

# The necessity of measurement, control and simulation

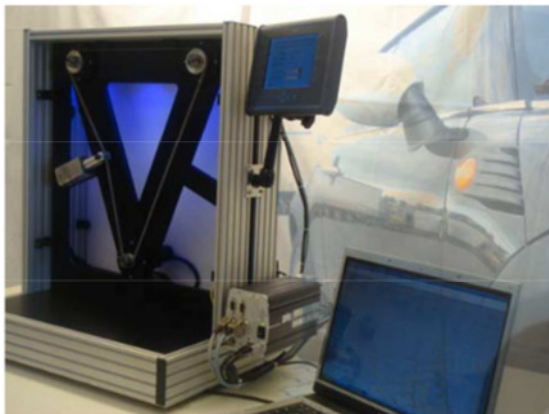
White Paper

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## Introduction

Many products and processes must now be simulated because a reproducible environment for further development of products is necessary.

This test simulates a control chain of an internal combustion engine comprising a crankshaft, two camshafts and a belt tensioner. The drive and load simulation is done with the help of electric motors, which are controlled by a PWM module. The engine crankshaft is available to provide the driving torque and the engine's camshafts can simulate different loads regardless of the independent speed synchronous rotation. With the help of the different angular velocity sensors, torsional vibration analysis can be carried out and give precise information about the dynamic behavior of the system. These can then be used for performance and economy optimization.



## Simulation – Verification – Quality

Today, simulation models are used to verify the performance of real products or components. Simulation results lead to structural modifications of the components of a product that can be verified under the idealized conditions of a simulation model without real-world testing. Because the test signals are both idealized and highly-accurate, reproducible simulation signals can be real time, and signals are recorded during actual operation of the product (just like road data). In addition, accurate thermal studies and endurance testing of dedicated product components under reproducible conditions can be performed on simulation test benches.

## Precision and synchronicity – a must

The simulation must be performed authentic to reality, which requires an increasing precision for technical measurement and control of process variables. The processing of the controller algorithms for accurate control of process variables must be timed perfectly, otherwise complicated control structures will arise that does not reflect exactly what happens in reality. This leads to a distortion of the results.

## The multi-talented imc CRONOScompact

The test stand was constructed based around the imc flagship the imc CRONOScompact. The imc CRONOScompact measurement system provides a variety of different inputs and outputs that enable a precise measurement of signals. In addition to digital inputs and outputs, analog inputs for measuring bridges, temperatures, voltages, currents, sounds, etc., are available. Analog outputs, incremental encoder inputs, and various connection options for different fieldbus systems (CAN, LIN, FlexRay, etc.). All inputs can be configured for different current and voltage ranges.



## A second option with the similar qualities

If the imc CRONOScompact is not what you're looking for, the imc C-SERIES is right up your alley.



The imc C-SERIES consists of smart network-capable, unventilated compact measurement devices for all-purpose measurement of physical quantities. These devices can operate either in computer-aided or autonomous mode and are lightweight, compact, and robust, thus, especially well adapted to applications in R&D or in the testing of mechanical and electromechanical components of machines, on board vehicles, or in monitoring tasks in installations. For the calculation and synchronized output of control variables to the synchronized control of multiple tasks, with even more functions offered by imc ONLINE FAMOS, both the imc

CRONOS*compact* and imc C-SERIES can handle the situation. This synchronized task interrupts control at a defined time. This ensures that an exact calculation of the controller is done. The data acquisition is independent of the synchronous task, so that there is no interference between data acquisition and controller calculation.

In the present simulation of the powertrain, three controllers for the drive and load motors are calculated in parallel and synchronously. For the drive motor, an angular velocity controller is coupled with a subordinate current controller. Thus, the optimal dynamics in the drive is achieved while simultaneously maintaining the robustness of the control.

### **More application opportunities...**

High-precision controller algorithms and parallel running fast time-synchronous data acquisition are required in many situations. In addition to the simulation including material testing, all studies with controlled excitation (shakers studies), studies with synthetic excitation by recorded measurement data, structural studies, and much more.

## Additional information:

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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

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