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STRUCTURE-PRESERVING DISCRETIZATION OF COUPLED PROBLEMS

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ABSTRACT

The design of structure-preserving numerical methods for coupled problems has become an increasingly attractive research field in recent years. Structure-preserving schemes come with the promise of enhanced numerical stability and robustness. They can be viewed as an extension to coupled dissipative systems of conserving schemes which were previously developed in the context of conservative Hamiltonian systems with symmetry. The coupling of several fields makes the design of structure-preserving schemes particularly demanding. On the other hand, the interaction of different fields may cause numerical instabilities when applying standard discretization techniques. Structure-preserving methods have the potential to correctly reproduce coupling effects in the discrete setting and are thus less prone to numerical instabilities.

The discretization in space and time of coupled problems is strongly affected by the way in which the underlying field equations are written, including the choice of variables. The structure of the underlying balance laws is built into specific descriptions such as GENERIC [1] or the port-Hamiltonian formulation [2] which thus might be of advantage for the design of structure-preserving schemes.

The present Invited Session aims at bringing together researchers from different fields dealing with the design of structure-preserving discretization methods for coupled problems. Applications may focus on both dissipative solids as well as fluids. Specific applications may deal with, among others, large-strain thermo-elasticity, electro-thermo-mechanics, magneto-thermo-mechanics, or complex fluids.

REFERENCES

[1] Schiebl M., Betsch P., *Structure-preserving space-time discretization of large-strain thermo-viscoelasticity in the framework of GENERIC*, Int. J. Numer. Meth. Engng, Vol. 122 (14), 3448-3488, 2021.

[2] Brugnoli A., Rashad R., Stramigioli S., *Dual field structure-preserving discretization of port-Hamiltonian systems using finite element exterior calculus*, Journal of Computational Physics, Vol. 471, 111601, 2022.