GPU computation of the isogeometric collocation matrix

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ABSTRACT

Isogeometric collocation was introduced as a viable alternative to the Galerkin formulation in isogeometric analysis. Collocation is less accurate than the Galerkin method per degree of freedom leading to a significantly larger systems of equations in order to achieve the same accuracy. While solving the resulting system of linear equations takes a larger portion of the computing time, both the formulation of the stiffness matrix and the solution of equations can benefit from domain decomposition techniques, efficient preconditioning, CPU and graphics processor unit (GPU) parallel solvers. In this work the inherent parallelization features of the method during the assembly of the matrix are investigated and an implementation methodology is presented for assembling the stiffness matrix in the massively parallel computing environment of the GPU utilizing its resources in the most efficient way to drastically accelerate computations. The collocation is parallelizable with virtually no need for synchronization and race conditions which typically present a limiting factor in the parallelism level of a method, making it especially suitable for the GPU architecture. Numerical examples are presented where the assembly time is lowered by orders of magnitude.

References:

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