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PHYSICS-BASED AND DATA-DRIVEN HYBRID MODELLING OF MATERIALS AND THEIR PROCESSING

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ABSTRACT

Physics aware digital twins of materials, processes, components and systems enable emulating real assets while ensuring fidelity and efficiency. They embrace physics-based and data-driven functionalities, both enriching mutually. Both should proceed in almost real-time, and the last being able to proceed in the scarce data limit.

When applied to materials and processes, model order reduction technologies enable the construction of the so-called surrogate model, whereas data-driven modelling, based in advanced machine learning and artificial intelligence technologies, must be informed by the physics to encompass rapidity and accuracy, in the low data limit.

This hybrid approach allows improving accuracy of existing models, as well as constructing models when the existing ones remains too poor or uncertain. Moreover, this setting allows to speed-up predictions, enabling real-time control, decision-making as well as the exploration of the whole design space, crucial in the design of materials and components.