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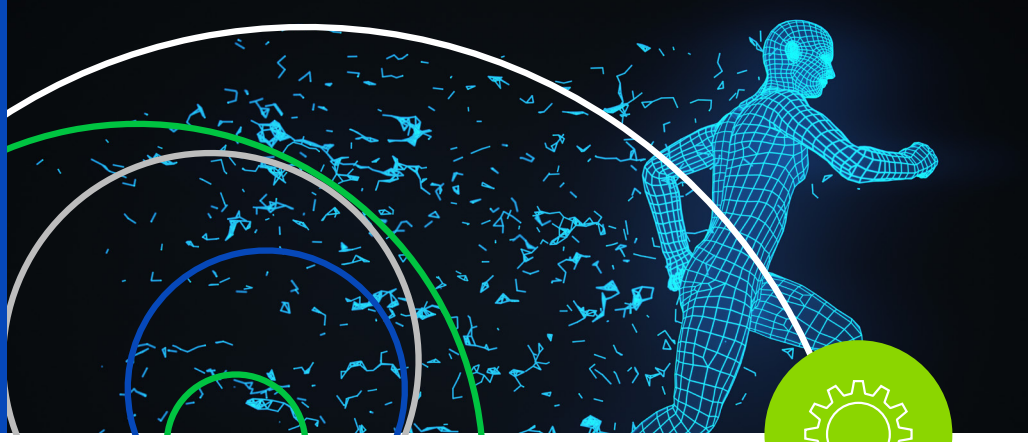

Project Results

MOSIM

Reducing the effort of human motion simulation

The ITEA project MOSIM (End-to-end Digital Integration based on Modular Simulation of Natural Human Motions) envisioned an open, modular framework for the interactive simulation and analysis of human motion. This can be used for professional applications in various fields.

Many domains can benefit from the realistic prediction of human behaviour. Factories, for instance, could improve working conditions for employees while optimising their operations. However, increasingly complex motion simulation currently requires the combination of heterogenous tools which focus on one area of the workflow, resulting in significant manual efforts for end-users. Modularisation via a single framework is a crucial step to increase the efficiency and uptake of human simulation across multiple markets.

MOSIM is part of a long-standing simulation strategy within ITEA and builds on previous successful projects (such as MODELISAR, AVANTI and ENTOC) with the co-simulation of human models from different environments. No universal framework previously existed for this. MOSIM has achieved this via Motion Model Units (MMUs), which serve as standardised interfaces for integration and were inspired by the Functional Mock-up Interface (FMI) standard. This framework and a number of tools/services have also been made open source, helping to further the project's reach beyond its original scope.

Technology applied

MOSIM's main technological focus has been a framework for natural human movement simulation for professional applications. This enables modularisation via the aforementioned MMUs, which are sets of movement that have been parameterised to adapt to their environment. The project distinguishes between basic MMUs, which are open source, and advanced MMUs that are used internally by the consortium. In addition, a pipeline has been developed using motion capture to create further advanced MMUs that are individualised to specific environments.

At the heart of the framework (and the project itself) is the MOSIM Core, which includes co-simulation and a Motion Model Interface (MMI) launcher. These tools and services homogenise different models into one simulation and can be used directly or in combination with a built-in task editor and/or AJAN reasoning engine. The latter two services provide automatic model generation, which the consortium aims to extend in the future. The innovations in this section of the architecture are all open source and can be found on GitHub (https://github.com/Daimler/MOSIM_Core). They ultimately form the bridge between MMUs and the target engine for integration in professional applications, which has been demonstrated with gaming engines Unity and Unreal and an internal tool by IPS AB.

Four industrial use-cases have also demonstrated MOSIM's potential, three of which focus on manufacturing: wood processing, car manufacturing and workplace optimisation. The final demonstrator is autonomous driving, which requires functionality simulations in realistic environments. Whereas pedestrian models once had to be programmed in a time-consuming manner, they can now be randomised to improve the overall quality of the simulation. This versatility is a key strength of MOSIM and will allow it to be expanded into domains like healthcare, construction and gaming.

Example for the automotive industry: MOSIM enables the automatic simulation of manual assembly processes.

Making the difference

At an individual level, MOSIM offers the opportunity to improve workplaces via human simulation. Before setting up a factory, for example, organisations can

carry out a virtual examination to ensure greater safety and ergonomics for their employees. Better working conditions lead to improved productivity, but the project has also demonstrated tangible results simply by moving away from manual simulation: by integrating the MOSIM framework into their systems, companies can expect human simulation creation time to drop by up to 80% compared to manual creation. Despite starting from scratch, MOSIM has so far created 13 basic MMUs, nine advanced MMUs and six tools/plugins.

For companies outside of the consortium, all of which can access MOSIM's open-source framework and services, the biggest advantage is early access to a completely new concept that will enhance the wider field of simulation. By reducing the manual efforts of modelling, for instance, the project can push down costs for companies of all sizes; new markets will also be opened up through the combination of formerly separate domains like manufacturing and gaming. The open-source nature of MOSIM is particularly beneficial for SMEs, which can now access such areas without the need for expensive proprietary solutions. For example the SME in2sight, which is currently integrating the MOSIM framework into their software game4automation.
The first steps to commercialisation are now beginning, such as Daimler's integration of walking simulations to improve their factory operations or TWT's integration of the framework into their Tronis solution.

Now at the end of the project, MOSIM is disseminating its results to a wider audience. In addition to 48 conference/journal publications, 11 theses and one book publication, work has been carried out to make MMI a standard under Modelica. As the project was based on the FMI standard, the consortium believes that interaction between FMI and an MMI standard will greatly benefit the simulation domain. Additionally, the ITEA project AIToc will further their work on automatic model generation by combining production equipment simulation with human simulation in one tool.

Major project outcomes

Dissemination

- 6 publication in books, journals or magazines (e.g. Springer Journal, ITEA magazine)
- 42 presentations at conferences (e.g. CARV2020, SIGGRAPH 2021, CIRP Conference on Manufacturing Systems)
- 8 Bachelor or Master theses and 3 PhD theses (one finalised, two in preparation)

Exploitation (so far)

- Main results are open source:
  - MOSIM Framework Core at https://github.com/Daimler/MOSIM_Core
  - MOSIM Tools at https://github.com/Daimler/MOSIM_Tools
  - MOSIM Task Editor at https://github.com/Lappeenranta-University-of-Technology/mosim-task-editor-server
  - AJAN Unity Integration at https://github.com/aantakli/AJAN-unity
  - AJAN Service at https://github.com/aantakli/AJAN-service
  - AJAN Editor at https://github.com/aantakli/AJAN-editor
  - Described process chain to create MMUs (Motion Model Units) from motion capture takes
- Several integrations of the MOSIM components in commercial tools of partners (e.g. IPS, MEVEA, proIscout3D, TRONIS)

Standardisation

- Several meetings with Modelica Association (https://modelica.org/) to prepare the standardisation of a Motion Model Interface (MMI)
- MOSIM is listed as an external project (https://modelica.org/external-projects.html) and the Motion Model Interface is a potential candidate for future standardisation

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MOSIM

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Partners

Austria

- Sign Time GmbH

Finland

- Dark Amber Softworks
- Kesla Oy
- Lappeenranta University of Technology
- Mevea Ltd
- Raute Corporation

Germany

- Daimler AG
- Daimler Buses - EvoBus GmbH
- Daimler Protics GmbH
- DFKI German Research Center for Artificial Intelligence
- ESI Software Germany GmbH
- Human Solutions GmbH
- Mimic Productions
- TWT GmbH Science & Innovation
- Siegen University

Sweden

- Fraunhofer - Chalmers Research Centre for Industrial Mathematics
- Industrial Path Solutions Sweden AB
- Scania
- Solme AB
- University of Skövde
- Virtual Manufacturing Sweden AB
- Volvo Trucks Corporation

Project start

November 2018

Project end

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Project leader

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