Second International Conference Math 2 Product (M2P 2025)
Emerging Technologies in Computational Science
for Industry, Sustainability and Innovation
June 4th -6yh, 2025, Valencia, Spain

FAST SOLVERS FOR WAVES WITH TECHNOLOGICAL AND ENGINEERING APPLICATIONS

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ABSTRACT

Waves are omnipresent in our environment and take different forms depending on the physical and application contexts, such as with acoustic waves for harnessing sound propagation, aeroacoustic waves for monitoring noise generation, elastodynamic waves for discovering natural resources, and electromagnetic waves, e.g., radiofrequency waves for designing communication systems or optical waves for shaping light-matter interactions. From the numerical modelling point of view, all these examples share a number of features that often represent challenges for developing accurate and efficient numerical methods applicable to realistic technological and engineering applications such as full waveform inversion for the reconstruction of complex geological media or inverse design of planar optical devices for imaging systems. The propagation medium is very often heterogeneous with material characteristics that can be anisotropic, dispersive, nonlinear, etc. In most of the situations of practical interest, the simulation domain involves irregularly shaped domains or structures, possibly with geometrical singularities. Finally, the underlying wave-matter interaction problems can exhibit multiple spatial, temporal or spectral scales. In the last 30 years, many types of discretization methods have been devised for the PDE models of these problems, with an emphasis on high order methods devised on geometry-conforming meshes. These methods are in general capable of handling the previously-mentioned modelling challenges with a sufficiently high fidelity, however they are also computationally expensive. This invited session aims to address this issue with contributions on topics ranging from, but not limited to, reduced-order modelling, physics-based machine learning, neural PDE solvers. Topics covering both methodology development and technological or engineering applications are welcome.