Formula Student testing with imc

Determining suspension forces on a Formula Student race car

"Formula Student" is a design competition for students, combining the theoretical academic learning from technical colleges and universities, with the opportunity for gaining practical experience on the race track. During a year's time, the students design and build their own race car under a specific set of guidelines.

The team from "Hochschule Ravensburg-Weingarten" was supported by imc Meßsysteme GmbH with an imc CANSAS-L-DCB8 module. It was used for determining the forces applied to certain areas of the race car's suspension.

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 a crucial role. The engine can produce an enormous amount of power, but if the suspension is unable to transmit the vehicle's power directly to the track surface, and hold it there through optimal tire contact, the car will prove to be very unsuccessful.

To measure mechanical stress and strain, 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 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
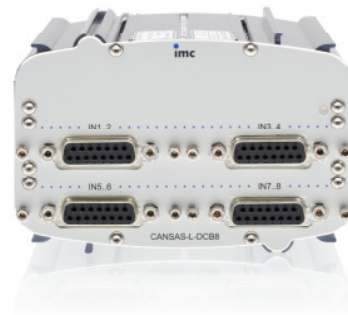
The imc CANSAS-DCB8 being used is a special bridge amplifier module with eight channels for voltage, bridge and strain gauge measurements. This lightweight and compact measurement module has a sampling rate that can be adjusted per individual channel in one, two or five Hz increments up to a maximum of 1 kHz. With 200 Hz analog bandwidth available, the digitalization and internal processing of all the measurement channels are carried out using 24 Bit, completely time-synchronized sampling. This proves to be very important to maintain signal synchronicity between several imc CANSAS modules or when additional imc loggers or measurement devices are used. It can be carried out via the CAN bus without additional synchronization lines.

The fully-conditioned and digitalized signals

(16 Bit resolution) are then provided via CAN. Typically, in the vehicle, the existing control bus already has a variety of data and information available. From here, these data can be read and stored using any typical data 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.

The connection of the measurement amplifier to the onboard network of the Formula Student race car for transmission of CAN messages and the voltage supply occurs via 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

At the conclusion of the Formula Student event, the teams must submit a "design report". Here, the students must justify their calculations and construction decisions.

Through the use of the imc measurement module, the students were able to prove they had designed appropriate components for proper load bearing and, thus, received many points in this area.

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imc Test & Measurement GmbH is a manufacturer and solution provider of productive test and measurement systems. imc implements metrological solutions for research, development, service and production. imc has particular expertise in the design and production of turnkey electric motor test benches. Precisely outfitted sensor and telemetry systems complement our customer applications.

Our customers from the fields of automotive engineering, mechanical engineering, railway, aerospace and energy use imc measurement devices, software solutions and test stands to validate prototypes, optimize products, monitor processes and gain insights from measurement data. As a solution provider, imc offers their customers an attractive and comprehensive range of services. These include project consulting, contracted measurements, data evaluation, specialist deployment, customer-specific software development and system integration. imc consistently pursues its claim of providing services for "productive testing".

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