

PHYSICS-BASED DIGITAL TWINS BY MEVEA

Addressing the business challenges of heavy equipment throughout the product lifecycle

MEVEA SOFTWARE

Laserkatu 6,
FI-53850 Lappeenranta
Finland

www.mevea.com
sales@mevea.com

MEVEA SIMULATION SOFTWARE:

BUILD PHYSICS-
BASED DIGITAL TWINS
THAT SUPPORT YOUR
BUSINESS THROUGHOUT
THE PRODUCT LIFECYCLE

BENEFITS

- Faster innovation owing to an earlier understanding of the product's behaviour
- Product development lead-time and physical prototyping cost decrease when fully functional physics-based Digital Twins are used
- Possibility of using product development Digital Twins in sales and marketing and increasing customer deal value
- Possibility to use product development Digital Twins in training and increasing end-customer business value and promoting efficient use of product capabilities.

SUMMARY

Increasing levels of machine intelligence enable more advanced operator assistance systems, work cycle automation and autonomy, which is rapidly growing in use with various types of machinery and changing the world of machine manufactures and operators.

Repeating the old ways of working is not enough to be successful in the future, instead, bold changes and new approaches are needed to stay competitive.

A rapidly growing new approach is the use of Digital Twins – i.e. physics-based virtual representations of physical products that can be used throughout the product lifecycle.

With Mevea Simulation Software you can build your physics-based Digital Twins, capable of simulating your product behaviour and use and thus gain significant business benefits throughout the product lifecycle – something already proven in practice by many world-class companies, including our clients.

MEVEA MODELLER

CREATE MODELS BASED ON YOUR EXISTING ASSETS

Mevea Modeller is our software tool for developing Digital Twins based on a real-time multibody dynamics simulation extended with multi-physics capabilities. Mevea Digital Twins include machine model, environment, work process (i.e. what your machine does), virtual sensors and I/O interface to machine control system (HIL – Hardware in Loop).

Management of models of a product family can be a complicated task. Mevea Modeller introduces the use of assemblies, that can consist of a single component, such as a boom variant or an attachment tool or a more complicated assembly, such as hydraulics, driveline or a working environment.

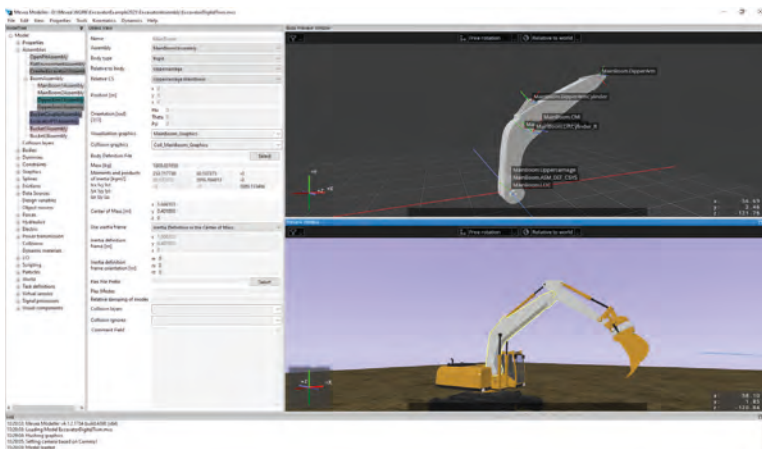
The simulation scenario which consists of machine's configuration, tool and working environment is set up selecting your desired assemblies.

Working environment assemblies can include deformable soil that can be defined accurately with our tools for work processes, such as excavation & bulk material handling.

You can define your model's I/O functionality, hydraulics, powertrain & other components in Mevea Modeller to simulate your products realistically.

Virtual sensors such as hydraulic pressures, laser scanners and LiDARs can optionally be added. Existing sub-models developed in other simulation environments can be included via standardized Functional Mock-up Interface (FMI) or Mevea synchronous interface.

The ability to set weather conditions, use several camera positions, possessing realistic audio effects & the use of operator interface components such as touch screens enable the immersive environment in your Digital Twin to operate in an identical manner to a real physical machine.



MEVEA SOLVER

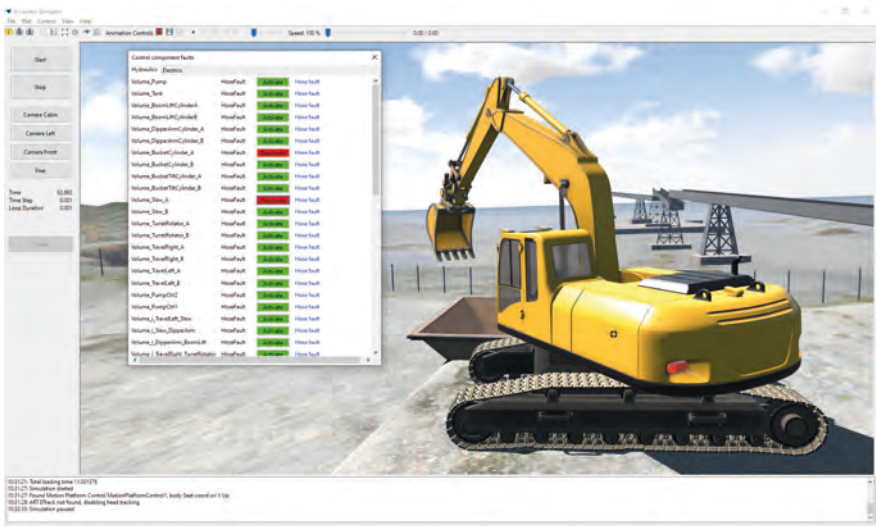
RUN YOUR MODELS IN REAL-TIME WITHOUT COMPROMISES

Mevea Solver is dynamics solver that offers the most efficient and optimized real-time solution methods combined with numerical solvers utilizing either a dense or sparse matrices approach.

In a real-time simulations, the computational efficiency and numerical stability must work hand-in-hand. To find the best solution for a certain application, a selection of different solution and modelling methods is available to the user.

Mevea Solver offers features such as the ability to view run-time results data and hydraulic schematics, including valves with internal spool motions, drawn in real-time.

The ability to generate hydraulics and I/O signal faults enables the study of the functionality of machine control systems in situations which are impossible to perform in real machines. Verifying the performance and safety of your equipment is of paramount importance.



MEVEA I/O TOOLBOX

CONNECT YOUR MACHINE CONTROL SYSTEM

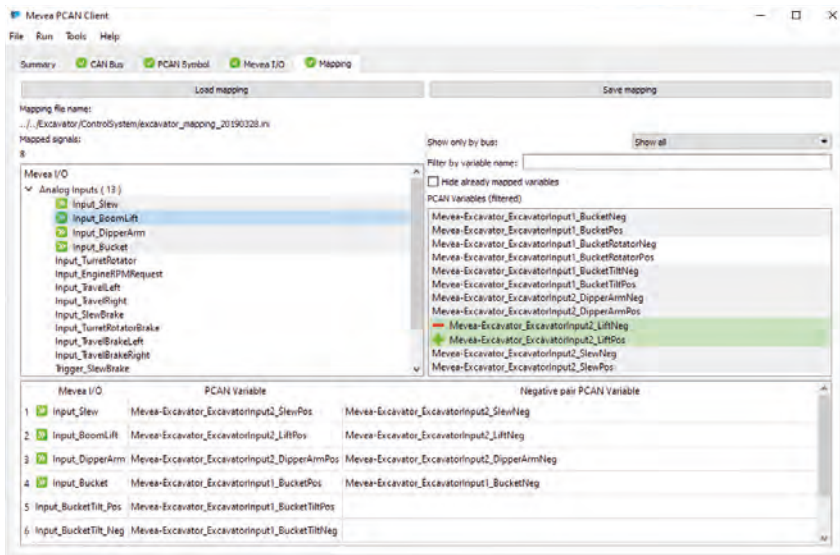
One of the greatest advantages of real-time simulation is the possibility to connect the Digital Twin with a real machine control system.

Mevea I/O Toolbox offers possibilities to systematically connect to physical CAN or CANOpen bus' or using a socket connection to a PLC.

- Asynchronous method for data transfer between Mevea Solver and separate software or hardware
- Real controllers, machine control systems and other hardware in-loop
- Support for large amount of inputs and outputs

Mevea has also implemented the use of PLCs as a bridge between socket connection and different bus approaches to connect for example Profibus based control systems.

If the I/O interface requires measurement of physical control signals like a voltage, current or PWM, the PLC based approach also operates in this case and can be used to produce a large variation of sensor signals, like voltages and pulse signals, to be connected to a physical ECU.



MEVEA INTERFACES

SEAMLESS INTEGRATION WITH YOUR EXISTING TOOLS

Mevea Software API and other interfaces enable several possibilities to connect to your existing development environment.

Using Mevea CAD interface, numerical information related to dynamics simulation and visualisation graphics for real-time visualisation can be produced directly from your CAD software like PTC Creo.

Mevea physics simulation can be visualised via various graphics engines like Unity via Mevea Unity API.

Unity assets add possibilities to implement high-level visualisation graphics and to use your Digital Twin for training and marketing purposes. Mevea Unity visualisation supports our realistic deformable soil behaviour.

Mevea ROS and ROS2 interfaces enable the fluent use of ROS/ROS2 development platforms with predefined Mevea sensor assemblies, such as IMU, odometer, GPS, camera and LiDAR.

Co-simulation based on Functional Mock-up Interface (FMI) standard or Mevea direct interfaces e.g. for MATLAB / Simulink enable the development of sub models with your existing tools.

C++, C# and Python interfaces enable various connections such as direct access to Mevea I/O interface to communicate with sensors and inputs from external systems.

TYPICAL USE CASES AND BUSINESS BENEFITS

Mevea Digital Twins can be used throughout the product lifecycle in:

Product Development:

- Product concept validation
- Virtual prototyping with fully functioning virtual products
- Autonomous system development including AI algorithm testing and learning data generation
- Co-development with customers

Manufacturing:

- Virtual preparation for Factory Acceptance Tests

Sales / Marketing:

- Experience-based marketing and sales
- Virtual product demonstrations

Training

- Training of all stakeholders from operators / supervisors to service personnel of traditionally, remotely, and autonomously operated systems

Product in Operation

- Operation optimization and performance analysis
- Problem detection and solving
- Product upgrade and modernization planning

Typical benefits gained by Mevea customers include:

50 %

decrease in physical prototyping cost

30 %

reduction in development lead time

10 %

increase in deal value

25 %

increase in operator efficiency



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sales@mevea.com

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