Nested Domain Decomposition to solve contact problems within the Cartesian grid Finite Element Method

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ABSTRACT

The main advantage of the Cartesian grid based methods, like the Cartesian grid Finite Element Method [1], is that the meshing process becomes simple and fast, with the corresponding reduction in the whole analysis time cost.

In this method a hierarchic structure of Cartesian grids is assigned to each body in the analysis. With this hierarchic structure of the mesh it is straightforward to obtain a Nested Domain Decomposition structure, where each level of decomposition corresponds to a Cartesian grid level. Direct methods to solve the corresponding linear system of equations can take advantage of this nested structure, both in a sequential and in a parallel computer environment [2].

The solution is obtained computing the Cholesky factorization of some diagonal blocks of the coefficient matrix of the finest Cartesian level. Then some linear systems whose right hand side is a non-diagonal block, and with coefficient matrix the corresponding Cholesky factor are solved, and the Schur complement of the rest of diagonal blocks are computed and factorized. This process is done through the different levels of the nested structure.

We present numerical results of this approach on some benchmark problems and it is compared with other strategies.

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