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MINI-SYMPOSIUM

Data-driven computational mechanics

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In their first centuries, scientific and engineering developments were dominated by empirical understanding, the first paradigm of scientific discovery. After, the scientific revolution and the development of calculus led to a new scientific viewpoint whereby physical principles, laws of nature, and engineering models were established by proposing new theoretical constructs that could be verified through specific experiments. This was the second paradigm of scientific discovery. More recently, the computational era, or the third paradigm of discovery, has allowed us to solve complex and nonlinear scientific and engineering problems. Today, there is a new fourth paradigm of discovery, which is a data-driven science and engineering framework whereby complex models and physical laws are directly inferred from data.

Many fields already have started to capitalize on such methods, developing algorithms for fuzzy relations, leading to data-driven decision making in many fields by constructing purely computational predictive analytics. The engineering sciences are now poised to also take advantage of data-driven methods in obtaining physical principles and models which yield reliable laws and accurate predictions, using fewer hypotheses and fewer analytical relations and balancing the parametrization of physical models with the amount of available measurements.

The purpose of this symposium is to explore the different computational complex algorithms and methodological themes, among them (i) data-mining; (ii) manifold learning and nonlinear dimensionality reduction; (iii) model learners and data-drive, computational mechanics and engineering and (iv) engineered data (from big-data to smart-data), as a sort of multi-scale description of data inspired from the multi-scale description of mechanics (atomic / kinetic theory / thermo-mechanics).