Formula Student testing with imc

Chassis and suspension system optimization on a Formula Student race car

"Formula Student Germany" is a design and engineering competition that brings together scientific and academic theory of technical colleges and universities with practical experience on a real race track. During a year's time, the students design and build their own race car that has to comply with a set of competition rules.

The German team from the Hochschule Ravensburg-Weingarten was supported by imc Meßsysteme GmbH with one of their imc CANSAS-L-DCB8 modules. This measurement module was used to determine and investigate forces and strain that the car's suspension system was subjected to under real race conditions.

The formula for intelligent design

The Formula Student competition is not simply about who has the fastest car, but rather, it consists of examining the entire process, e.g., design, budgeting, business plans and teamwork. imc supported the team from “Hochschule Ravensburg-Weingarten” with an imc CANSAS-L-DCB8 module in order to accurately measure their race car’s suspension dynamics.

Suspension measurements

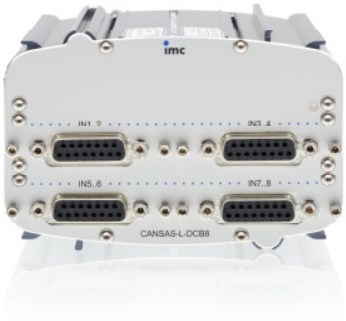
When it comes to building a race car, the chassis and suspension play one of the most crucial roles. The engine can unleash enormous power, but if the suspension system is unable to transmit the vehicle’s power directly to the track surface, maintaining road grip and traction control, the car will prove to be very unsuccessful.

To measure mechanical stress, strain and load conditions, the students applied strain gauges to the key suspension components, such as the control arms and tie rods. The goal was to measure the forces that are present in the components under actual driving conditions.

Measurement system requirements

- Power supply via 12V battery (mobile testing)
- Simultaneous measurement of eight full-bridge strain gauges: to be able to compare load situations, i.e., each axis, at least eight inputs for full-bridge measurements are necessary.
- Data transfer via CAN bus: because a data logger is already integrated within the vehicle, it is important to be able to acquire measurement and control data via a CAN interface.

imc CANSAS-DCB8



The imc CANSAS-DCB8 being used is a special bridge amplifier module with eight channels for voltage, bridge and strain gauge measurements. This lightweight and compact measurement module has a sampling rate that can be set individually per channel, in a flexible stepping (1/2/5) - up to a maximum of 1 kHz. With 200 Hz analog bandwidth available, the digitizing and internal processing of all measurement channels are carried out in 24 Bit resolution and with completely time-synchronized sampling. Precise synchronous-acquisition proves especially important when correlating multiple channels' signals and forces. Synchronicity is maintained not only between multiple imc CANSAS modules, but even in conjunction with additional imc loggers or measurement devices - without the

need for extra sync-lines, but by means of CAN-based synchronization.

The fully-conditioned and digitized signals (16 Bit resolution) are then provided via Can-Bus. In the vehicle, these measurement data are typically fed onto the existing CAN control bus that already provides a multitude of control data and information. From here, these data can be read and stored using any available CAN logger. This, of course, could be an imc BUSDAQ or imc CRONOS device with a CAN interface. In this case, an existing Bosch Motorsport data logger was used.

Connecting the measurement amplifier to the onboard CAN network and the car's power supply was accomplished by plugging into the central onboard electronics connector. The dynamic measurements acquired by the Hochschule Ravensburg-Weingarten team during the various test drive cycles were stored for further study on the integrated data logger.

Results

The concluding event of the Formula Student competition requires the teams to submit a "design report". Here, the students must justify their construction calculations and design decisions.

Through the use of the imc measurement module, the students were able to prove they had appropriately designed the components to face the real loads when exposed to race situations, and thus, earned high marks in this field.

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imc measurement systems work in mechanical and mechatronic applications offering up to 100 kHz sampling rate per channel with most popular sensors for measuring physical quantities, such as pressure, force, speed, vibration, noise, temperature, voltage or current. The spectrum of imc measurement products and services ranges from simple data recording via integrated real-time calculations, to the integration of models and complete automation of test benches.
Founded in 1988 and headquartered in Berlin, imc Meßsysteme GmbH employs around 160 employees who are continuously working hard to further develop the product portfolio. Internationally, imc products are distributed and sold through our 25 partner companies.

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imc Test & Measurement GmbH is a system house that offers products and services for measurement applications. Our team of about 40 proven experts, having mainly backgrounds in engineering or science, work to realize customer-oriented and application-specific solutions on the subject of "electrical measurement of physical quantities."

imc Test & Measurement GmbH markets the recognizably innovative and powerful hardware and software products from their strategic partner, imc Meßsysteme GmbH, Berlin.
We complement these products with our comprehensive engineering services. These range from design, consulting and sales, with pre-and after-sales service, as well as customer and application-specific extensions, system integration, commissioning, training, rental of measuring systems, personnel contracting and much more.

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