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Fastest on the track

The team from Augsburg University of Applied Sciences holds the Formula Student world record

starkstrom AUGSBURG
FS Racing Team UAS-Augsburg

Record-braking speed and precision

Formula Student is Europe's most renowned series of races for young engineers. Two years ago, competitions for driverless single-seaters with all-electric power were added to its program. The "StarkStrom" team from Augsburg University of Applied Sciences (UAS) competed in this event from the outset – and last season, they secured the world record in the "Acceleration" category. The cars have to cover 75 meters as quickly as possible on a 3-meter-wide track staked out with cones, and then the vehicle must come to a standstill within 100 meters. At the Hockenheimring in 2018, the Augsburg team left the competition standing with a time of 4.267 seconds and a speed of about 95 km/h.

Successful teamwork: Christoph Winter (IT), Elena Zehnder (management), Christian Scheglmann (image processing), new captain Dennis Religa, long-serving captain Mathias Pechinger and advisor Prof. Carsten Markgraf – a team that stands together when it matters (left to right).

At Silverstone a few weeks previously, the team even managed to secure first place in the overall ranking for three disciplines: as well as "Acceleration", the program includes "Skid Pad" (driving in a horizontal figure of eight) and "Track Drive" (a course of straights, curves and chicanes, etc.). Kistler made its Correvit SF-II ground speed sensor available to the team four weeks before Silverstone. "Kistler's sensor really was an enormous help for us. In combination with an IMU (Inertial Measurement Unit), the Correvit SF-II supplies precise positional data; it's independent of tire slip, so it compensates perfectly for the drawbacks of the GPS, which is prone to interference," Mathias Pechinger explains. He has been a team member for six years and was its long-serving captain; now he is about to complete his Masters in Applied Research, specializing in driverless mobility.

High-precision measurement technology – essential for success

At Hockenheim, where the season's most important and most fiercely-contested race is staged, StarkStrom secured an honorable fourth place as well as the world record for acceleration. Prof. Dr.-Ing. Carsten Markgraf, of the Faculty of Electrical Engineering at UAS Augsburg, stresses the importance of this result: "It's a remarkable success for a small university like Augsburg, pitted against teams from giants such as the Technical University of Munich (TUM) and the Swiss Federal Institute of Technology Zurich (ETH)." An achievement of this magnitude calls for a degree of technological expertise in fields such as environmental perception and path planning for autonomous driving. In the 2018 season, the team chose a D-GPS module to determine the car's absolute position; however, this device starts up slowly and is quite likely to fail. "But periods when there is no GPS signal can be bridged over very well with data from the Kistler sensor," according to Christian Scheglmann, who is also studying for a Masters in Applied Research and is the team member responsible for camera systems.

What are the factors behind a success on this scale? First and foremost: committed students who dedicate their time to

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>
> **Mathias Pechinger, long-serving captain of the team "Starkstrom" Augsburg**
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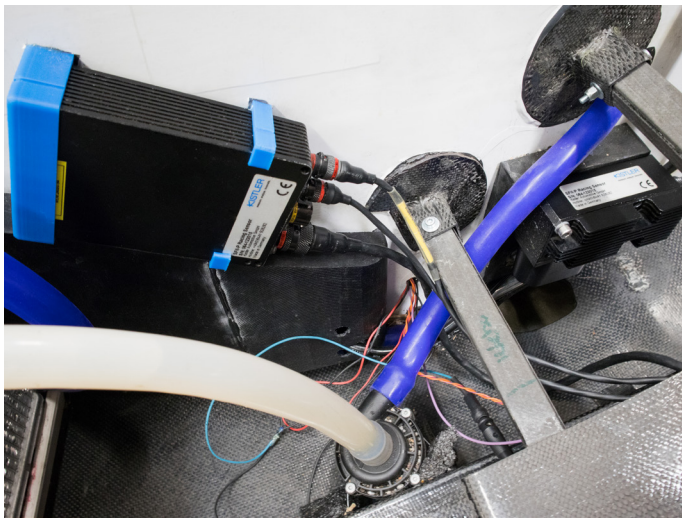
The "StarkStrom" team's driverless single-seater currently holds the record in Formula Student's "Acceleration" category.



Thanks to precise, robust speed data from Kistler's Correvit SF-II, the position can be recalculated every 5 ms.

applied research in electromobility as members of StarkStrom Augsburg, which is a registered nonprofit association. The club is supported by sponsorships from companies who provide financing and equipment, helping the young engineers to put their know-how into practice on the racing track. Pechinger explains how the team views Formula Student: "We're proud of the record, of course, but that's not the main thing – above all, the objective is to learn something new. And that's why we chose Formula Student's motto: 'It's not about getting faster, it's about getting smarter.'"

Young engineers shoulder responsibility

Prof. Markgraf is available to advise the students, but they take on most of the responsibilities themselves within a structure based on corporate lines. The core team comprises electrical engineers, mechatronics and IT specialists and a business economist. "Many students attain new levels of achievement in the team, and they open up wider horizons in terms of personal development. They tackle demanding assignments – most of them are directly related to the subjects they study, but they gain deeper insights by putting their knowledge to practical use," Prof. Markgraf observes.

The racing car, a miniaturized classic single-seater (or "monoposto"), can also be steered by a driver if necessary; it is built entirely on site at Augsburg. The functions for autonomous driving are added to the mechanical and electronic structure, as Scheglmann explains. "Driverless racing cars are far more complex than their conventional counterparts. Many features simply have to be included as requirements, and then the extra functionalities are added on top." As regards Formula Student, Pechinger adds: "Strict requirements have to be met before you're even allowed to enter the race – there's a braking test, for instance. Many teams already fail at this hurdle. And after you've spent so many hours building a racing car, you don't want it to crash into a wall!"

High precision, simple integration, minimal drift

Kistler's Correvit SFII racing sensor supplies the current speed (x and y) every 5 ms via CAN bus. In combination with the IMU, the vehicle's position relative to the starting point can be calculated every 2 ms. This is more than sufficient for the Acceleration and Skid Pad disciplines, where StarkStrom is regularly among the best contenders. "The sensor was mounted on the vehicle with a special fixture in less than half a week," Scheglmann recalls. "In fact, integration was really easy; the values are available quickly, and it all works very reliably." Pechinger adds: "The sensor is very accurate and there is virtually no drift, so it's almost 100% reliable over shorter distances."

This is why the team plans to eliminate D-GPS from the setup entirely for the 2019 season. Depending on requirements, navigation will then be implemented solely with Kistler measurement technology and the IMU, or with Kistler, IMU and SLAM (Simultaneous Localization and Mapping, now in development). The new setup will undergo intensive testing on the asphalt in spring 2019. Formula Student will also continue to evolve – new and more challenging disciplines will set the bar even higher.

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