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High-performance Coupled Simulations Based on Partitioned Approach

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Target phenomena of computational mechanics have become more complex, i.e. multi-physics and multi-scale. Typical multi-physics phenomena include fluid-structure interaction, fluid-thermal-structure interaction, magneto-structure interaction, soil-structure interaction and so on. To perform those simulations on high performance computers ranging from PC clusters to the K-computer in a flexible and efficient way, we have been developing a parallel coupled simulation platform. A basic strategy of our research is to employ partitioned iterative coupling algorithms for combining existing parallel solvers developed for single physics phenomenon. In this lecture, we first briefly review past coupled analysis approaches, and then describe theories, algorithms and software implementation of the developed platform, and finally show several practical applications with verification and validation, i.e. (1) Acoustic-fluid structure interaction (AFSI) of a seismic response of nuclear fuel assembly embedded in fluid, (2) fluid-structure interaction (FSI) of elastic flapping wing, and (3) Magneto-structural coupling vibration of magnetic resonance imaging (MRI) device.