

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION steel spaceframe
MATERIAL BS4 T45 and DOCOL R8
OVERALL L / W / H 2947mm / 1590mm / 1195mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1250mm / 1250mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 146kg / 146kg
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 90kW
COMBINED ACCUMULATOR CAPACITY 7.46kWh
BRAKE SYSTEM 4-Disk system, self developed rotors with 235 / 220mm diameter and T-Floaters
PROCESSING UNITS STM32, Raspberry Pi, AMD Ryzen 5 5600G, NVIDIA Tesla T4
PERFORMANCE OF PUs 65000 FP16 GFLOPS
POWER CONSUMPTION OF PUs 135W W
CAMERAS 1x Stereolabs ZED 2i Stereo Camera: 0.3-20m Range, 110° FOV H, 70° FOV V
RADAR -
LIDAR 1x Velodyne VLP16 Puck Hi-Res: 16 Channels, 100m Range, 20° Opening Angle Number
OTHER SENSORS 1x Novatel PwrPak7D dual antenna GPS: up to 1cm position and 1° heading accuracy
HIGHLIGHTS OF THE DV SYSTEM newly developed UKF SLAM algorithm based on single-track model using GPS, Lidar, Camera, IMU, Wheelspeed Sensors and Steering Wheel Angle; also newly developed MPC for control of motor, brake and steering actuator

MANNHEIM

University of Applied Sciences Mannheim

Car 168 **Pit 41-B** **WRL 174** Germany

In this year's Formula Student electric race car of the Delta Racing Mannheim electric e.V., the DR22-E, we especially focused on enhancing the manufacturing and assembly procedure as well as the overall driving performance.

ELECTRIC

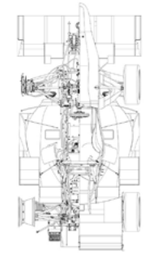
FRAME CONSTRUCTION spaceframe
MATERIAL steel docol R8/800
OVERALL L / W / H 3072mm / 1388mm / 1118mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 135kg / 165kg
SUSPENSION KW Spring Damping System connected to double A-Arms by push rods. ARB
TYRES (Fr / Rr) Continental or Hoosier
WHEELS (Fr / Rr) OZ 13-7 inch Magnesium rim
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / rear / 80
MOTOR TYPE EMRAx 208
MAX MOTOR RPM 6000
MOTOR CONTROLLER 2x Bamocar D3 700 160
MAX SYSTEM VOLTAGE 504
ELECTRODE MATERIALS LiPo
COMBINED ACCUMULATOR CAPACITY 7,258
TRANSMISSION RATIO (PRIMARY / SECONDARY) 4,5 / No
DRIVE TYPE planetray gearbox
DIFFERENTIAL Torque vectoring
COOLING Single, water-based cooling system. Rearwards oriented radiator w/ additional suction fan for optima
BRAKE SYSTEM 4-Disk, self developed disk, fully adjustable
ELECTRONICS LV Battery LIFePo 4s4p, Logging via dSpace Software inside our main ECU

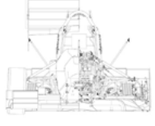
MILANO

Polytechnic University of Milan

Car 90 **Pit 19-C** Italy

Dynamis PRC, after 15 years of combustion prototypes, switched to the EV category in 2021. After only one year of experience, the team decided to embrace the new challenge to compete with the same vehicle also in DV competitions. DP13autonoma was designed to integrate the DV system, developed with track tests on the 2021 car, with low impact on volume and weight. All the other systems were improved with new battery pack, suspension scheme, lighter monocoque and aero package with hollow laminate.





DRIVERLESS ELECTRIC

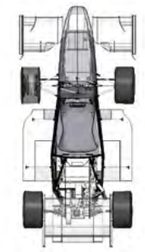
FRAME CONSTRUCTION CFRP monocoque
MATERIAL High strength and high modulus Carbon Fiber, Nomex, Aluminium, Honeycomb, Rohacell foam
OVERALL L / W / H 2978mm / 1483mm / 1173mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1270mm / 1270mm
WEIGHT WITHOUT DRIVER (Fr / Rr) kg / kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / FR, FL, RR, RL: In-wheel / 12.3 kW
COMBINED ACCUMULATOR CAPACITY 8,09 kWh
BRAKE SYSTEM 4-Disk system, self developed Titanium rotors, adjustable balance bar
PROCESSING UNITS AMD 5800H
PERFORMANCE OF PUs GFLOPS
POWER CONSUMPTION OF PUs 200 W
CAMERAS 2, 120° mono configuration
RADAR n/a
LIDAR 1, 32 layer
OTHER SENSORS n/a
HIGHLIGHTS OF THE DV SYSTEM LiDAR-Camera perception, YOLOv5 camera cone detection, cone cluster-detection for LiDAR, sensor fusion with 3d to 2d reprojection of the clusters on the image. Graph-SLAM and JCBB algorithm, Delaunay triangulation for planning with an online trajectory oprimization and a double combined MPC for control.

MUMBAI

K. J. Somaiya College of Engineering

Car 27 **Pit 40-C** **WRL 87** India

Orion Racing India, a team of 60+ dedicated engineers, traces its inception to 2006. After a successful run of developing 12 combustion vehicles and 1 electric vehicle, this year Lemnos enters FSG with a reliable powertrain, balanced aerodynamic package and agile vehicle dynamics. Through a self-designed AMS, Z-type anti-rollbar and a high power-to-weight ratio providing PMSM motor, Lemnos is ready to take the world of FS by storm.



ELECTRIC

FRAME CONSTRUCTION AISI 4130 chromoly tubular spaceframe chassis
MATERIAL AISI 4130 Chromaly
OVERALL L / W / H 2951mm / 1562mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 136kg / 136kg
SUSPENSION Double unequal length A-arm. Push rod actuated spring and damper system
TYRES (Fr / Rr) 18x6-10 (inch), Hoosier R25B / 18x6-10 (inch), Hoosier R25B
WHEELS (Fr / Rr) 7x10 in, 20mm offset, 3 piece Al rim / 7x10 in, 20mm offset, 3 piece Al rim
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear Centre / 80kW
MOTOR TYPE Permanent Magnet Synchronous Motors
MAX MOTOR RPM 5900
MOTOR CONTROLLER Unitek Bamocar D3-700
MAX SYSTEM VOLTAGE 428V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7,19kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4,3 / 1:1
DRIVE TYPE Chain Drive
DIFFERENTIAL Drexler Clutch pack limited slip differential
COOLING Main hoop bracing mounted single radiator
BRAKE SYSTEM 4-Disk system, self developed rotors with 180mm diameter, adjustable brake balance
ELECTRONICS Multifunctional Steering Wheel, Highspeed CAN 2.0 B, Launch control

MÜNCHEN

Technical University of Munich

Car 31 **Pit 20-A** **WRL 1** Germany

The TUfast Racing Team from the TU Munich consists of 80 team members who designed and built the xb022 - the second race car in TUfast history that can participate in EV and DV disciplines. Besides the seamless integration of the autonomous system, the main goals designing the xb022 are lightweight design, aerodynamic performance and vehicle control. Feel free to come to our pit and talk to us!

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION CFRP Monocoque
MATERIAL Aluminum honeycomb sandwich panel
OVERALL L / W / H 2995mm / 1450mm / 1165mm
WHEELBASE / TRACK (Fr / Rr) 1650mm / 1225mm / 1225mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 108kg / 117kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / in-wheel drive / 35kW
COMBINED ACCUMULATOR CAPACITY 6,2kWh
BRAKE SYSTEM 4-Disk system, self-developed floating disks, 193 outer diameter; aluminum milled calipers
PROCESSING UNITS AMD Ryzen™ Embedded V1807B quad-core CPU, AMD Vega GPU
PERFORMANCE OF PUs 0,015304 GFLOPS
POWER CONSUMPTION OF PUs 54 W W
CAMERAS 0
RADAR 0
LIDAR 1, 120m, 45°, Ouster OS1 64 Layer rotating LiDAR
OTHER SENSORS -
HIGHLIGHTS OF THE DV SYSTEM TUfast's DV system is based on a minimal sensor set, adding only a rotating 64 layer Ouster OS1 LiDAR. The driverless steering ist actuated by a small servo motor sitting at the bottom of the steering column.The software pipeline is built on the ROS framework and features a particle filter SLAM and minimum curvature optimized path planning.

MÜNCHEN

University of Applied Sciences München

Car 113 **Pit 34-A** **WRL 15** Germany

#passionworks - not only the name of our cars but also our guiding principle! Focusing on the utilization of last season's lessons learned we concentrated on reliability and driveability to further improve our dynamic performance. With the help of many testing kilometers and a strong team, our goal is to surpass last year's results.

ELECTRIC

FRAME CONSTRUCTION Full Composite Monocoque
MATERIAL CFRP, Aluminium honeycomb core
OVERALL L / W / H 2935mm / 1458mm / mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1230mm / 1230mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 126kg / 126kg
SUSPENSION Double unequal length A-Arms, Push-rod actuated horizontally mounted two spring system
TYRES (Fr / Rr) 16,0x7,5-10 Hoosier R25B / 16,0x7,5-10 Hoosier R25B
WHEELS (Fr / Rr) 7,5x10 CFRP rims
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Wheelhubdrive / 35kW
MOTOR TYPE CDF optimized watercooled PMS machine
MAX MOTOR RPM 20
MOTOR CONTROLLER Mobile DCU 60/60
MAX SYSTEM VOLTAGE 571V
ELECTRODE MATERIALS LiNiMgCoO2
COMBINED ACCUMULATOR CAPACITY 7,34kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 12,3 / n/a
DRIVE TYPE Planetery gearbox with step planets
DIFFERENTIAL Torque vectoring
COOLING Sidepot mounted thermostatically contorlled fans, CFD optimized watercooled motor housings
BRAKE SYSTEM 4 calipers, fl oating, x20cr13, hub mounted, eff ective diameter 170/165mm (front/rear)
ELECTRONICS Recuperation, Traction Control, Torque Vectoring, Live Time Telemetry, HMI

NÜRNBERG

Georg-Simon-Ohm-Hochschule Nürnberg

Car 66 **Pit 38-B** **WRL 53** Germany

Strohm & Söhne is committed to sustainable motorsports since the beginning of Formula Student Electric in 2011. This year we fixed the minor mistakes noticed during the 2021 racing season to build an even more reliable and better performing car while focusing on areas of the car where we could see a lot of performance potential according to the principle: evolution instead of revolution. We are loocking forward to FSG22 to race our team to the top ranks!

ELECTRIC

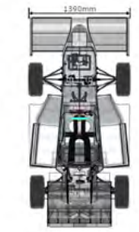
FRAME CONSTRUCTION Aluminium sandwich monocoque with integrated fronthoop and steel mainhoop
MATERIAL Aluminium honeycomb sandwich panels
OVERALL L / W / H 2703mm / 1400mm / 1095mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1190mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 119kg / 152kg
SUSPENSION Double A-Arm. Pushrod-actuated KW dampers. Adjustable damping, ride & roll rate
TYRES (Fr / Rr) 205x47 R13 34M Continental
WHEELS (Fr / Rr) 7Jx13 in., 30mm offset, Magnesium center lock
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Fr, Fl, Rr, Rl / 35kW
MOTOR TYPE AMK DD5-14-10-P0W-18600-B5
MAX MOTOR RPM FL,FR: 20.000; RR,RL: 20.000
MOTOR CONTROLLER AMK - KW26-S5-FSE-4Q 2
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS Li-Ion
COMBINED ACCUMULATOR CAPACITY 6.22kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:13.83 / N/A
DRIVE TYPE Planetary Gearbox
DIFFERENTIAL N/A
COOLING two 800cc radiators mounted on each side of the car, no fan used, carbon cooling duct
BRAKE SYSTEM 4-Disk system, self developed rotors with 202mm/176mm diameter (front/rear)
ELECTRONICS Self developed CAN sensor node system, dashboard screen with touchscreen

OSNABRÜCK

University of Applied Sciences Osnabrück

Car 167 **Pit 46-A** **WRL 55** Germany

The Ignition Racing Team electric is a student association founded in 2006. Since 2011 we have been building cars with an electric drivetrain. After some hard years with the Corona pandemic and no running cars, we now have a young and motivated team. This year we will participate in four competitions in Europe. With our new AMS based on an new microchip, we are confident to have a reliable car. Now we are very excited to meet you all here in Hockenheim and compete against each other.



ELECTRIC

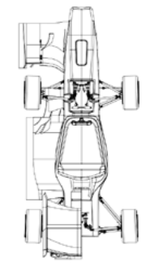
FRAME CONSTRUCTION two piece carbon fibre monocoque with metal roll hoops
MATERIAL foam core sandwich panel (20mm core)
OVERALL L / W / H 2860mm / 1390mm / 1100mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1190mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 145kg
SUSPENSION Double unequal length A-Arm. Pushrod-actuated horizontally oriented spring and damper
TYRES (Fr / Rr) 18.0x6.0-10 Hoosier R25B / 18.0x6.0-10 Hoosier R25B
WHEELS (Fr / Rr) 10x7 aluminium
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear centre / 109kW
MOTOR TYPE Emrax 228 CC HV
MAX MOTOR RPM 6500
MOTOR CONTROLLER Unitek Bamocar D3
MAX SYSTEM VOLTAGE 596
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7,15kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:3.73 / N/A
DRIVE TYPE fixed gear carbon belt drive
DIFFERENTIAL limited slip differential with slip adjustment
COOLING rear mounted radiators
BRAKE SYSTEM 4-Disc system, electric adjustable brake balance
ELECTRONICS Multifunctional Steering Wheel, live-telemetry, self-designed pcbs

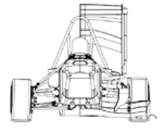
PADERBORN

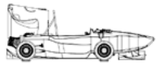
University of Paderborn

Car 58 **Pit 38-C** Germany

In this season the UPB Racing Team from Paderborn University is going to compete with the PX422E which is the second electric race car of our team history. After making our first steps in the last season we are now trying to build up on the good experience we made last year and want to exploit as much potential as possible, the car showed to us in the last year.







ELECTRIC

FRAME CONSTRUCTION full Monocoque
MATERIAL CFRP
OVERALL L / W / H 3077mm / 1524mm / 1182mm
WHEELBASE / TRACK (Fr / Rr) 1630mm / 1200mm / 1160mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 133kg / 150kg
SUSPENSION CFRP Double Wishbone Suspension. Pushrod-actuated, horizontally oriented spring and damper
TYRES (Fr / Rr) Hoosier 16.0 x 7.5-10
WHEELS (Fr / Rr) Hoosier 16.0 x 7.5-10
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / FR, FL, RR, RL / 32kW each
MOTOR TYPE AMK DD5-14-10-POW-18600-B5 each
MAX MOTOR RPM 20.000 each
MOTOR CONTROLLER AMK KW-R25 / KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiCoO2 - graphite
COMBINED ACCUMULATOR CAPACITY 7,67kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:12.77 / n/a
DRIVE TYPE Planetary gearbox at wheel hubs
DIFFERENTIAL no Differential
COOLING CFD simulated SLM cooling plate, 2 rear radiator with BLDC fans
BRAKE SYSTEM Brembo P4.24
ELECTRONICS WLAN Telemetry, LV supplied by HV-DCDC, torque vectoring

PFORZHEIM

Pforzheim University

Car 79 **Pit 41-A** Germany

We are the Rennschmiede Pforzheim, the FS team of UAS Pforzheim. After building seven combustion vehicles, we built our first electric vehicle in 2021. We are proud to have successfully made the leap to an electrically powered vehicle and strive for further improvement. With our current vehicle RSP22 „Amber", we set new standards with our first carbon fiber monocoque, newly developed suspension kinematics and lots of optimisations in the electric systems and cooling. See you on the track!

ELECTRIC

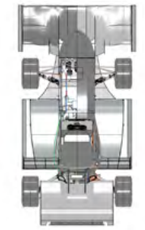
FRAME CONSTRUCTION Aluminium honeycomb CFRP sandwich panel monocoque with steel roll hoops
MATERIAL Aluminium honeycomb sandwich panel (18mm core, sides 1 and 1mm)
OVERALL L / W / H 2876mm / 1521mm / 1159mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 168kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented decoupled SDS
TYRES (Fr / Rr) 16
WHEELS (Fr / Rr) Ø10
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 40 kW
MOTOR TYPE Stöber EZ703
MAX MOTOR RPM 11000
MOTOR CONTROLLER STÖBER SI6A361
MAX SYSTEM VOLTAGE 580V
ELECTRODE MATERIALS LiCO2
COMBINED ACCUMULATOR CAPACITY 7,68 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:6,33 / -
DRIVE TYPE Planetary gear
DIFFERENTIAL -
COOLING Cooling circuit for drive controllers and motors with 2 side mounted 120 mm radiators
BRAKE SYSTEM Self-developed floating rotors, 91mm outer diam., adj. brake balance
ELECTRONICS self designed EtherCAT Master, driver interface with display, live telemetry

PRAGUE

Czech Technical University in Prague

Car 67 **Pit 28-B** **WRL 49** Czech Republic

We are the first electric formula team in the Czech Republic. The 11th generation of the eForce Fee Prague Formula is FSE.11. With its powerful drivetrain and lightweight chassis, it can compete against any other FS electric team. Brand new powertrain combined with four in-wheel motors and a two-stage planetary gearbox, each motor controlled independently, produces the best on-track performance and is already prepared for DV class modifications.



ELECTRIC

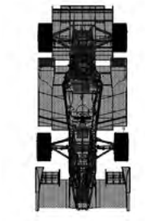
FRAME CONSTRUCTION Composite monocoque
MATERIAL Steel mainhoop 30x2, steel MH support 28x1,5, aluminium welded front hoop, CFRP monocoque
OVERALL L / W / H 2849mm / 1516mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 122kg / 122kg
SUSPENSION Double wishbone, direct acting
TYRES (Fr / Rr) 16x7,5-10, LC0, Hoosier / 16x7,5-10, LC0, Hoosier
WHEELS (Fr / Rr) 8 inch, Keizer Al Rims/ 8 inch, Keizer Al Rims
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Wheel assembly / 4x35,37
MOTOR TYPE Fischer TI085-052-070-04B7S-07S04BE2
MAX MOTOR RPM 20000
MOTOR CONTROLLER Lenze Schmidhauser DCU 60/60
MAX SYSTEM VOLTAGE 605V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7,45 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:13,3 / N/A
DRIVE TYPE Gearbox
DIFFERENTIAL Electronical
COOLING Water cooling system with radiators
BRAKE SYSTEM 4-Disk system, self develpoped
ELECTRONICS Strain gauge sensor,vehicle dynamics control unit and customisable steering wheel display

REGENSBURG

Ostbayerische Technische Hochschule Regensburg

Car 62 **Pit 14-A** **WRL 81** Germany

Dynamics e.V. was founded in 2007 building combustion vehicles until 2019. After two predecessors, the RP22e is the third and most sophisticated electric vehicle to leave our facility. This racecar is also the last step toward a completely electric platform that exploits all the advantages of this new driveline.



DRIVERLESS ELECTRIC

FRAME CONSTRUCTION CFRP Monocoque
MATERIAL CFRP, Kevlar, Honeycomb, Rohacell
OVERALL L / W / H 2863mm / 1450mm / 1113mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1200mm / 1160mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 48kg / 52kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / one on eacht wheel / 35kW each
COMBINED ACCUMULATOR CAPACITY 7.14kWh
BRAKE SYSTEM 4-Disk system
PROCESSING UNITS NVidia Jetson AGX Xavier IPC/ RMLA3K22-D203S
PERFORMANCE OF PUs 1410 GFLOPS
POWER CONSUMPTION OF PUs 35 W
CAMERAS 2, 60°, Sony IMX265 color CMOS sensor
RADAR n/a
LIDAR 1, MRS6124R-131001, 200m, 120°, infrared Sensor
OTHER SENSORS GPS, VectorNav VN-300 Rugged
HIGHLIGHTS OF THE DV SYSTEM LiDAR focused perception with camera assisted color classification. High performance EKF-SLAM with constant time position estimation. Low power ARM based processing unit. Asynchonous sensor shutters.

SANKT AUGUSTIN

University of Applied Sciences Bonn-Rhein-Sieg

Car 45 **Pit 37-B** **WRL 30** Germany

BRS Motorsport is the Formula Student team of UAS Bonn-Rhine-Sieg with about 50 students of all faculties, who share their love for designing, developing and manufacturing their fifth all-wheel driven electric car. It sticks out with its CFRP monocoque with 10" aluminium wheels, heave-spring system, a powertrain package by AMK combined with a compound planetary gearbox in the uprights and an aerodynamic package powered by a self-developed accumulator.

ELECTRIC

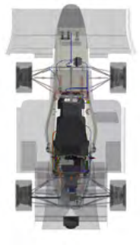
FRAME CONSTRUCTION Aluminium Honeycomb Baguette with CFRP Monocoque
MATERIAL Aluminium
OVERALL L / W / H 2908mm / 1416mm / 1156mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1240mm / 1220mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 140kg
SUSPENSION double wishbone, pushrod, heave-spring
TYRES (Fr / Rr) 18x6,0-10, Hooser R25B
WHEELS (Fr / Rr) 6,5J x 10 aluminium forged, machined
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / All wheel hubs / 49,2 kW
MOTOR TYPE AMK - KW26-S5-FSE-4Q 2
MAX MOTOR RPM 20000
MOTOR CONTROLLER AMK Racing Kit
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiFePO
COMBINED ACCUMULATOR CAPACITY 8.3 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 13,6 /
DRIVE TYPE Wheelhub Motors
DIFFERENTIAL e-diff with Torque Vectoring
COOLING 2 side Radiators
BRAKE SYSTEM 4-Disk system, self developed rotors with 245mm diameter, adjustable brake balance
ELECTRONICS wiring harness , Multifunctional Steering Wheel, 7full self developed ECUs, High Speed CAN

SCHWEINFURT

University of Applied Sciences Würzburg-Schweinfurt

Car 97 **Pit 38-A** **WRL 88** Germany

Mainfranken Racing e.V. was founded in 2006 out of the idea of some motor sport enthusiastic students from the University of Applied Sciences Schweinfurt. The team consist of 30 motivated students building the team´s 14th racecar. After having our most successful season in the history of the club last year, we are determined to continue with the improvement of last year's component, the first development of a CRFP monocoque and the development of our own motor controller.



ELECTRIC

FRAME CONSTRUCTION CFRP Monocoque with a aluminium FH & steel MH
MATERIAL CFRP prepreg, aluminium honeycomb
OVERALL L / W / H 2945mm / 1749mm / 1133mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1250mm / 1250mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 134kg / 134kg
SUSPENSION Double unequal length A-Arm, pull (front) / push (rear) rod actuated
TYRES (Fr / Rr) 16.0 x 7.5-10 R20 Hoosier
WHEELS (Fr / Rr) 7.0x10 22mm offset, 1pc CFRP Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear middle / 107kW
MOTOR TYPE EMRAX 228 MV LC
MAX MOTOR RPM 5500
MOTOR CONTROLLER self-developed Motor Controller
MAX SYSTEM VOLTAGE 587V
ELECTRODE MATERIALS Li-Ion (LiNiMnCoO2)
COMBINED ACCUMULATOR CAPACITY 7,75
TRANSMISSION RATIO (PRIMARY / SECONDARY) 3,48 / 1
DRIVE TYPE Belt-drive
DIFFERENTIAL Drexler limited slip differential 50Nm
COOLING Rear mounted AKG cooler with self developed electric fans and CFD optimized fan channels
BRAKE SYSTEM 4-Disk system, floating self developed brake rotors; front: 4pistons, rear: 2pistons
ELECTRONICS Multifunctional steering wheel with dashboard for debugging, datalogger, self designed AMS

SEVILLA

University of Seville

Car 51 **Pit 09-C** **WRL 100** Spain

Since its founding in 2012, being the first team from Andalusia, in southern Spain, ARUS has manufactured 8 combustion and 4 electric cars. After huge efforts and sacrifice, our ART-E achieved passing scrutineering and finishing endurance for the first time last summer. This year we have focused on the extraction of performance always bearing in mind reliability, and always keeping that spirit and that joy that makes us be remembered by everyone who happens to share a moment with us. FORZA ARUS!

ELECTRIC

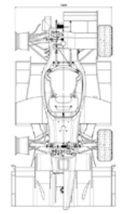
FRAME CONSTRUCTION Spaceframe
MATERIAL Steel E355
OVERALL L / W / H 3059mm / 1506mm / 1115mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1240mm / 1172mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 152kg / 152kg
SUSPENSION Double unequal length A-Arm. Pull rod actuated spring and damper, anti-roll bar
TYRES (Fr / Rr) 18x6,0-10. R20. Hoosier/18x6,0-10. R20. Hoosier
WHEELS (Fr / Rr) 3pc Al Rim, custom Al center/3pc Al Rim, custom Al center
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear center / 109
MOTOR TYPE EMRAX 228 Medium Voltage
MAX MOTOR RPM 5500
MOTOR CONTROLLER Bamocar-PG-D3
MAX SYSTEM VOLTAGE 450
ELECTRODE MATERIALS Polymer Li-Ion battery
COMBINED ACCUMULATOR CAPACITY 6,4
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:3.82 / 1:3.82
DRIVE TYPE Drivechain
DIFFERENTIAL Limited slip differential
COOLING
BRAKE SYSTEM 4-Disk system, self-developed rotors with 200mm diam, calipers AP Racing CP4227-2S0
ELECTRONICS wiring harness sealed to IP67, Multifunctional Steering Wheel

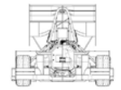
STUTTGART

Baden-Württemberg Cooperative State University Stuttgart

Car 177 **Pit 16-B** **WRL 5** Germany

Our team, the DHBW Engineering Stuttgart, consists of 110 motorsport enthusiastic students of the DHBW Stuttgart. Founded in 2008, we are already competing with our 13th Sleek. Every season we try to build on previous achievements, push the limits of our performance and strive to improve the lap time. Because of our special form of study, we are highly dependent on a great team spirit. This leads us to our motto: You need an A-Team to build an E-Car.





DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Unibody monocoque with integrated front hoop
MATERIAL HM / HT Carbon fibers, Aluminium honeycomb
OVERALL L / W / H 2912mm / 1523mm / 1222mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1220mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 113kg / 139kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / All wheels / 36kW
COMBINED ACCUMULATOR CAPACITY 6.98kWh
BRAKE SYSTEM 4-Disk system, self developed rotors with 190mm outer diameter, adjustable brake balance
PROCESSING UNITS Intel Core i7-10750H, RTX 2080 mobile
PERFORMANCE OF PUs 9829,5 GFLOPS
POWER CONSUMPTION OF PUs 330 W
CAMERAS Stereolabs ZED 2i
RADAR n/a
LIDAR Ouster OS1 64 Layer
OTHER SENSORS Novatel PwrPak7D, 2x XSENS IMU
HIGHLIGHTS OF THE DV SYSTEM First time use of stereo camera, self developed fusion of camera and LiDAR data, laptime optimization algorithm, curvature based Motion Controller

STUTTGART

University of Stuttgart

Car 26 **Pit 12-A** **WRL 7** Germany

We are GreenTeam Uni Stuttgart e.V., Electrical Formula Student Team of the University of Stuttgart. We've been developing electric prototype racecars since 2009. With 2 world records and constantly in Top 10, we're one of the best FS Teams worldwide. After getting #1 on the world ranking list, we are focusing on making the car 100% reliable, improving vulnerable sub systems on the car and efficiently integrate the autonomous system in the car. This year we will compete in 5 events around europe.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION CFRP sandwich structure with tubular steel main / rectangular aluminum fronthoop
MATERIAL CFRP prepreg (Twill, UD), aluminium honeycomb
OVERALL L / W / H 2934mm / 1430mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 124kg / 130kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / one at each wheel / 39
COMBINED ACCUMULATOR CAPACITY 7,67kWh
BRAKE SYSTEM 4-disk, 6 floating piston front, 4 floating piston rear, self-developed
PROCESSING UNITS Raspberry Pi, Speedgoat Real Time Target Machine
PERFORMANCE OF PUs 10.07 TFLO GFLOPS
POWER CONSUMPTION OF PUs 500 W
CAMERAS Full HD driver camera
RADAR 0
LIDAR 1 solid state lidar
OTHER SENSORS
HIGHLIGHTS OF THE DV SYSTEM LiDAR only concept, All new steering actuation system, All new EBS, Rebuild Development Infrastructure

TALLINN

Tallinn TU - University of Applied Sciences

Car 124 **Pit 44-B** **WRL 8** Estonia

FS Team Tallinn is based in Estonia and is the only team in the country. Although being far away from the automotive heart of Central Europe we have enjoyed a steady growth since the team came together in 2006. This season our team has focused on improving the aerodynamic stability, control system driveability and overall maximising the tire potential. Over several years we have got the opportunity to take part in FSG and we are excited to meet with all the teams in Hockenheim.

ELECTRIC

FRAME CONSTRUCTION Composite one piece monocoque chassis
MATERIAL CFRP monocoque with square aluminium profile front hoop and steel main hoop
OVERALL L / W / H 2914mm / 1428mm / 1153mm
WHEELBASE / TRACK (Fr / Rr) 1532mm / 1237mm / 1211mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 125kg / 125kg
SUSPENSION Double unequal length A-Arm. Push rod actuated with an ARB on both axles
TYRES (Fr / Rr) 16x6.0-10 Hoosier 43070 LC0/16x6.0-10 Hoosier 43070 LC0
WHEELS (Fr / Rr) 7.0x10, 45.84 offset, 1-piece CFRP/7.0x10, 45.84 offset, 1-piece CFRP
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Hub motors in each corner / 35
MOTOR TYPE AMK DD5-14-10-POW PMSM
MAX MOTOR RPM 22 000
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7.9 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:13.58 / N/A
DRIVE TYPE Hub mounted two stage planetary gearbox
DIFFERENTIAL N/A
COOLING Sidepod mounted radiator assemblies with 274 CFM electric fans, 3D SLM printed inverter cold plates
BRAKE SYSTEM 4 disc system, self-developed calipers and rotors, adjustable brake balance
ELECTRONICS 4G telemetry, Self-developed: RHS, GSS , DC-DC converter

TERRASSA

Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa (UPC)

Car 21 | **Pit 23-B** | **WRL 52** | Spain

Founded in 2008, at UPC ecoRacing the design of our car is not only focused on performance but also takes into account sustainability by using renewable materials (Wooden inserts, Flax Fibers, Natural Resins). This season we go one step further with the evolution of the 1st autonomous and manual car developed in Spain, the ecoRD 2022, which is composed of a 4WD system, a CFRP monocoque, full aero-package and an autonomous system. A single-seater with the potential of making us dream this season.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION CFRP and Aluminum honeycomb monocoque sandwich structure
MATERIAL Twill and unidirectional CFRP and Aluminum honeycomb
OVERALL L / W / H 2938mm / 1406mm / 1182mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1140mm / 1140mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 143kg / 147kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Upright mount, each wheel / 35kW, 35kW, 35kW, 35kW
COMBINED ACCUMULATOR CAPACITY 8,48kWh
BRAKE SYSTEM 4-Disk system, self developed rotors with 173mm diameter, adjustable brake balance
PROCESSING UNITS ZOTAC Magnus EN052060C-BE (Intel i5 10300H, NVIDIA GeForce RTX 2060)
PERFORMANCE OF PUs 5030 GFLOPS
POWER CONSUMPTION OF PUs 120 W
CAMERAS 2x IDS UI-5240CP-C-HQ with GMTHR36014MCN (FOV 82º), IDS UI-5260CP-C-HQ with GMGMHR31214MCN (FOV 30º)
RADAR
LIDAR
OTHER SENSORS IMU MTI-680G XSens
HIGHLIGHTS OF THE DV SYSTEM 165º Field of View. High-Frequencies algorithms runs. Implementation of modular plug and play algorithms.

TRENTO

Università degli Studi di Trento

Car 111 | **Pit 35-C** | **WRL 111** | Italy

E-Agle Trento Racing Team is a reality made up of 70 young students from the University of Trento. The team was born in 2016 from the synergy between a team of 10 engineers and our Faculty Advisor. Since then, we have worked hard to design and build our cars as competitive as possible. Our latest project, Fenice, was designed to achieve maximum performance. To do this, we redesigned the entire vehicle from scratch, refining the rough edges of our two previous models using the data we collected.

ELECTRIC

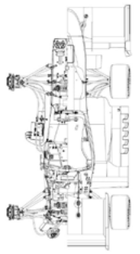
FRAME CONSTRUCTION Tubular space frame with 3D printed joints on the nodes and rear monocoque
MATERIAL Stainless steel / carbon fiber (13mm aluminum honeycomb core, 4 plies per side of GG630T
OVERALL L / W / H 3010mm / 1437mm / 1120mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1270mm / 1210mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 94kg / 140kg
SUSPENSION Front pull rod, rear push rod, double wishbone, adjustable coilovers.
TYRES (Fr / Rr) Hoosier LCO 6.0x10 / Hoosier LCO 7.0x10
WHEELS (Fr / Rr) Carbon fiber self developed and hand-crafted rims, 6.0x10 / 7.0x10
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 50kW, 50kW
MOTOR TYPE Emrax 188 HV LC
MAX MOTOR RPM 6500 (8500 for few seconds)
MOTOR CONTROLLER UniTek Bamocar D3-700-160
MAX SYSTEM VOLTAGE 453V
ELECTRODE MATERIALS Li-ion
COMBINED ACCUMULATOR CAPACITY 6,22
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4.5 / 1:1
DRIVE TYPE planetary gearbox, 3 planetary gears
DIFFERENTIAL Electronic traction control
COOLING Rear mounted 96mm fans and 2000cc radiators
BRAKE SYSTEM 4-Disk system, self developed rotors. Adjustable brake balance with proportioning valve
ELECTRONICS Advanced steering wheel, mostly self designed PCBs, control computer in output loop

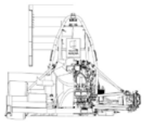
TRONDHEIM

Norwegian University of Science and Technology

Car 63 | **Pit 26-B** | **WRL 10** | Norway

Revolve NTNU was founded in 2010. We developed two combustion cars, before switching to electric in 2014, and we had our first 4WD electric car in 2016. Since 2017 we have been developing both an autonomously and a manually driven race car each year. This year, we are producing our 10th car: AURORA, named as an homage to our first car, BOREALIS. This is a new era of Revolve NTNU, and we are excited to see how our technology will evolve in the future.





DRIVERLESS ELECTRIC

FRAME CONSTRUCTION CFRP two-piece monocoque
MATERIAL M46J(HM 6k) 2x2 twill DT120, UD 513 w/ HR40, Foam & ALUHC core, CRFP and Alu insert
OVERALL L / W / H 2875mm / 1482mm / 1193mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1220mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 115kg / 115kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Hub mounted, all wheels / 35.3 kW per motor
COMBINED ACCUMULATOR CAPACITY 6.98 kWh
BRAKE SYSTEM 4-Disk system, 2 calipers at each wheel in front, one at each wheel at the rear
PROCESSING UNITS Mio-5393 (Intel Xeon)
PERFORMANCE OF PUs 268.8 GFLO GFLOPS
POWER CONSUMPTION OF PUs 103 W W
CAMERAS N/A
RADAR N/A
LIDAR 1x, 120m, 45°, Ouster OS1-32
OTHER SENSORS N/A
HIGHLIGHTS OF THE DV SYSTEM We are running our ROS-based pipeline using a single LiDAR with an INS with RTK and a rugged embedded system, utilizing graph-SLAM for mapping and localization. Different control implementations are used for different events. In skidpad, a coupled MPC is used. For acceleration, launch control is run on a custom PCB.

TURIN

Polytechnic University of Turin

Car 46 | **Pit 28-C** | **WRL 32** | Italy

Squadra Corse PoliTO was founded in 2004, being one of the oldest Italian Formula Student Team. In 2012 switched to fully electric powertrain, making this the 10th year in the EV class. Compared to previous cars, SC22 features a way better performing aerodynamic package and a significantly more advanced control system. This year we focused a lot on reliability and driver feeling, to get the most out of our testing phase. It is also the first time at FSG in 9 years, so we are thrilled to be here!

ELECTRIC

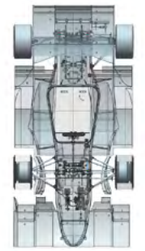
FRAME CONSTRUCTION CFRP monocoque
MATERIAL High strength / high modulus CFRP with aluminum and Nomex honeycomb core
OVERALL L / W / H 2913mm / 1451mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1202mm / 1202mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 126kg / 146kg
SUSPENSION Double A-Arm. Push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) 185/40 R13 S, Pirelli / 185/40 R13 S, Pirelli
WHEELS (Fr / Rr) OZ 7x13 Magnesium / OZ 7x13 Magnesium
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Mounted on each upright / 35 kw each
MOTOR TYPE AMK DD5-14-10-POW
MAX MOTOR RPM 20000
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q 2
MAX SYSTEM VOLTAGE 574
ELECTRODE MATERIALS LiPo
COMBINED ACCUMULATOR CAPACITY 7,72
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4.83 / 1:2.83
DRIVE TYPE Two stage planetary gearbox
DIFFERENTIAL n/a
COOLING Radiator mounted on diffuser with electric fans, thermostatically controlled
BRAKE SYSTEM 4-disk system, self developed rotors, Brembo calipers, adjustable brake balance
ELECTRONICS Multifunctional steering wheel, live telemetry

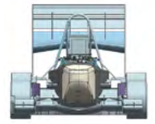
ULM

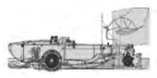
Technische Hochschule Ulm

Car 44 | **Pit 28-A** | Germany

Einstein Motorsport is the Formula Student team from Ulm, Germany, which was founded in 2006. The series of combustion racecars was completed in 2019 with the AL19 and the place22 on the world ranking list. Since then, the team has been working on their electric-autonomous vehicle.







DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Aluminium sandwich panel box structure with tubular steel roll bars
MATERIAL Aluminium honeycomb sandwich panel (10/20/30 mm core thickness; 9 mm diameter; 1.6 mm CFRP sides)
OVERALL L / W / H 2460mm / 1390mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1270mm / 1194mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 129kg / 129kg
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 35 kW per Motor
COMBINED ACCUMULATOR CAPACITY 7.4 kWh
BRAKE SYSTEM 4 disk system, CFD-optimized rotors, adjustable brake balance by proportional valve
PROCESSING UNITS Nvidia Jetson AGX Xavier; VCU MS6.2
PERFORMANCE OF PUs 11000 GFLOPS
POWER CONSUMPTION OF PUs 75 W
CAMERAS 1, Basler ace 2, 160 fps, FOV horizontal 76° vertical 48°
RADAR n/a
LIDAR 1, FOV horizontal 360° vertical 20°, velodyne LiDAR VLP-16 puck high-res
OTHER SENSORS 1 Correvit SF-motion groundspeeds-ensor
HIGHLIGHTS OF THE DV SYSTEM Cone and ground detection with LiDAR sensor; Space-saving steering actuator; cone classification with an innovative neuronal network

WEINGARTEN

University of Applied Sciences Ravensburg-Weingarten

Car 60 | **Pit 37-C** | Germany

After 14 years and 32 events building and racing combustion cars, we decided to finally build our first electric race car. We took on this new challenge with a lot of respect. Since we are known for our lightweight cars, we didn't miss the opportunity to go down this path again and save weight in all possible places. We are very proud of our performance and our Stinger 22E.

ELECTRIC

FRAME CONSTRUCTION full CFRP monocoque
MATERIAL CFRP Sandwich with aluminium honeycomb core
OVERALL L / W / H 2868mm / 1512mm / 1177mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1200mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 109kg / 134kg
SUSPENSION Double Wishbone. Pushrod actuated horizontally oriented spring and damper via Rocker
TYRES (Fr / Rr) Hoosier LCO 16.0x7.5 - 10
WHEELS (Fr / Rr) 8x10, 2inch offset, 3pc Al Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / one motor per wheel / 35kW
MOTOR TYPE AMK DD5-14-10-POW-18600-B5
MAX MOTOR RPM 20000
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7.246kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:12.69 / 1:1
DRIVE TYPE planetary gearbox on each wheel
DIFFERENTIAL n/a, software controlled torque vectoring
COOLING watercooling for motors & inverter, rear mounted radiators with 7 inch fan, accumulator air cooled
BRAKE SYSTEM 4-disk system, 191mm diameter self developed rotors, adjustable brake balance, 4/2 piston
ELECTRONICS distributed LV electronics system, self-developed controller boards

WIEN

Vienna University of Technology

Car 41 **Pit 20-B** **WRL 61** Austria

For its 15th anniversary, TU Wien Racing is competing with its 8th electric vehicle, EDGE13. After years of running RWD concepts, the team is now tackling the next frontier by switching to all-wheel drive. TUWR is using a completely revised drivetrain packaging featuring an all new self-developed 30kW wheel hub motor. The EDGE13 will also be competing in the Driverless events. These innovations provided many exciting challenges for a group of highly motivated students! We are one - 41!

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Monocoque sandwich construction with no lap joints
MATERIAL T800 ER450 mesh and M46J-DT806R UD, Honeycomb ECM-P-3D 64 3.0 1mil 5056 Alu
OVERALL L / W / H 2848mm / 1408mm / 1181mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1200mm / 1189mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 124kg / 115kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / All-wheel drive / 30kW
COMBINED ACCUMULATOR CAPACITY 6.33kWh
BRAKE SYSTEM 4 x self developed floating rotors, adj. brake balance via recuperation
PROCESSING UNITS STM32, NVIDIA Jetson AGX Xavier
PERFORMANCE OF PUs 8000,07 GFLOPS
POWER CONSUMPTION OF PUs 31,8 W
CAMERAS 1, 20m, 120°, Stereolabs ZED2
RADAR -
LIDAR -
OTHER SENSORS SBG Ellipse-N INS/GPS
HIGHLIGHTS OF THE DV SYSTEM Modular assembly of DV components

WIESBADEN

University of Applied Sciences RheinMain

Car 65 **Pit 29-C** Germany

The Scuderia Mensa HS RheinMain Racing Team is proud to present their thirteenth Formula Student car, SPR21e. After four years of building combustion driven cars, we are back to electric propulsion - with the first four-wheel-driven car in the teams' history. We are especially proud of our self-developed Accumulator Management System and Vehicle Control Unit. The team consists of 35 students from various courses of studies, which are looking forward to come to Hockenheim.

ELECTRIC

FRAME CONSTRUCTION Single-piece CFRP Sandwich Monocoque
MATERIAL Carbon Fibre Prepreg (Woven & UD IMS65), Aluminium Honeycomb and Inserts
OVERALL L / W / H 2850mm / 1435mm / 1160mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1225mm / 1225mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 132kg / 161kg
SUSPENSION Double unequal length A-Arm. Push Rod with front and rear ARB
TYRES (Fr / Rr) 16.0x7.5-10, Hoosier / 16.0x7.5-10, Hoosier
WHEELS (Fr / Rr) 7
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / wheel hub mounted / 35 kW
MOTOR TYPE AMK DD5-14-10-POW
MAX MOTOR RPM 20
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS Li-Ion
COMBINED ACCUMULATOR CAPACITY 7.78 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:11.71 /
DRIVE TYPE Planetary Gearbox
DIFFERENTIAL
COOLING Twin side pod mounted radiators and seperate cooling systems for motors and inverter
BRAKE SYSTEM 4-Disk system, self developed rotors
ELECTRONICS self developed AMS & Vehicle Control Unit

WINTERTHUR

Zürcher Hochschule für Angewandte Wissenschaften

Car 16 **Pit 40-A** Switzerland

Zurich UAS Racing is the fourth and newest team based in Switzerland. In 2021, we have built, tested and attended an event with our 1st racecar. This 2nd iteration comes with many improvements, such as switching to wheel hub motors, including a full aerodynamic package and much more. With this year's DV rule changes, we've also already fully embedded our DV systems into the racecar. Being such a young team, we encounter plenty of challenges, which we can only surmount thanks to our sponsors!

ELECTRIC

FRAME CONSTRUCTION Spaceframe welded with tubular steel tubes
MATERIAL E235+C
OVERALL L / W / H 2931mm / 1663mm / 1197mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1269mm / 1343mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 137kg / 208kg
SUSPENSION Double-wishbone. Push rod actuated horizontally oriented spring and dampener
TYRES (Fr / Rr) 533x178 R13, Hoosier R25B / 533x178 R13, Hoosier R25B
WHEELS (Fr / Rr) 7x13, G AlSi7 Mg / 7x13, G AlSi7 Mg
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Left, Rear Right / 35kW, 35kW
MOTOR TYPE RL, RR, Perm Motor AMK DD5-14-10-POW
MAX MOTOR RPM RR, RL: 18617
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 596V
ELECTRODE MATERIALS LiFePO4
COMBINED ACCUMULATOR CAPACITY 7,668kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 16,3 / n/a
DRIVE TYPE planetray gear system + wheelhub motor
DIFFERENTIAL Electronically controlled differential
COOLING AKG F1 radiator mounted on each side
BRAKE SYSTEM front: 4 piston d25mm, d240mm rotor; rear: 2 piston d25mm, d245mm rotor
ELECTRONICS Selfdesigned Driver Interface incl. Telemetry, Database storage and pit crew webinterface

WOLFENBÜTTEL

University of Applied Sciences Ostfalia

Car 35 **Pit 12-B** **WRL 48** Germany

We're proud to race for the UAS Ostfalia with the WR17 – our 18th FS car, 11th electric and 1st driverless car. Besides embedding the DV system, there is no system, which we did not revolutionize. More than 45% increase of downforce @60 kph, self-developed inverters and a slimmer monocoque are the result of our hard work. We want to reward that with a good start in the teams' driverless chapter and learn as much as possible for improving the concept for next year. #We Race dr1verles7

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Single piece Monocoque
MATERIAL UHM Carbon fiber prepreg and aluminium honeycomb
OVERALL L / W / H 3009mm / 1552mm / 1135mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1250mm / 1240mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 123kg / 136kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / hub mounted, all wheels / 4x 34 kW @ 16000 rpm
COMBINED ACCUMULATOR CAPACITY 7,14
BRAKE SYSTEM 4x floating Ø180mm rotors, 2 bycicle callipers per front wheel, 1 per rear wheel
PROCESSING UNITS Intel i9-10900 10-core @ 5.2 GHz, NVIDIA Jetson AGX Xavier Dev Kit
PERFORMANCE OF PUs 2415 GFLOPS
POWER CONSUMPTION OF PUs 180 W
CAMERAS mono, 25 meters, 44.5° fov, XIMEA xiQ USB 3 camera
RADAR n/a
LIDAR Ouster OS1, 360° fov, 120 meters, 128 channels
OTHER SENSORS n/a
HIGHLIGHTS OF THE DV SYSTEM event-specific control strategy. fast generation path planning. low-impact integration into vehicle, low center of mass.

WROCŁAW

Wrocław University of Technology

Car 12 **Pit 25-C** Poland

Wrocław University of Science and Technology. PWR Racing Team. PWR Racing Team was formed in 2009 and since then has built 11 combustion cars. We are the most recognizable science club in Poland. This year we took a challenge and our RT12e will take part in EV class and DV Cup. In previous years we were winning and standing on podiums several times. We're still looking for opportunities to develop our skills and knowledge. Checkout our self-designed electric motors. See You on the track!

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Full monocoque
MATERIAL Carbon fiber, rohacell, aluminum honeycomb
OVERALL L / W / H 3045mm / 1478mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1200mm / 1180mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 145kg / 185kg
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear left and right wheel / 47
COMBINED ACCUMULATOR CAPACITY 8,54
BRAKE SYSTEM 4-disc system, self developed calipers. Adjustable brake balance.
PROCESSING UNITS Speedgoat baseline real-time target machine, NVIDIA Jetson
PERFORMANCE OF PUs 32000 GFLOPS
POWER CONSUMPTION OF PUs 425 W
CAMERAS 2 stereoscopic cameras, Range 20m, System operating angle 160 deegres, StereoLabs ZED2
RADAR -
LIDAR 1, Range 100m, Operating angle 360 degrees, Velodyne Puck Hi-Res
OTHER SENSORS -
HIGHLIGHTS OF THE DV SYSTEM First-year autonomous system. ROS2 based software. Cameras and LiDAR recognition accelerated with NVIDIA hardware. FastSLAM 2.0 based mapping. Team-developed BLDC controller for steering actuator using 6-step algorithm. 2 line pneumatic EBS and servobased brake actuator.

ZÜRICH

Swiss Federal Institute of Technology Zurich

Car 33 **Pit 16-A** **WRL 37** Switzerland

The AMZ Racing team was founded in 2006 by students of ETH Zurich. After having built three cars powered by combustion engines, AMZ has moved forward to developing electric racing cars since 2010. For this season the AMZ electric Team built their fifteenth car, bernina.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Single piece carbon fibre reinforced polymer (CFRP) Monocoque
MATERIAL CFRP&AFRP(Plain/Twill/UD), aluminium honeycomb core with variable thickness
OVERALL L / W / H 2850mm / 1500mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 132kg / 123kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Front Right, Front Left, / 40kW, 40W, 40kW, 40kW
COMBINED ACCUMULATOR CAPACITY 6.495kWh
BRAKE SYSTEM 4-Disk system, self developed rotors with 245mm diameter, adjustable brake balance, RIT de
PROCESSING UNITS AMD V1807B CPU + GTX 1060 GPU
PERFORMANCE OF PUs 4929 GFLOPS
POWER CONSUMPTION OF PUs 200 W
CAMERAS Basler 5MP Camera with Kowa 4.7mm Lens providing 106° field-of-view
RADAR /
LIDAR Hesai Pandar 64-beam LiDAR
OTHER SENSORS /
HIGHLIGHTS OF THE DV SYSTEM Model Predictive Controller using a spatial (for autoX) and temporal (for trackdrive) discretized curvilinear abscissa formulation with a non-linear 4-wheel model

Formula Student Worldwide

907 teams – 54 nations – 5 continents – one passion

Every year students from various disciplines share their enthusiasm for the competition. The various venues are visited annually by hundreds of student teams. The Formula Student community is growing steadily and other countries are joining in with their own competition. Every year at the Hockenheimring, Formula Student Germany is hosting a joint meeting for all Formula Student organisers, in order to share and develop the competition further.

907 Teams – 54 Länder – 5 Kontinente – eine Leidenschaft

Jedes Jahr teilen weltweit Studenten unterschiedlicher Fachrichtungen ihre Begeisterung für den Wettbewerb. Die verschiedenen Austragungsorte werden jährlich von hunderten studentischen Teams besucht. Die Formula Student-Gemeinschaft wächst stetig und weitere Länder schließen sich mit einem eigenen Wettbewerb an. Im Rahmen der Formula Student Germany findet normalerweise jedes Jahr ein Meeting aller weltweiten Formula Student Organisationen auf dem Hockenheimring statt, um den Wettbewerb gemeinsam weiterzuentwickeln.

Formula SAE
Formula Hybrid
02.05.2022 – 05.05.2022
Loudon, NH
Competitions: H

FS
Germany
15.08.2022 – 21.08.2022
Hockenheimring
Competitions: C E D

FS
Netherlands
09.07.2022 – 14.07.2022
TT Circuit Assen
Competitions: C E H

FS
Czech
18.07.2022 – 24.07.2022
Autodrom Most test track
Competitions: C E D H

Formula SAE
Korea
26.08.2022 – 28.08.2022
Samangeum Gunsan Automobilrennbahn
Competitions: C E

Formula SAE
Thailand
13.01.2023 – 15.01.2023
Pathumthani Circuit
Competitions: C E

FS
UK
06.07.2022 – 10.07.2022
Silverstone
Competitions: C E D H

FS
Austria
24.07.2022 – 28.07.2022
Red Bull Race Track in Spielberg
Competitions: C E H

FS
Switzerland
13.07.2022 – 17.07.2022
Switzerland Innovation Park Zürich
Competitions: E

Formula
Alpe Adria
23.08.2022 – 28.08.2022
St Rauš, Novi Marof
Competitions: C E H

Formula SAE
Italy
13.07.2022 – 17.07.2022
Riccardo Paletti Circuit, Varano 'de Melegari, Parma
Competitions: C E D

FS
East
08.08.2022 – 12.08.2022
Hungaroring in Mogyoród, Ungarn
Competitions: C E D H

FS
China & FSEC
Competitions: C E D

Formula
Bharat
20.01.2023 – 25.01.2023
Kari Motor Speedway in Coimbatore
Competitions: C E

Formula SAE
Japan
06.09.2022 – 10.09.2022
Ogasayama Sports Park ECOPA
Competitions mixed: C E

FS
Spain
29.08.2022 – 04.09.2022
Circuit Parcmotor Castellolí
Competitions: C E D

Formula SAE
Michigan May
18.05.2022 – 21.05.2022
Michigan International Speedway, MI
Competitions: C E

Formula SAE
Michigan June
15.06.2022 – 18.06.2022
Michigan International Speedway, MI
Competitions: C E

Formula SAE
Brasil
09.08.2022 – 14.08.2022
ECPA – Esporte Clube Piracicabano de Automobilismo
Competitions: C E

Formula SAE
Australasia
08.12.2022 – 12.12.2021
Winton Motor Raceway, Rural City of Benalla, Victoria
Competitions: C E D

World Ranking Lists

C https://fs-world.org/C/

E https://fs-world.org/E/

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Austin Brauser, Fabian Maknapp, Catharina Schiffter, Tim Schulte, Theresa Stach, Jennifer Stratmann, Ludwig Vollrath, Julia Weber, Robert Weingart

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Formula Student Germany:
Alastair Rankin, Cornelius Mosch, Gina Döhla, Maximilian Partenfelder, Oliver Peters, Patrick Wintermantel Shidhartha De, Vivek Maru, Yannick Pieper
* if without reference; excluding team profiles

Team profiles
Text and pictures provided by the teams (July 2022)

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*wenn ohne Angabe; Teamprofile ausgenommen

Teamprofile
Text und Bilder bereitgestellt von den Teams (Juli 2022)

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Weitere Informationen
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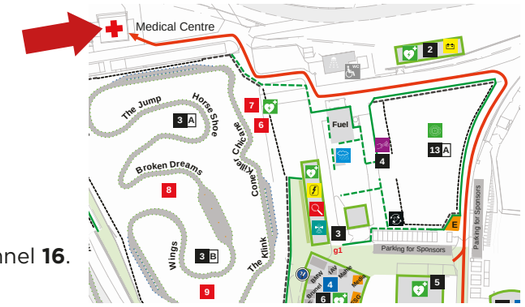
magazine.2022@formulastudent.de

EMERGENCY INFORMATION

Minor Injury
Medical Centre:
Please accompany the injured person to the Medical Centre.
Emergency aid is provided there.
The Medical Centre is occupied whenever the Pits are open.



Severe Injury
Contact someone with a two-way radio:
Every Official and Security has two-way radio.
Ask them to call the Medical Centre or an ambulance on channel **16**.

Call an ambulance:
Call an ambulance yourself if someone is severely injured and needs urgent help. The Emergency Number for every phone and mobile phone is **112**.

During dynamics:
On the days that the dynamics are running, an ambulance is on site during the dynamic events.
They are located next to the Medical Centre and are marked on the Event Plan in blue.
To contact them, ask someone with a two-way radio (Official, Security) to call them.

Hospital:
Krankenhaus (Schwetzingen), Bodelschwinghstrasse 10,
68723 Schwetzingen, phone: +49 (0) 6202/84-30

https://fsg.one/hospital

Emergency Numbers
In case of an emergency call **112**.
This number works with each phone, also with mobile phone or coin-operated telephone as international GSM-standard. It is alway free of charge.

112

Officials

Pit Marshal - Philipp Vaudlet	+49 (151) 560 747 00
Event Support - Matthias Brutschin	+49 (151) 560 747 02

(In case of an emergency please call 112 and afterwards Philipp or Matthias.)

Emergency Call Contents
The emergency control centre will ask you some questions to ensure proper help for you. To support you at your call, here are some standard questions and some hints for your answers in English and German.

Who is calling? (Wer ruft an?)
Say your name and your telephone number for callbacks. Digits in German: 0 (null), 1 (eins), 2 (zwei), 3 (drei), 4 (vier), 5 (fünf), 6 (sechs), 7 (sieben), 8 (acht), 9 (neun)

Where did it happen? (Wo ist es passiert?/Wo ist es geschehen?)
the event site has the adress "Hockenheimring, Sachshaus, Am Motodrom", make it more precise!:
pit lane (Boxengasse), dynamic area (Fahrerlager);
the adress for campsite C2 near the Motodrom Hotel "Hockenheimring, Zeltplatz C2 beim Motodrom Hotel"
and for campsite C3 on the other site of the highway "Hockenheimring, Zeltplatz C3 an der Continental Straße"

What happened? (Was ist passiert?/Was ist geschehen?)
accident (Unfall), traffic accident (Verkehrsunfall), fire (Feuer), fall (Sturz), explosion (Explosion)

How many people are affected? (Wie viele Personen sind betroffen?)
1 (eins), 2 (zwei), 3 (drei), 4 (vier), 5 (fünf), 6 (sechs), 7 (sieben), 8 (acht), 9 (neun), 10 (zehn)

What kind of injury has happened? (Welche Verletzung liegt vor?)
fracture (Knochenbruch), bleeding (Blutung), unconsciousness (Bewusstlosigkeit), burn (Verbrennung), electric shock (Stromschlag), suffocation (Ersticken), heart attack (Herzinfarkt), shock (Schock)

Don't hang up after answering these questions! Wait to hear if the control centre has further questions!

FORMULA STUDENT GERMANY 2022

Supporter:

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