Review

HORIBA Mechatronics Product Lines

Karl-Hermann Breyer

HORIBA has several decades of experience in providing solutions for automotive test systems. We have focused on testing components of the vehicle powertrain including the engine, transmission, clutch, torque converter, axles or brakes up to the complete vehicle. In all cases the missing parts of the vehicle and its environment is replaced by a system able to reproduce the load the specimen would see in the real car. These systems consist of actuators, sensors, controller and simulation and automation software.

Introduction

HORIBA is providing Mechatronics (MCT) products to test individual or groups of components of a vehicle up to the complete vehicle mainly to the R&D test facilities of the automotive industry. The MCT products are used to measure and optimize performance, verify functionality, check quality and durability, calibrate the increasing number and more and more complex in-car electronic control units, minimize noise and vibrations or improve drivability. HORIBA MCT business is divided into different product lines to provide focus onto the specific needs and requirements of our customers (Figure 1). In this article, outline of the HORIBA MCT products is summarized.

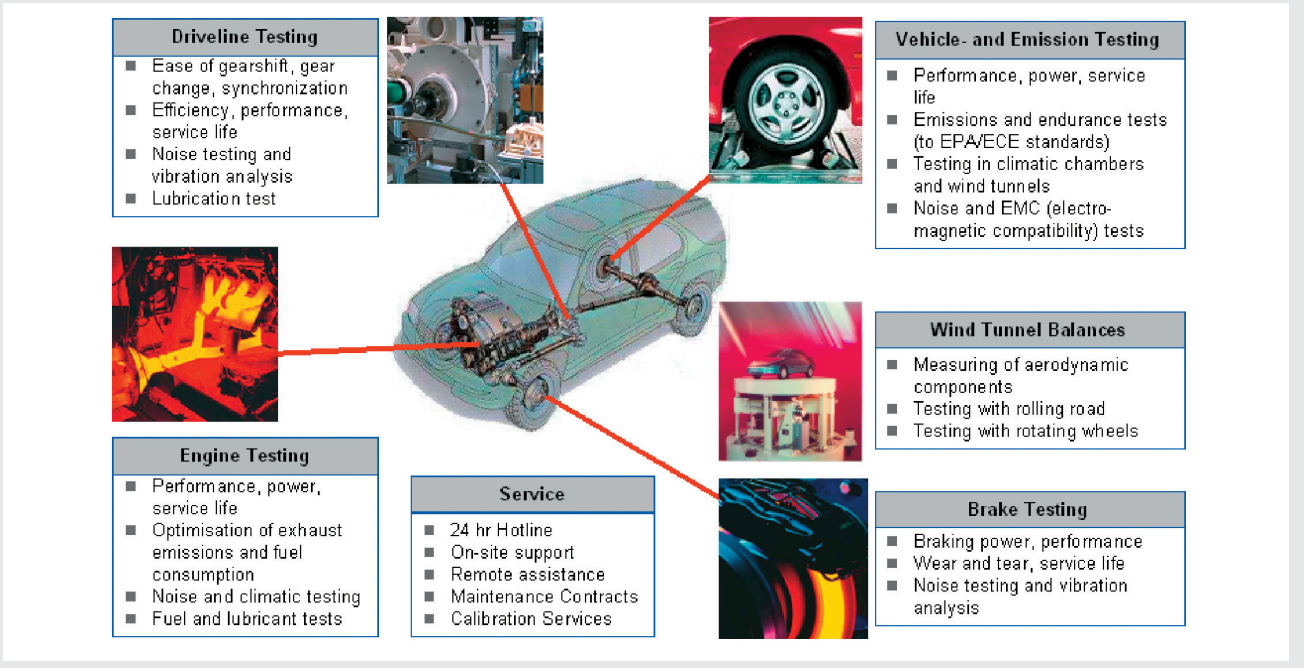

Figure 1 HORIBA MCT Product Lines

Engine Test

The engine test has been conducted for various purposes, such as evaluation of engine performance and durability, optimization of emission and fuel consumption, noise testing and environmental testing. The dynamometer applies the load to the specimen and therefore is another key component in automotive engine testing. In the beginning engine testing was limited to steady state torque and speed measurement in absorbing mode only. This application perfectly matched the capabilities of the eddy current and water brake dynamometers. In the 1980's however, increasing exhaust emission regulations required more and more transient testing including motoring. Therefore already in the early 1990's HORIBA started to develop a dynamometer product range based on alternating current (AC) technology called DYNAS (Figure 2). These dynamometers could cover the whole speed range and were also suitable for the high dynamic testing methods. DYNAS series are equipped with digital encoders for speed measurement and torque flanges for torque measurement, because highly accurate speed and torque measurements with minimal delay time are key factors for dynamometer control.

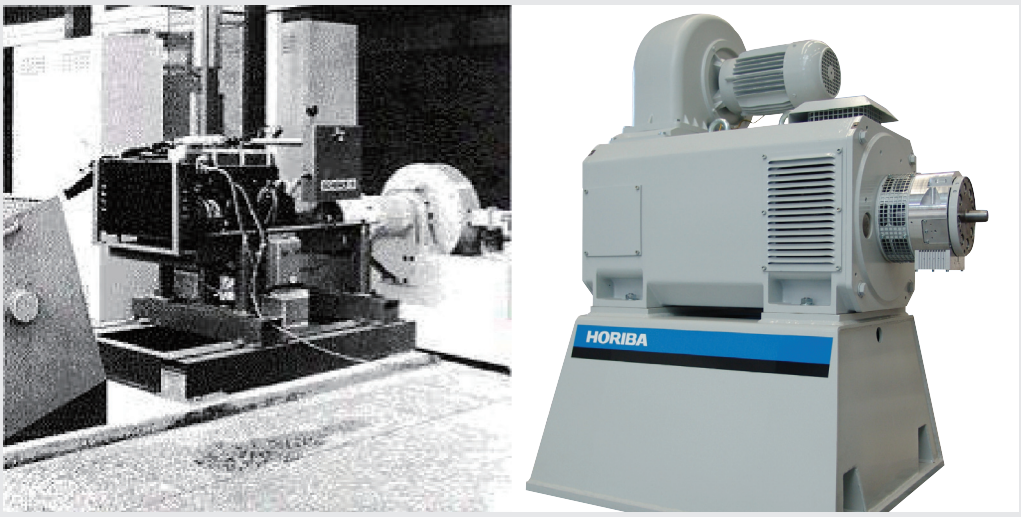

Figure 2 1970's Engine Test Bed with Eddy Current Dynamometer and latest AC Dynamometer DYNAS3

Driveline Test

Driveline test means the evaluation of the various powertrain components, e.g. transmission, clutch, torque converter and axle. When testing such powertrain components, the load of the missing parts of a vehicle have to be replicated or simulated. For example when testing a transmission, at the input shaft the load of an engine and at the output shaft the load of the vehicle body has to be applied. At the interface between specimen and test stand, speed and torque has to be measured and fed into a controller which calculates a command signal to the actuator - a dynamometer - which is connected to the specimen by a shaft (Figure 3, Figure 4). Within the last 20 to 30 years the requirements have changed significantly from just applying steady state speed and torque values to fully transient profiles and finally to simulating virtual engines and vehicles. The command signal generation has changed from manual input to fully computer controlled and automated test systems. This allows the testing of transmissions with different types of engines just by changing the engine model in the computer.

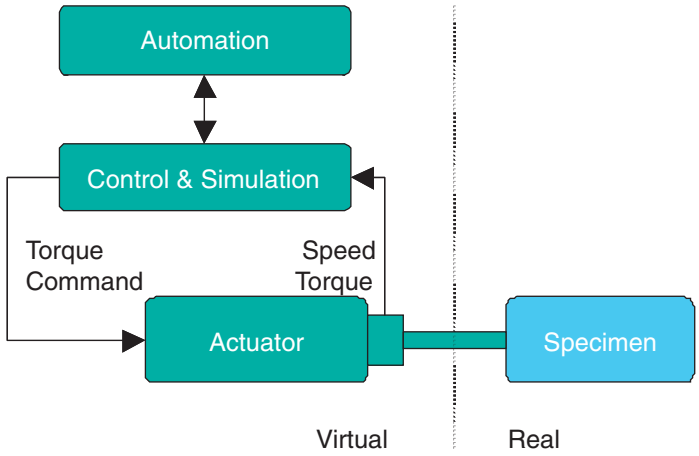

Figure 3 Basic Control Structure

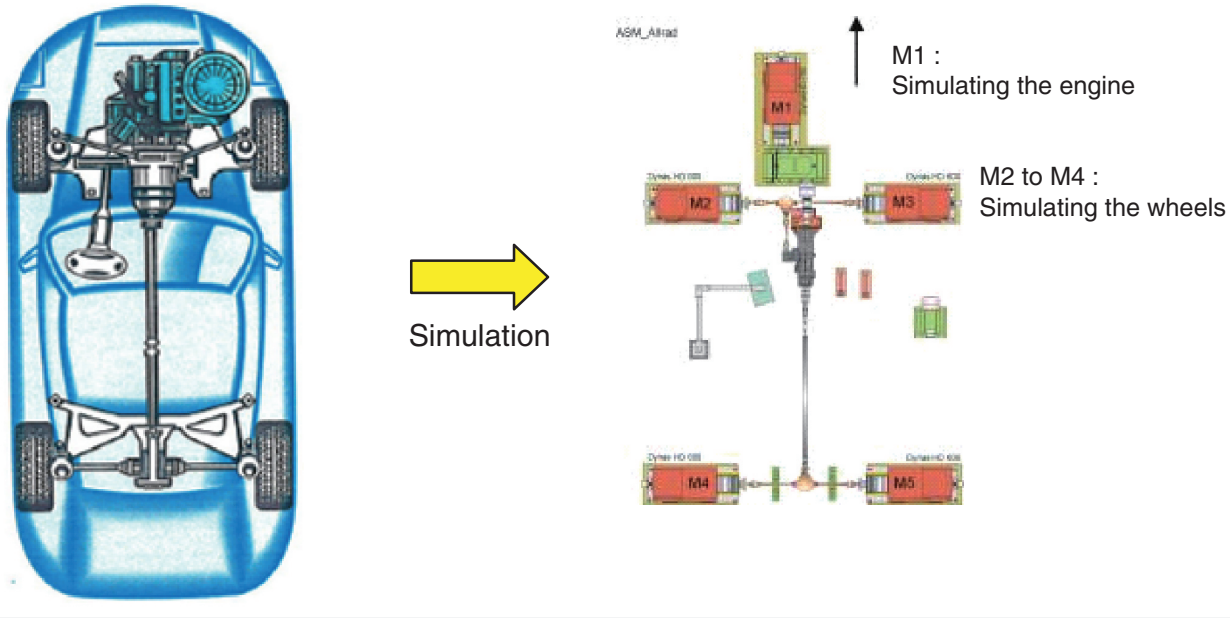

Figure 4 AWD Transmission Test Bed with M1 Simulating the Engine and M2 to M4 Simulating the Wheels

Brake Test

For the vehicle brakes, friction coefficient and wear behavior of friction materials are tested as well as braking performance of components. Additionally, noise, vibration and harshness (NVH) tests are carried out using whole vehicle or complete assemblies of brake including axle and wheel. A Brake test facility is basically equipped with a dynamometer or motor in order to rotate such test pieces or wheels.

Vehicle Test

The vehicle test is performed on the dedicated facility called a chassis dynamometer, where the test vehicle is set on the rollers which are connected to dynamometer and is made to run. A Chassis dynamometer is typically used for mileage accumulation tests, emission tests and NVH tests.

Wind Tunnel Balances

Wind tunnel balances are a little bit different from test systems for engines, drivelines, brakes and vehicles. A wind tunnel balance is a high-tech force measuring unit which is integrated into a complete wind tunnel. However in recent years wind tunnel balances are not only measuring forces but also simulating parts of the environment of a vehicle like rolling road and spinning wheels to provide results which are as close to reality as possible. This trend towards increased simulation of real world conditions in wind tunnels is in common with all the other MCT products.

Test Automation System

With the functionality and complexity of the whole test system there was also the increasing demand for automation functions to support the operators to run the test beds most efficiently. The automation system is providing test schedule generation (command signals), data acquisition and data logging, result data evaluation and reporting and monitoring. Automation functionality was and still is continuously improved and extended by HORIBA. Since 2002 STARS has been HORIBA's automation platform based on Microsoft's latest .NET technology.

Conclusion

The tasks in automotive test to be performed are quite similar in the different application domains, and common technologies can be shared. The equipment to measure speed and torque, dynamometer which applies the load to the specimen, and simulating software are common key components in various automotive testing. HORIBA is continuously improving existing test solutions and looking for new technologies which could open up new applications for our customers.

Karl-Hermann Breyer
HORIBA Europe GmbH
Managing Director
Ph.D