





THE ADDED VALUE

Improved efficiency. Enhanced flexibility. Increased productivity.

AVL InMotion 4[™] is a system driven hardware-in-the-loop test solution for virtual road-testing: Ask questions, get answers and make decisions early in the process before committing to massive costs. Based on real-life scenarios efficient powertrain development is made possible from the very early, coarse levels all the way down to the final product performance down the road.

AVL InMotion 4[™] generates robust and reliable engineering results through industrialized interface models between virtual and real components (testbed integration): This is the key to link up virtual and physical development environments and to enhance process flexibility.

For more than a decade AVL has acquired outstanding system and application know-how to leverage integrated physical and virtual testing. AVL is the global market leader in this domain, with the most systems in use around the world today. AVL InMotion 4[™] experts will assist you in implementing a tailored solution that provides the highest level of quality and increased productivity in development and testing.

AVL InMotion 4[™] covers the 3P's to make testing business successful: products, process, people.

Test driving starts now

THE CHALLENGE

SHIFTING FROM COMPONENT TO SYSTEM DRIVEN INNOVATION

50 % of today's innovation is system driven and this will increase in the future. Powertrain development activities are getting more and more continuous, progressive and pervasive. They increasingly require a convergence of disciplines as well as complex decision-making under uncertainty. Real and virtual worlds are converging. This leads to an approach that incorporates real-time simulation and rig-testing into an integrated mechatronic development and test environment. Such kind of mixed-reality engineering environments combine the best aspects of both worlds: test and simulation. As a result they significantly increase productivity and efficiency by enabling sub- and full-system functional and performance testing without expensive outdoortesting on real proving grounds.

LEVERAGING INTEGRATED VIRTUAL AND PHYSICAL TESTING

The vehicle of the future is driven by strong market demands within an increasingly complex system and user environment. New technologies evolve at an ever faster pace to tackle these changing market needs. The variety of topologies for the electrified powertrain poses

AVL InMotion 4™ REAL-LIFE SIMULATION

AVL InMotion 4[™] powered by Car-Maker delivers a scalable portfolio of real-life simulation solutions for different test environments. By building on leading-edge technology, superior usability and respected quality, AVL InMotion 4[™] makes maneuver-based testing an integral business practice. It improves testing performance, reduces the number of prototypes and drives innovation:

- Unmatched ability to evaluate realworld driving behaviour on the testbed
- End-to-end virtual road testing environment empowering teams to develop better products faster

challenges with respect to the best integration of an increasing number of hybrid subsystems:

- How do the combustion engine, electric motor, battery and hybrid control strategy interact in the diverse situations of real-life vehicle usage?
- What is the impact of ADAS on predictive powertrain controls?
- How should we calibrate the powertrain to the people?
- How will the vehicle as a system of systems interact with its environment?

These questions should already be addressed in full knowledge of facts at the testbed. Therefore, mapping the product DNA into the test process and anticipating the operational, real-life driving conditions at the testbed is more and more important for intelligent and competitive powertrain development. Making the virtual and physical environments link up significantly reduces time-to-market and boosts the pace and power of innovation.

CREATING SUSTAINABLE VALUE

System boundaries need to be overcome to create successful and complete testing-solutions. There is a clear market trend towards partnering with suppliers such as AVL that provide comprehensive solutions from a single source. Industry recognizes that both vertical and horizontal expertise all along the test live cycle are required to boost efficiency and to guarantee long-term stability. This simultaneously improves overall functionality and system output.



Simulated environment and maneuvers

- Real-life driving profiles
- GPS and maps
- Climatic influences
- Road conditions
- Incidental events
 Active and reactive maneuvers
 Different driver types

• Traffic

Simulated system integration



Virtual vehicle integration under simulated real-life conditions.

THE AVL SOLUTION

PIONEER SPIRIT

During the last decade AVL has pioneered a unique and world-leading testing solution to synthesize integrated virtual and physical real-life testing on all types of testbeds: AVL InMotion 4^{TM} .

AVL InMotion 4[™] bundles IPG's cutting-edge CarMaker/HiL with any type of testbed into one integrated solution.

Driven by AVL's deep understanding of the requirements to deliver successful testing technologies, AVL InMotion 4[™] is bundling the two hitherto disconnected worlds, the physical and the virtual, into one integrated testing solution. It incorporates the core of what is needed when combining simulation and test: hiding the complexity of the testbed from the simulation - and vice versa!

When the differences between real- and virtual road-testing disappear, when it is possible to switch between any kinds of testbed topologies within minutes, the entire way of how we develop powertrains is affected. AVL InMotion 4[™] is a key enabler from a more anticipatory, prescriptive style (define-design-build) of development to the much needed adaptive style (envision-explore-refine).

CLEAR BENEFITS THROUGH COMPREHENSIVE SOLUTIONS FROM A SINGLE SOURCE

A significant strength that AVL InMotion 4[™] brings to the testbed is the ability to take over responsibility over the complete simulation solution.

AVL InMotion 4TM/CarMaker is by far the global market leader in this field. Countless projects result in today's technological expertise to realize virtual road testing on powertrain testbeds. The innovative solutions are customized to address specific requirements and supported by experts over the entire testing lifecycle.

AV



POWERTRAIN DEVELOPMENT IS A TEAM SPORT

Today's requirements in powertrain development move forward every second. Complex systems, shorter times to market and a global world of opportunities challenge you to be better, more flexible and faster than your competitors.

Development tasks aren't stand-alone. And it's not (just) about how good single individuals or tools are...

... it's about how well they work together.

AVL Team SUITETM SUCCESS BASED ON INTERPLAY





COMBINE YOUR STRONG TEAM FLEXIBLY OUT OF COMPATIBLE, COMPLEMENTARY PLAYERS TO MEET YOUR NEEDS.

- AVL PUMA Open 2™
- AVL EMCON 6™
- AVL LYNX 2™
- AVL SANTORIN MX 2[™]
- AVL TESTLIFE 1™
- B AVL CAMEO 3™
- AVL CRETA 4™
- Zeric AVL CONCERTO 4™
- AVL-DRIVE 4™
- SAVL VSM 4™
- aVL ARTE.Lab 4™
- j AVL InMotion 4™
- AVL IndiCom 2™
- AVL iGEM 2™
- AVL TESTGATE 1™
- AVL ISAC 6™
 - ... and more joining soon

APPLICATIONS AND FUNCTIONS

VIRTUAL PROVING GROUND TESTING

With AVL InMotion 4[™] the test engineer has the capability to perform corporate test procedures in a repeatable and controlled testbed environment prior to expensive outdoor testing on the proving ground. The ultimate task is to map the corporate maneuver catalogue to the testbed. This can include misuse tests like handbrake U-turns, bootleg turns, clutch kicking, bumping and jumping.

REAL WORLD FUEL ECONOMY AND CONSUMER REPORT TESTING

Test engineers appreciate the efficiency and speed with which they can now test-drive their mixedreality prototypes on the virtual Nürburgring or their city circuit and see the virtual consumer report tests upfront - and long before the first real vehicle prototypes are released: lean and mean, fast and cost efficient.

REAL DRIVING EMISSIONS (RDE)

Minimizing RDE is a global challenge. Testing with AVL InMotion 4^{TM} is part of the answer.

FUNCTIONAL AND FAILURE INSERTION TESTING

Efficient test preparation and test execution allow to confirm the functional integrity of the powertrain control systems on a vehicle level. Failure insertion facilitates testing the vehicle's behavior in critical situations, stress and failure to achieve real life test coverage and avoid expensive recalls.

CONNECTED POWERTRAIN TESTING AND ADAS

Predictive powertrain controls using ADAS and maps are the cutting-edge today. Development, calibration and validation of the powertrain and vehicle in a virtual environment are critical. AVL InMotion 4[™] allows customers to make decisions before committing to massive costs.

FUNCTIONS OF AVL InMotion's TIP

The testbed integration packages (TiP) are AVL's layer between testbed and simulation. They hide the complexity of the testbed from the simulation – and vice versa. Hot Swapping, Second Life, Torque and Speed Shaping (Silverback Algorithms), Absinth Control Strategies, Free-Mode // Servo-Mode, Mixed Mode Tire Simulation and extended Signal Filters are just a few key words which might quickly summarize the functions and features of this package.



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