SPECIAL SESSION PROPOSAL

The proposal should be submitted by October 1st 2024 to esrel-srae2025-program@uis.no.

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Title	Challenges and advancements towards trustful Digital Twins: uncertainty, automation, and AI.
Topic and/or industrial area of the special session (see the list at...)	Aeronautics and Aerospace Civil Engineering; Critical Infrastructures Cyber Physical Systems Manufacturing Maritime and Offshore Technology Natural Hazards Nuclear Industry Innovative Computing Technologies in Reliability and Safety Resilience Engineering Risk Assessment Uncertainty Analysis Artificial Intelligence, Machine Learning Decision Making Under Uncertainty Maintenance Modelling and Applications
Description of the subject	Digital Twin (DT) has seen significant interests in the dynamic modelling of complex engineering and physical systems. It allows prediction under critical situations difficult or impractical to be recreated in practice, through time-evolving combinations of physics-based and data-driven analytics. DT underpins intelligent automation by enabling dynamic asset-twin assimilation and real-time decision making.

Motivation of the proposal	The complexity and scale of complex systems towards automation necessitate the accounts for reliability and robustness. Challenges in relation to imprecision in the data, verification of computing, validation of simulation and assimilation with empirical data lead to the needs of computational models, as well as the resulting decision-makings, of DTs to be trustful and efficient. The prospects of DT can be improved by means of intelligent algorithms that take explicit account of uncertainties. With this said, AI and deep learning analytics offer great opportunities to real-time data assimilation, trustful modelling, data-driven decision making, and finally automation.
Objectives of the proposal	This special session aims to bring together experts from academia and industry on digital twinning in order to address the following challenges: • Computational cost (and stability in fact) to propagate uncertainty through a high-fidelity simulation: intrusive vs non-intrusive approaches. • Quantify the uncertainty in the simulation and model: how twin is the twin? • How to assimilate data from different sources and different quality and different representations into the model? • How to control the different fidelity levels of the digital twin in different tasks or analyses?
Peculiarities of the special session with respect to a regular session on the same topic and/or industrial area	There are no regular sessions and application areas in place about digital twin. This is an important and priority in academia and in industry.

Potential Contributors **(name, surname, affiliation and email)**	In ESREL 2022 we had 13 presentations and 10 presentations in 2023 in the sessions we run (we expect to attract even more contribution this year). A potential list is given below: Edoardo Patelli, University of Strathclyde, UK, edoardo.patelli@strath.ac.uk Marco de Angelis, University of Strathclyde, UK, marco.de-angelis@strath.ac.uk Sibo Cheng, Imperial College London, sibo.cheng@imperial.ac.uk Sifeng Bi, University of Southampton, UK, sifeng.bi@strath.ac.uk Michael Beer, Leibniz University Hannover, Germany, beer@irz.uni-hannover.de Matteo Broggi, Leibniz University Hannover, Germany, beer@irz.uni-hannover.de Matthias Faes, TU Dortmund University, Germany, matthias.faes@tu-dortmund.de Marcos Valdebenito, TU Dortmund University, Germany, marcos.valdebenito@tu-dortmund.de Ioanna Ioannou, University of Liverpool, UK, ioanna.ioannou@liverpool.ac.uk Scott Ferson, University of Liverpool, UK, ferson@liverpool.ac.uk Yu Chen, University of Liverpool, UK, yu.chen2@liverpool.ac.uk