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Local Stiffness Matrix Calculations for FSI Applications on multi-GPU Systems

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Abstract

Numerical simulations of systems are often modeled using Partial Differential Equations (PDEs). This involves the construction and solution of systems of linear or nonlinear equations that arise from the discretization of the underlying PDEs by means of the Finite Element Method (FEM). Recently, the construction of the system of equations has attracted the attention of researchers, with several efforts concerning GPU implementations [1, 2, 3, 4]. Our interest is in fluid-structure interaction simulations (FSI) of next generation wind turbine blades in which local stiffness matrices must be calculated anew at each timestep. We recently presented results with a code in which the stiffness matrix is constructed on a single GPU [5]. Since this is the second most time consuming segment of the simulation, the overall performance gain was significant. As there is demand for more realistic simulations, we are currently concerned with implementations on GPU clusters, involving MPI and CUDA. In this presentation we discuss the main features of our parallelization strategy and the steps taken to obtain high performance.

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