Model reduction for decision-making in simulation-based engineering: real-time, inverse and optimization in real engineering problems

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Computational Mechanics tools are well integrated in the technological practice. However, the global effort (pre-process, solve and post-process) is a major overhead for real engineering problems. Thus, simulation-based engineering are not extensively used in **real-time** for decision-making. **Real-time** (fast-queries) is critical for control of manufacturing processes, non-destructive-testing and fast decision-making at production phases. This is also the case for multiple-queries: **optimization** and **parameter identification**. These problems are pivotal for exploring the large parametric spaces; that is, for solving a large number of problems selected among a parametric family. Addressing multiple-queries in an efficient and reasonably accurate manner is crucial in some applications. The actual bottleneck lies in the computational effort to be furnished in solving each of the queries with the desired accuracy.

This presentation aims at presenting novel approaches in simulation-based engineering for fast and multiple-queries in real problems. The Proper Generalized Decomposition is extended to solve two engineering applications: automated tape placement (ATP) for thermoplastic composites parts in aerospace and automobile industry (left figure), and analysis of wave agitation induced by the incoming sea state in harbors (right figure).