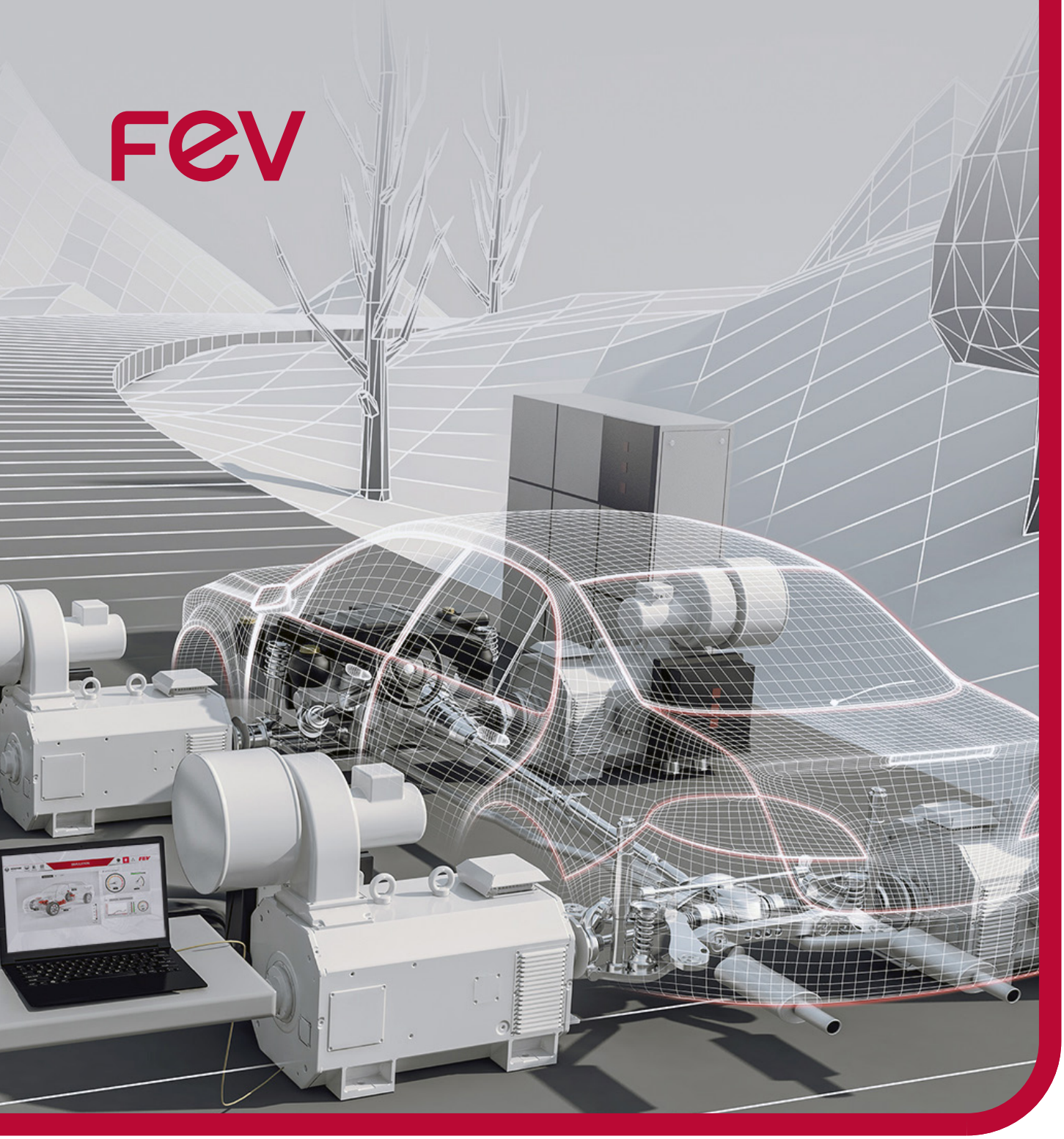


xMOD™

Co-simulation and HIL platform

feel evolution

FEV software technologies for simulation

xMOD™, Co-Simulation and HIL Platform

Simulation techniques have crossed new boundaries over the past ten years: they were restricted to the field of design but have now extended their scope of application to testing, calibration and on-road validation in the near future. To do that, they have increased their ability to be connected to real worlds, with physical components combining with them to create complex systems.

The xMOD™ software facilitates the integration of heterogeneous models and co-simulation between several simulation tools. While in the initial development phases, it enables collaborative work between the different domains; in the subsequent physical powertrain and ECU validation phases, it facilitates the use of models, developed during the design phase, on the test bed without any loss in quality.

With xMOD™, boost the efficiency of your development facilities!

POSSIBLE APPLICATIONS WITH xMOD™

Model and software IN THE LOOP

- From scratch: design of a complete and optimized hybrid vehicle (components and energy management) in order to assess component or architecture capabilities
- From an existing vehicle (conventional or hybrid): optimization of the vehicle components or energy management system (EMS)

Hardware IN THE LOOP

- Adaptation of a current MIL or SIL simulation platform for HIL use
- Establishment of a complete modeling environment in order to couple it to the real EMS (in SIL and/or HIL)

Engine IN THE LOOP

- Validation of the vehicle EMS on the engine test bench
- Evaluation of hybrid powertrain performances in several virtual vehicle configurations

Battery IN THE LOOP

- Development of a unique powertrain platform for application on several vehicles with a highly accurate system when integrated in each vehicle;
  The powertrain is tested in all the usage scenarios to validate the battery and BMS performance.

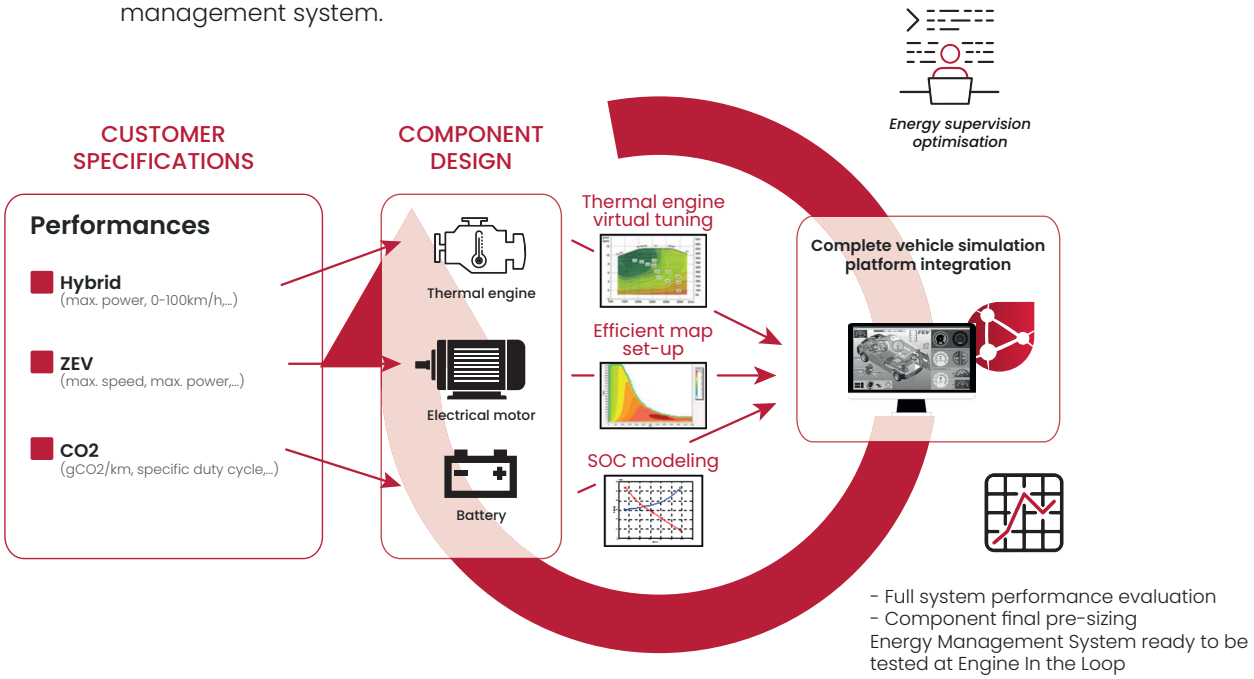
System IN THE LOOP

- Implementation of the Energy Management System (EMS) without the constraint of the battery's state of charge, i.e. the long time to recharge it...
  When the battery pack is well known, it can be simulated.
  The powertrain is tested in all the usage scenarios to validate the battery and BMS performance.

Use case: MIL/ SIL for a hybrid vehicle

- Specification of battery capacity, electric motor and thermal engine maximal powers & energy management optimization

- **Deliveries:**
  - Full vehicle virtual specification and first dynamic performance and consumption assessment
  - Hybrid vehicle platform that can be used for on-line development and validation of the energy management system.



- Full system performance evaluation
- Component final pre-sizing

Energy Management System ready to be tested at Engine In the Loop

A challenge

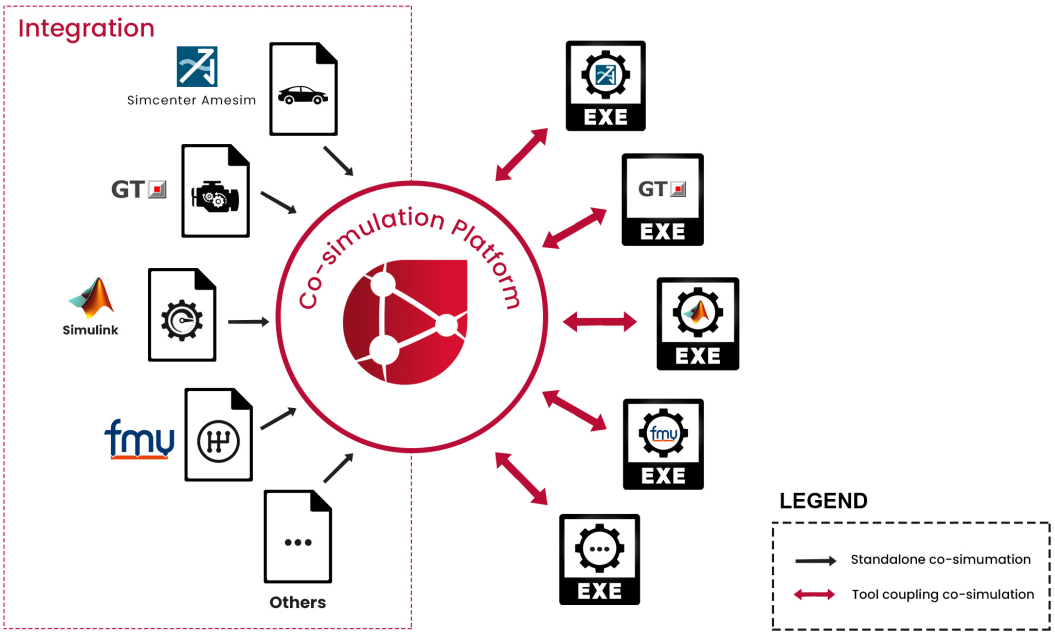
With regard to simulation, the crucial issue is intelligent CPU resource management. Why is this crucial? Because creating a representation of a vehicle and a complete powertrain – in particular a hybrid one – using models is an extremely cumbersome process and therefore requires highly-sophisticated CPU resource management, both in the design office and even more so on the test bed. Furthermore, the quality of this representation is critical in terms of obtaining simulation results that reflect reality.

A solution

The FEV solution is 10 to 40 times faster than anything else available on the market. In simple terms, FEV can execute complex models during the design phase in a compressed time, and consequently much more quickly than it would be in real time. Then, during the testing phase, FEV manages extremely complex models in "hard" real time on the engine test bed.

More generally speaking, time management inside xMOD™ is an intelligent operation that facilitates the best-possible use of CPU resources, considering the resources and the priorities required of each task: this is the so-called ASAP (As Soon As Possible) time.

Co-Simulation



xMOD™ is not designed to replace the original modeling and simulation tools, but to promote coexistence. Feel free to use the most efficient modeling tool/language

Models from third-party tools can be incorporated in the form of a file, which means that there is no need for the presence of the actual third-party tools to simulate the system as a whole. However, it is also possible to retain the third-party models in the original software during integration.

> Over integration: some models are faster than real time. With this functionality, run different models at different speeds

> Reduced global license cost
> Two possible modes:
  - Tool coopling co-simulation: tools from different origins are connected to xMOD™
  - Stand-alone co-simulation: models from different origins are converted in a dll and then executed in xMOD™.
> Extensive use of FMI, the standard for co-simulation

The offer

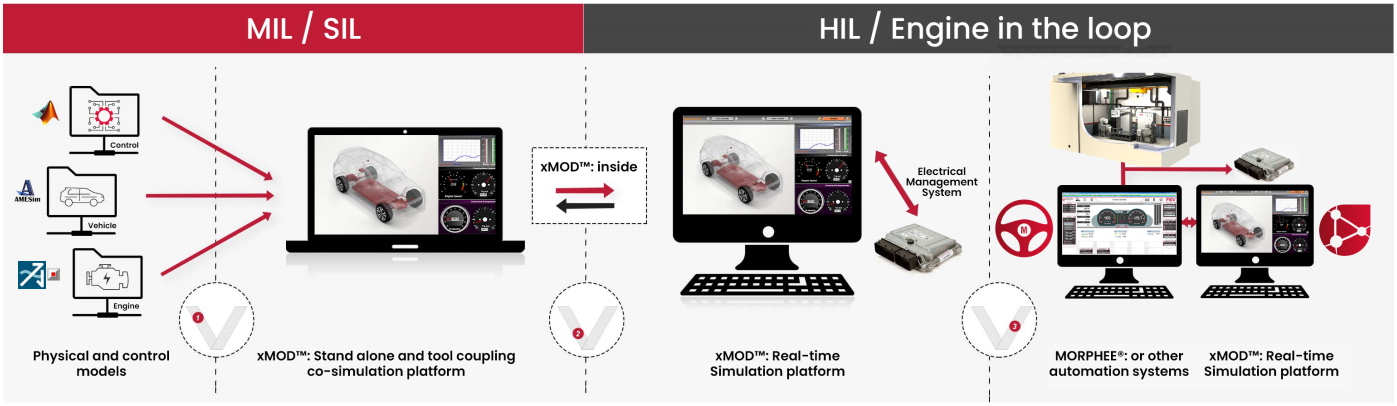
xMOD™, the FEV simulation software offer, is based on the MORPHEE® technology. This enables models, tests, processes and screens to be shared throughout the development processes.

> Use of simulation in the design phase: with xMOD™, co-simulate heterogeneous models and create a complex system. Then transform this into a virtual experimentation and adapt iteratively your models.

> Use of simulation in the design and also the subsequent automation, calibration and validation phases: connect xMOD™ to the automation and calibration tools (FEV, third parties).

Plug your xMOD™ to the most known Automation systems and get benefit of the efficient execution of your models in deterministic real-time.

From MIL/SIL to HIL and EIL



The xMOD™ platform enables the real-time connection of hardware and models without compromising the quality or representativeness of the tests.

Without implementing complex models in hard real time, it is impossible to obtain a high level of precision on the HIL or engine test beds: rapid prototyping on the HIL test bed or calibration of the ECU on the engine test bed is then not possible.

With xMOD™, the real-time connection of hardware and models does not compromise the representativeness of the tests, as the precision of the model is retained and can be reproduced directly in hard real time and, in a deterministic way, on the test bed. To achieve this, unique features have been incorporated that allow multi-solver and multi-core execution with advanced algorithms for data prediction.

With xMOD™, it is possible to validate a new hybrid powertrain concept or scale the air circuit of a new engine, its turbo and its EGR system by evaluating pollution emissions and fuel consumption long before the physical existence of the parts or the system.

> Exceptional Speed-up: 10 to 40 times faster than the competition
> Multi-core, automatic load balancing, multi-solver and multi-threads
> Reuse the same models from MIL to HIL, while preserving the same accuracy of models
> On the test bed: enables connection to the bed and allows the engine to behave as if it were in a vehicle

Are you interested in innovative, pioneering software solutions?

Contact us!

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