

Modeling by MicroNova

Creation, maintenance and further development of simulation models



- » Actuator models
- » Sensor models
- » Scenario models

- » Environment models
- » AI-based model components
- » Simulation models for vehicles and wind turbines
- » Support for EXAM library models (test automation)

Efficient modeling with hardware competence

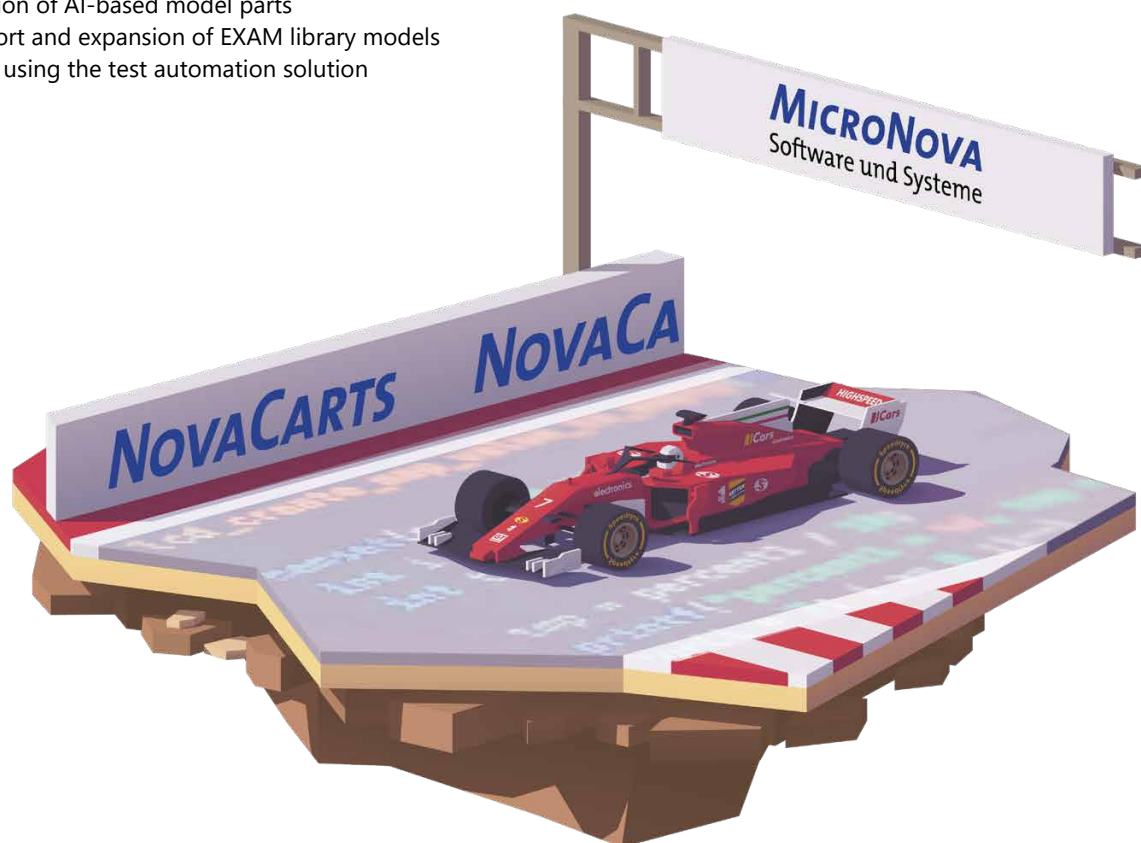
MicroNova, the software and systems vendor, has decades of experience in the development of hardware-in-the-loop (HiL) systems – expertise that also benefits the modeling quality of simulations. Systematic modularization, which has been incorporated into the entire NovaCarts product range, significantly reduces the compilation times of software models. This means that a separate model is created for each control unit and each function, which can be run independently directly on the HiL simulator – without the need for costly re-compiling of the entire model. In addition, no special hardware is required for modeling. Modifications to the models can also be carried out easily and with minimum time loss.

Besides the development time, the runtime of a model is crucial in order to achieve the desired real-time behavior. This is accomplished both by the type of modeling and by adapting the computing hardware, for example co-simulation on optimized simulation computers or different constellations of FPGAs (Field Programmable Gate Arrays).

These advantages are particularly evident in the NovaCarts HiL systems, as the entire architecture is designed to efficiently replicate control units. Of course, MicroNova's experts also have many years of experience in integrating their own models into the test environments of all common hardware vendors in the automotive sector.

Services at a glance:

- » Development & maintenance of models
- » Sensor simulation & complex simulation of electrical loads
- » Simulation of physical relationships in real time
- » Replication of the environment through a combination of simulation and reality
- » Integration of models into the test infrastructure
- » Restbus simulation
- » Creation of AI-based model parts
- » Support and expansion of EXAM library models when using the test automation solution

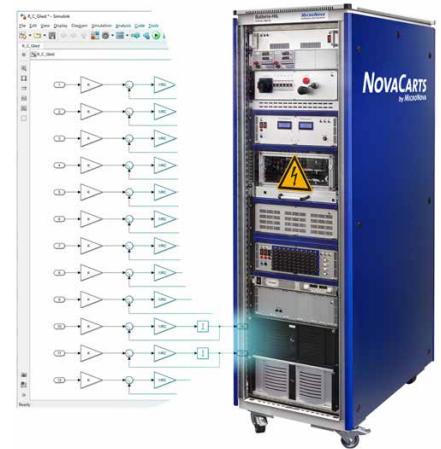


Simulation models for High-Voltage batteries

Simulation models for high-voltage batteries:

- » Cell simulation
- » Cell controller simulation
- » Replication of proprietary communication protocols
- » BMC simulation
- » Vehicle restbus simulation

MicroNova develops sophisticated models that meet common real-time requirements in terms of computing intervals for internal and external variables. The signal resolutions meet the requirements of modern ECUs. In combination with NovaCarts hardware, even high-resolution analog signals can quickly be created. The models are delivered as open base models that can be extended through self-contained add-ons. They offer resolutions of up to one millisecond (1 ms). One special feature of the models is the high number of parameters that can be changed at runtime, doing away with the need for frequent re-compiling. This also benefits test automation.

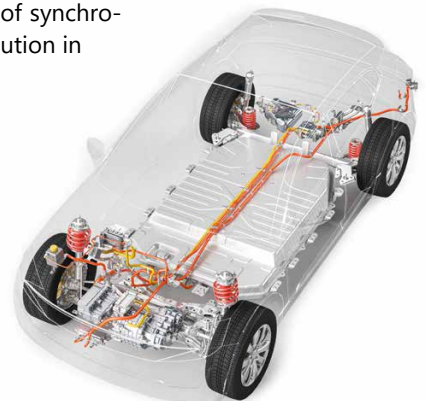


The models take into account the following properties:

- » Ohmic polarization
- » Cell voltage simulation as a function of charge state, temperature and current
- » Simulation of series and parallel connection
- » Simulation of overcharging and deep discharging
- » Replication of different age states of the cells through the use of OCV (open circuit voltage) curves
- » Simulation of the output current as input of the shunt simulation
- » Temperature model of the battery
- » Simulation of the pre-charging function

Simulation models for electric drives

For testing power electronics without rotating parts, MicroNova creates simulations of synchronous and asynchronous electric machines in HiL mode. Real-time models with a resolution in the microsecond (μs) range are used. The models are optimized for use on an FPGA.



Simulation models for power electronics

In combination with an electric machine simulation, it is possible to create a complete simulation of the drivetrain without ECU hardware in a virtual environment.

Flexible basic and custom special models

MicroNova offers flexible basic models that are precisely to meet the focus of the application. If necessary, further modifications can be easily made at any time. MicroNova also develops special models for a huge range of applications, for example for the exact determination of a battery's status (state-of-health, SoH) using electroimpedance spectroscopy, or for conversion between two buses (RDB and ADTF).

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Model Integration

Model integration means the integration of in-house and third-party models into the testing infrastructure, to create one overall network. This creates a link between the simulation and the real world. The development of model solutions in cooperation with the client's specialist departments is just as much part of MicroNova's portfolio as the in-depth analysis of model behavior for troubleshooting. The aim is to provide coordinated models for integration test benches. This also includes creating appealing and intuitive layouts. Scripts to complete recurring tasks also increase efficiency. The simulation cannot be distinguished from the real vehicle in terms of testing.

Internal combustion engines

When it comes to internal combustion engines, MicroNova's experts support the creation of route models and the provision of signals for engine ECUs in real time. Suitable solutions are also available for high-resolution signals, such as internal cylinder pressure, which require computing times of a few microseconds.

With many years of experience, MicroNova developers support the adaptation and maintenance of existing models as well as the integration of existing models into NovaCarts HiL systems.



Transmission systems

In order to integrate a transmission ECU into the overall network without requiring the complete transmission block, NovaCarts models simulate the hardware signals of the transmission in real time. This allows component test benches to be designed specifically for the ECU in question.

Steering systems

The behavior of power steering can also be accurately replicated with NovaCarts simulation models. They are characterized in particular by their extreme speed (simulation steps in the 100 microsecond range). In combination with the relevant servo actuator, even complex electromagnetic simulations of steering behavior are possible.

FPGA modeling

The experts at MicroNova have the expertise to outsource models with high real-time requirements to FPGAs and optimize them accordingly for this purpose. Another use case is the simulation of hardware that is not readily available. After optimization, the FPGAs are integrated into an existing test landscape. This is done directly in the hardware, in a real-time node or in a cloud solution with leasable FPGA nodes.

Restbus simulation

With the help of NovaCarts restbus simulation, ECUs that are not available can be simulated in no time at all. In the simplest case, this is done by sending static bus signals, but dynamic correlations can also be simulated without much effort thanks to integrated logic.

Wind turbines

Besides the automotive sector, MicroNova's model expertise has also proven itself in the renewable energy sector. On behalf of a large wind energy company, models have been developed for the following applications:

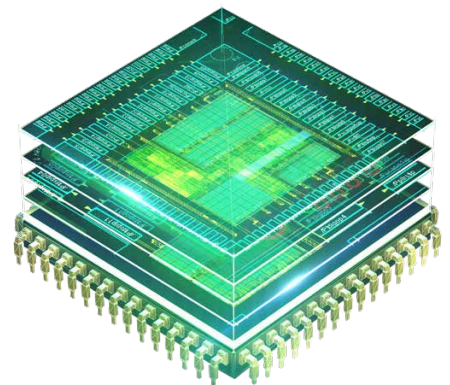
- » Operation control
- » Tower adjustment
- » Motor simulation of rotor blade pitching
- » Emergency power supply (relevant to functional safety)
- » Sensors
- » Anemometers

Virtual ECUs

Virtual ECUs have a wide range of applications for which MicroNova offers a comprehensive portfolio of products and services. Many topics from the field of modeling are relevant, such as the restbus simulation described above. The NovaCarts Virtual software enables development departments to run real test systems as a virtual version with the same models and parameters.

In ECU virtualization, an ECU is simulated in full detail with a high degree of compatibility to the actual device under test (DUT). This allows the unchanged original software to be analyzed in a virtual DUT.

In addition, virtualization enables new manipulation operations and the requirements for ISO 26262-compliant tests are also met.



Artificial Intelligence (AI)

The need for simulation models is increasing due to the growing prevalence of testing in virtual environments. Neural networks or AI technologies are used to support or replace sometimes time-consuming and complicated physical modeling. This can lead to conventional modeling being replaced permanently, or provide a transitional solution until manual modeling is completed.

The AI specialists at MicroNova Consulting are happy to advise and support companies in the use of AI technologies.

Test automation with EXAM

An EXAM model is a database schema that contains all the data necessary for test automation. A key component is the libraries which pool the abstracted operations for test case development. A distinction is made between functional operations and technical hardware and software interfaces. In graphically supported modeling, these library functions are drawn into sequence diagrams. This is an intuitive way to define the test execution. The aim of this approach is firstly to increase maintainability and secondly to obtain results quickly by using the basic concepts.



MicroNova supports companies in this process with years of experience: from conception to setting up the infrastructure through to the library and test case creation. Particular attention is paid to the reusability of the test sequences.

MicroNova is your partner for modeling

Benefit from over 30 years of experience in model creation as well as the maintenance and extension of customer models. MicroNova has extensive experience in agile software development gained from numerous projects. The internal hardware development team also works agilely. In modeling, our experts and customers are usually organized together in scrum teams.

MicroNova supports your development processes on site. Individual project tasks can also be outsourced to nearby countries.

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