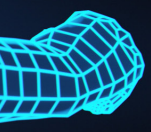
Success story

MOSIM



Revolutionising human motion simulation for industry

Whether in factory floors, ergonomics research, or autonomous driving simulations, the need for precise and adaptable human motion modelling has grown exponentially. This provides clear benefits: factories, for instance, could improve working conditions for employees while optimising their operations. However, traditional motion simulation approaches require multiple heterogeneous tools, each focusing on a specific aspect of the workflow. This fragmentation leads to inefficiencies, requiring significant manual intervention and limiting the broader adoption of digital human simulation.

Recognising these challenges, the ITEA project MOSIM gathered 22 partners from four countries to co-develop an open, modular framework for interactive human motion simulation. This enabled co-simulation of human models in different environments. MOSIM became part of a long-standing simulation strategy within ITEA and was founded on previous successful projects (MODELISAR, AVANTI and ENTOC). By unifying disparate simulation tools into a single, standardised ecosystem, MOSIM drastically simplified the process of human motion modelling, paving the way for more effective and widespread use of simulation technologies across various industries.

Project start
November 2018

Project end
November 2021

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More information
https://itea4.org/project/mosim.html

Integrating diverse models into a unified simulation
MOSIM introduced an innovative approach to motion simulation through Motion Model Units (MMUs). These MMUs, inspired by the Functional Mock-up Interface (FMI) standard, serve as modular components that can be easily integrated into different simulation environments. By distinguishing between basic MMUs (open source) and advanced MMUs (customised for specific applications), MOSIM enabled both accessibility and specialisation.
The key differences between MMUs and simple prerecorded motion data are their adaptability to the environment, very good generalisation capabilities, and interactive nature that allows them to modify the environment.

At the heart of the framework is the MOSIM Core, which provides essential functionalities such as co-simulation and the Motion Model Interface (MMI) launcher. This comprises tools and services that aim to homogenise different models into one simulation and can be used directly. In that case, the simulation actions are specified at a low functional level or in combination with a high-level task editor and/or AJAN reasoning engine, which offer automatic low-level model instruction generation based on high-level task descriptions and environment data. This enables the use of the same task description for concrete processes in different workspace scenarios, thereby enabling factory layout and worker level performance optimisation.

MOSIM's open-source architecture ensures that its benefits extend beyond the project consortium. By making core components available to the broader research and development community, the project has established a foundation for ongoing innovation and expansion into new domains such as healthcare, construction, and gaming.

Real-world applications

MOSIM's technological advancements have been validated through four industrial use cases, demonstrating its versatility and real-world impact. Three of these use cases focused on manufacturing, specifically wood processing, car manufacturing, and workplace optimisation, while the fourth targeted autonomous driving simulations:

- **Wood processing**: Planning safe walking paths around wood processing machinery requires a first-person viewing perspective to evaluate the accessibility and visibility of control elements, access hatches, process supervision, or space requirements for maintenance tasks. Ergonomics and safety can also be evaluated by checking if, for example, sufficient barriers are provided to separate humans from moving machine parts. Another use case is the preparation of training and safety instructions for end customers in the form of videos.
- **Automotive manufacturing and workplace optimisation**: The automotive industry has long relied on manual methods to design and validate assembly processes. With MOSIM, companies like Daimler Buses have been able to simulate manual assembly tasks efficiently, increasing efficiency. Furthermore, MOSIM enables organisations to conduct virtual assessments of factory layouts before they are physically constructed. This ensures optimal working conditions, reducing strain and injury risks for employees. In the meantime, Daimler Buses has developed a solution called pro|scout3D to semi-automatically simulate all walking paths in every station, which enables an increase in efficiency (partly up to 10%).
- **Autonomous driving simulations**: Autonomous driving simulations require functionalitysimulations in realistic environments. Whereas traditional pedestrian behaviour models require extensive programming effort, with MOSIM, they can now be customised and adapted dynamically, improving the overall quality and realism of the simulation. This also drastically reduces implementation time: previously, integrating an intelligent pedestrian into a scenario could take approximately one week per character. With MOSIM, the same task can be completed in just half a day per character, with minimal scaling costs, making it at least 10 times faster for a single pedestrian in a single scenario. Moreover, MOSIM allows for easy scalability, enabling multiple avatars to follow similar behaviour patterns with just a few clicks. When multiple pedestrians need to behave identically across various scenarios, the efficiency gain becomes even bigger.

By adopting MOSIM's framework, companies can expect up to an 80% reduction in the creation time for human motion simulation

While initially developed for manufacturing, MOSIM's framework has proven adaptable to other industries. For example, SMEs such as in2sight are integrating the framework into game4automation, demonstrating the project's potential beyond its original scope.

Huge reduction in creation time for human motion simulation

MOSIM's success is not just theoretical; it has delivered measurable results. By adopting MOSIM's framework, companies can expect up to an 80% reduction in the creation time for human motion simulation compared to manual processes. This drastic improvement translates into significant cost savings, faster product development cycles, and enhanced worker safety. Despite starting from scratch, MOSIM has so far created 23 basic MMUs, 10 advanced MMUs and 19 tools, plugins, and services.

The project's contributions have been widely recognised in the scientific and industrial communities. Discussions with the Industrial Digital Twin Association (IDTA) are ongoing to see how the results could be integrated into the Asset Administration Shell (AAS) standard.

In addition, MOSIM is already making its way into commercial applications. Daimler has started integrating MOSIM into its factory simulations, while TWT has incorporated the framework into its Tronis solution and DFKI has integrated MOSIM into the CARLA driving simulator. In addition, participation in MOSIM gave Finnish SME Dark Amber Softworks confidence to try to achieve greater and bigger things and the research they did during the project permeates the work they do every day; be it console games, virtual reality, digital heritage time machines, or learning environments. These early adopters demonstrate how MOSIM is transforming industrial workflows and setting a new standard for human motion simulation.

The next step for MOSIM was ensuring its widespread adoption and ongoing development. The award-winning follow-up ITEA project AIToC built upon MOSIM's foundation by integrating human and robotic simulation in a single environment. Finally, some of the MOSIM results are being used and further elaborated in the ongoing ITEA project ARTWORK.

By reducing the manual effort required for digital human modelling and fostering cross-industry collaboration, MOSIM has positioned itself as a game-changer in the world of motion simulation. Its open-source nature ensures that innovation will continue beyond the project's official timeline, benefiting industries and researchers for years to come.