What’s new in UM 7.0

Universal Mechanism Software
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New features and possibilities of Universal Mechanism 7.0 are considered in the present paper.

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Windows 7 compatibility.
Service of automatic update of components of program package Universal Mechanism is now available.
Automatic bug report sending tool was added.

Program package Universal Mechanism includes a specialized module **UM Driveline**, which contains force elements for simulation of drivelines e.g. in road, tracked, rail vehicles and other mechanical systems.

The following elements are available in the module:
- Mechanical rotation converter with a constant ratio;
- Simplified model of a planetary drive;
- Fluid coupling;
- Hydraulic torque converter;
- Hydrostatic drive;
- Differential;
- Internal combustion engine.

Tools for simulation of the car driveline are implemented, Sect. 12.8.

New features for generation of road roughness are implemented, in particular ISO 8608, Sect. 12.3.2.2.3.

Tools for simulation of main resistance forces are added:
- aerodynamic forces, Sect. 12.6.1;
- tire rolling resistance, Sect. 12.6.2.

A new test type ‘Simulator’ is added. The test allows the user to evaluate UM ability in the field of real-time simulation of cars taking into account main car elements like engine, throttle, gearbox, clutch, braking system, Sect. 12.8.3.8.

UM COM server now includes interfaces, which methods can be applied to development of car simulators based of UM car models.
IComCar and IComICEngine interfaces have been developed. The interfaces are intended for development of real time car simulators.

UM Loco/Ride Comfort

UM 7.0 now supports new functionals to quickly estimate ride comfort based on obtained acceleration time histories with the help of built-in tool. Special tool considers comfort estimation based on UIC 513\(^1\) and Sperling Index\(^2\).


UM Vehicle-Bridge Interaction

A module for simulation of combined vehicle-bridge interaction is developed. The railway bridge is considered as a flexible multibody system. The dynamics of flexible bodies are simulated using data imported from finite element analysis (FEA) software. An application of the approach to the investigation of dynamics of a railway vehicle and a bridge supposes taking into account the flexibility of the bridge.

UM VBI considers bridges under train motion along them. The main object of investigations can be both a bridge and a railway vehicle. As for bridges, purposes of researches could be the detection of resonance phenomena on railway bridges, dangerous operation conditions such as train speed and weight, specific bridge design and so on. As for high speed trains, a dynamic analysis is necessary because of resonance phenomena of the structures due to regularly spaced axle groups of the
train. In the case of resonance, excessive bridge deck vibration can cause loss of wheel/rail contact, destabilization of the ballast and exceedance of the stress limits.

Analysis of the dynamics of the railway bridge and time histories of stresses and strains are required for the calculation of their durability. In this case, stress loading blocks are the results of dynamic simulation. These blocks are calculated based on time histories of bridge stresses obtained for selected modes of loading. The loading depends on the weight and speed of rail vehicles, track irregularities on the bridge and so on.

As for railway vehicle dynamics, it is important to consider the additional flexibility of the bridge in both vertical and lateral dynamics on safety, stability and ride comfort.

UM Control / Block Editor

Starting from UM YM 7.0 UM Control module includes the new Block Editor tool. Block Editor is a standalone application designed to describe the structural schemes using basic functional elements. In fact, Block Editor is an analog of the Simulink tools from Matlab / Simulink software package. Schemes developed in Block Editor and in the Matlab / Simulink software are connected to Universal Mechanism exactly in the same way. In this sense, the Block Editor and Matlab Import are functional analogs with very similar methods of description of block diagrams and connection to the dynamic model in Universal Mechanism software.

Let us consider the differences between Block Editor and Matlab Import tools. First, this is difference in licensing. Matlab Import needs installed on your computer Matlab / Simulink, which is not included in Universal Mechanism software and should be licensed separately, which gives separate expenses. Block Editor tool includes both the tool for
development of structural schemes and the interface of their connections to UM models. Purchase additional software, in this case, is not required.

Secondly, exporting structural schemes developed in Matlab / Simulink to Universal Mechanism using the Matlab Import tool requires compiling the source code for C / C++ with an external compiler, which also need to be purchased separately. Moreover, different versions of Matlab / Simulink support different versions of external compilers, that in practice gives additional difficulties and confusions. In the most cases Microsoft Visual C can be used as an external compiler. Recent versions of Matlab support free Microsoft Visual C Express.

However, the built-in Block Editor is significantly limited compared with the possibilities of Matlab / Simulink. Block Editor supports basic and widely used types of elements and its capacity will be sufficient for most applications. However, the Block Editor has no analogues of many Simulink libraries, such as the library of neural networks, fuzzy logic, etc.

Block Editor can be recommended for beginners and for simulation relatively simple structural schemes. Matlab Import tool can be recommended, first, in those situations where the opportunities of the build-in Block Editor is not enough, and, secondly, for professional users of Matlab / Simulink.

UM Control / Matlab Import

UM Control / Matlab Import in UM 7.0 now supports Matlab R2009-2012 releases.
Calculation of scanning project in UM 7.0 is optimized for multi-core processors. Architecture of such multi-core processors makes parallel running of several solvers to be very effective. It reduces CPU time almost proportionally. Now parallel computing is available not only based on UM Cluster solution for running scanning project on several computers of the local network but also for running scanning projects locally.
UM 7.0 includes completely new service of distributed calculations (UM Cluster). Service of distributed calculations runs dozens of numerical experiments of the scanning project simultaneously on other computers that are available in your local or corporate network or Internet. It significantly decreases total time of completion the project. Service of distributed calculations consists of client and server parts. There might be arbitrary number of computer with installed UM client and/or server parts.

Please find some basic improvements below.

- There is a built in tool to determine all computers in your local network that simplify initial procedures of searching and adding the client computer.
- Remote install and uninstall of the client parts on client computers are supported. Remote installation runs automatically without disturbing remote users.
- UM Cluster now supports remote turning on and off client computers.
- Cluster Server now supports multiple scanning projects running on the computer.
- Now several cluster servers can correctly work in the local network using the same client computers simultaneously. Every client computer can answer inquiries of several cluster servers.