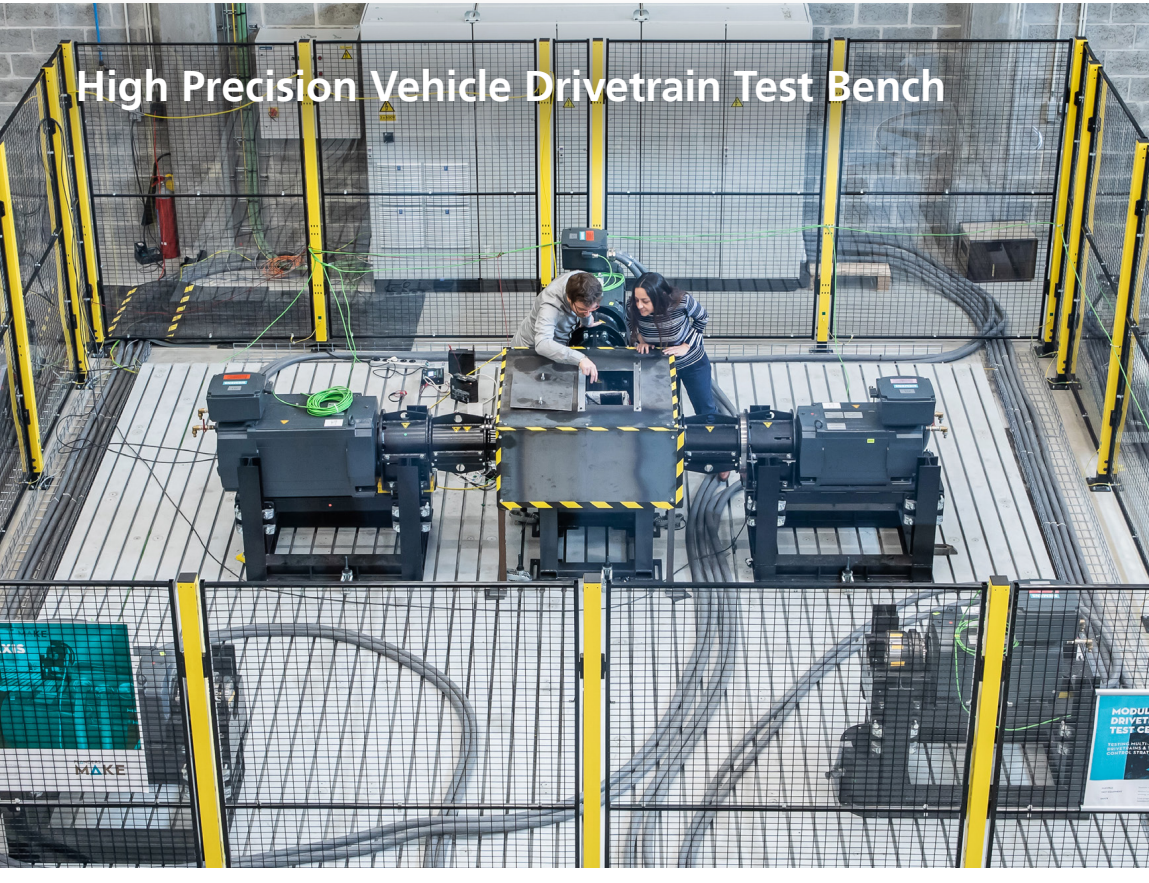
Flanders Make



speedgoat
real-time simulation and testing

Flanders Make built a powerful drivetrain test bench for passenger and heavy-duty vehicles, emulating wheels, loads, and the engine with five electromotors, all synchronously controlled by a Speedgoat target computer with PROFINET IRT at a 250µs closed-loop sample rate.

Flanders Make contributes to the technological development of vehicles, machines, and factories through research, development, and access to modular test benches such as for manufacturers of vehicle components.

Essential expertise is maintained in the vehicle and environmental simulation for precision drivetrain testing, which increasingly requires extensive testing to improve energy efficiency, introduce novel concepts, and meet regulatory requirements.

Drivetrain Test Bench

For a new modular test bench for drivetrains up to 5 axles, Flanders Make introduced an innovative motion system capable of simultaneously controlling five electric motors. Elemental power and speed motor characteristics include:

- 1x 221 kW – 1750 Nm nominal – 6000 rpm max.
- 2x 178 kW – 586 Nm nominal – 3200 rpm max.
- 2x 140 kW – 461 Nm nominal – 3000 rpm max.

Also, five high precision torque and speed sensors were used.

Synchronized Low Latency Motion Control

For many industrial applications, non-synchronized bus cycle times between components in the range of 1-10ms are sufficient.

However, to collect actual speed and torque, the drivetrain test bench requires a cycle time below 250µs and synchronized power controls for the motors.

To achieve such precision, Flanders Make leveraged a Speedgoat real-time target machine, controlling the five motor drivers with the low latency PROFINET Isochronous Real-Time (IRT) communication protocol interface.

For synchronized behavior, controls of all five motors are simultaneously triggered with an interrupt, and the receipt of current speed and torque values are guaranteed within the same time step.

MathWorks products are used for the control design and to automate testing. Furthermore, signal data can be logged to perform an in-depth analysis of the drivetrain components' performance, including the drivetrain controller.

Future Proof Test Bench

The seamless model-based design workflow enabled the rapid development of the hybrid physical/digital test bench for drivetrain testing.

Combined with the Simulink Real-Time and Speedgoat integrated real-time capabilities, the vast range of supported I/O, and encompassing test automation capabilities, the setup proved pivotal for the test bench development.

"We needed a reliable and fast controller to perform real-time testing. Speedgoat's modular target machine fitted our technical requirements to control motors drives synchronously."

Jasper De Smet, Project Leader at Flanders Make

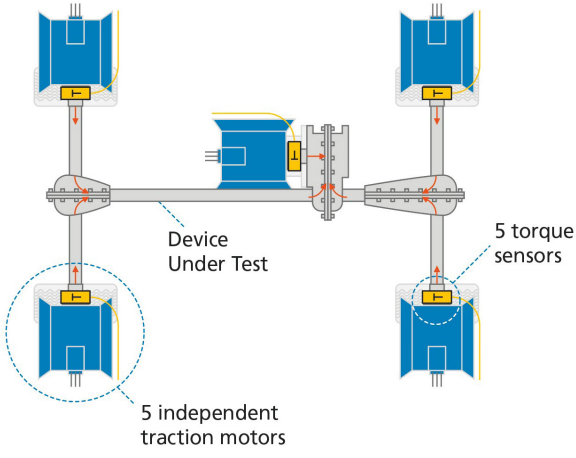
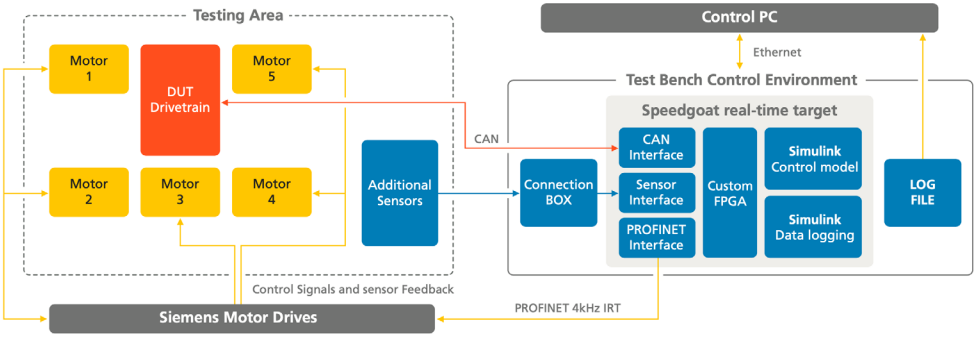


Diagram of the Modular Multi-Load Drivetrain Test Bench



Utilized Speedgoat products:
» Performance real-time target machine
» Fast 16-bit analog/digital I/O modules
» Configurable FPGA-based I/O modules
» IO601 CAN I/O Module
» IO710 Gigabit Ethernet I/O Module
» IO751 PROFINET Controller I/O Module

Utilized MathWorks products:
» MATLAB®
» Simulink®
» MATLAB Coder™
» Simulink Coder™
» Simulink Real-Time™

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