# New Drive Concept on the AVL Test

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**Christian Schyr, AVL List GmbH, Graz Austria**

## 1. Integration in the Development Process

The development and testing of new control concepts for powertrain management systems can now with the help of a modern AVL powertrain test bed be fully integrated in the vehicle development process (1), (2):

?? The model of the new control algorithm is created and tested on an open simulation system like MATLAB / SIMULINK (Phase 1 – Offline Simulation)

?? The software coding is optimized, automatically loaded on the real target hardware and tested with a complete online simulation of the powertrain and vehicle on a dSPACE platform (Phase 2 – Hardware-in-the-Loop Simulation).

?? The same dSPACE platform and the real target hardware is interfacing the real hardware components on the AVL powertrain test bed via the test bed control and automation system (Phase 3 – Test Bed). The non-existing components of the powertrain and vehicle are simulated, see figure 1.

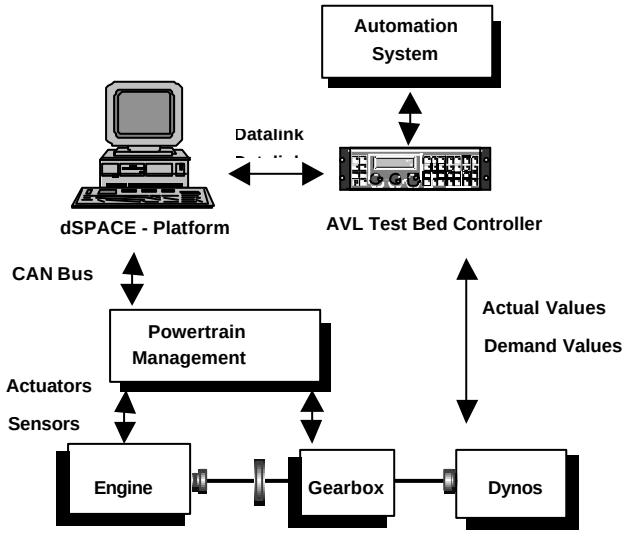


Fig. 1 Layout of the test bed

?? The target hardware is installed in the prototype vehicle and tested on the track (Phase 4 – Prototype Vehicle).

## 2. Online Simulation on the Test Bed

Depending on the actual configuration of the test bed the following non-existing components are simulated:

?? Vehicle (Roadload, Mass, Brakes, Drivetrain).
?? Manual transmission, automatic transmission and continously variable transmission (CVT) on the engine test bed.
?? Combustion Engine on the transmission test bed.
?? Driver with throttle, brake and gearshift.

The dSPACE Realtime Platform together with the AVL Test Bed Controller enables the development engineer to combine the proven control algorithms and simulation models of the test bed with the open and flexible architecture of the dSPACE platform using the same software tools as in phase 1 for offline simulation and phase 2 for HiL simulation.

Fig. 2 AVL powertrain test bed with combustion engine and manual gearbox in Front-Wheel-Drive configuration

By using the combination of dSPACE and AVL simulation technology the realization of complex test beds like multiconfiguration powertrain / engine test beds for alternative drives or powerpack / transmission test beds for automated manual gearboxes and CVT have been already possible.

## 3. Application Example

The described concept was sucessfully implemented on a multiconfiguration test bed for fuel cell drives. The test bed can be used either for engine only testing using one of the two highly dynamic AC dynamometers and an adaption gearbox, as a powertrain testbed or for testing the complete vehicle, where the dynamometers are connected directly to the wheel hubs, see figure 4 and 5.

Fig. 3 Multiconfiguration Test Bed for Fuel Cell Drives – Complete Vehicle Setup


Fig. 4 Multiconfiguration Test Bed for Fuel Cell Drives – Complete Vehicle Setup

The modular hard- and software concept allows to test the complete powertrain design from an early stage in a pure engine configuration with simulation of the DC source up to the integrated vehicle on one test bed using the same dSPACE environment for all development stages.

## References

(1) Moser, F., Kriegler, W. and Zrim, A.: Powertrain Optimization by Means of Simulation Tools, ATZ Automobiltechnische Zeitschrift 101 from 11 / 1999.

(2) Zuber-Goos, F.: Der BMW-Forschungsprüfstand zur Entwicklung neuester Antriebskonzepte und seine Anforderungen an die Simulationstechnik, VDI Congress, Aachen Germany, September 1999.