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MODEL ORDER REDUCTION FOR COMPUTATIONAL MECHANICS IN MARINE APPLICATIONS

NICOLA DEMO[*], MARCO TEZZELE[†] AND GIANLUIGI ROZZA[*]

[*] International School for Advanced Studies,
Mathematics Area, mathLab, I-34136, Trieste, Italy
nicola.demo@sissa.it - gianluigi.rozza@sissa.it

[†] Oden Institute for Computational Engineering and Sciences,
University of Texas at Austin, USA
marco.tezzele@austin.utexas.edu

ABSTRACT

Marine engineering applications present a wide range of complex problems that require efficient and reliable numerical methods. Model order reduction enables fast and accurate numerical studies such as sensitivity analysis, structural optimization [1], uncertainty quantification, inverse problem resolution, and decision-making for structural digital twins [2]. Despite the progress being made in the last decade, still many challenges remain open: how to efficiently integrate deep learning models and structure-preserving reduced order methods, or how to account for the human in the loop for surrogate-based optimization, optimal control, and decision-making. Moreover, we are in a large-scale scenario where computational performance, visualization, and real-time computing represent a challenge.

This invited session aims to bring together experts in model order reduction, uncertainty quantification, artificial intelligence, and digital twins to devise new integrated solutions for marine applications. We encourage contributions regarding, but not limited to, surrogate-based design optimization, reduced order modeling for uncertainty quantification and inverse problems, parameter space reduction, multi-fidelity methods, and scientific machine learning.

REFERENCES

[1] M. Tezzele, L. Fabris, M. Sidari, M. Sicchiero, and G. Rozza, “A multi-fidelity approach coupling parameter space reduction and non-intrusive POD with application to structural optimization of passenger ship hulls,” International Journal for Numerical Methods in Engineering, vol. 124, no. 5, pp. 1193–1210, 2023. DOI: 10.1002/nme.7159

[2] M. Torzoni, M. Tezzele, S. Mariani, A. Manzoni, and K. E. Willcox, “A digital twin framework for civil engineering structures,” Computer Methods in Applied Mechanics and Engineering, vol. 418, p. 116 584, 2024. DOI: 10.1016/j.cma.2023.116584