

INDUSTRIAL APPLICATIONS OF NUMERICAL COMPUTING AND DIGITAL TWINS

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ABSTRACT

The invited session on Industrial applications of numerical computing and digital twins will highlight industrial applications where numerical computing technologies have been successfully implemented at the industry sector. As industries face growing demands for efficiency and digital integration, techniques like digital twins, predictive control systems, and reduced-order models (ROMs) are playing a critical role in optimizing processes, reducing downtime, and enabling real-time decision-making.

This session will explore the use of advanced simulation methods that provide detailed insights into complex systems and how standardization plays a vital role in enabling interoperability across industrial platforms. Specifically, Functional Mock-up Units (FMUs), designed to facilitate the exchange of simulation models, and OPC UA (Open Platform Communications Unified Architecture), a widely adopted machine-to-machine communication protocol, will be examined as essential elements in this process [1].

A key focus will be the use of reduced-order models (ROMs) for simplifying high-fidelity simulations while maintaining accuracy, allowing industries to perform faster, real-time analyses and apply predictive control systems. Recent innovations in ROMs have been demonstrated in the development of hybrid twin models, which combine physics-based approaches with data-driven insights for maximum accuracy in real-time applications [2]. These hybrid models enable industries to merge traditional simulation techniques with advanced data analytics, creating digital twins that are more accurate and adaptable.

This session will present industrial case studies where these technologies have been applied to create more efficient systems. Attendees will gain insights into best practices for implementing digital twin technologies and how numerical computing is shaping the future of industrial operations.

REFERENCES

- [1] OPC Foundation. OPC UnifiedArchitecture, Release 1.04,2017-2020. OPC10000-1/14; Link: <https://opcfoundation.org/about/opc-technologies/opc-ua/>
- [2] Ammar, A., Bensaada, M., Cueto, E., & Chinesta, F. (2024). Casting Hybrid Twin: Physics-based reduced order models enriched with data-driven models enabling the highest accuracy in real-time. *International Journal of Material Forming*, 17, 16.