A parallel coupled algorithm for the solution of deformable two-body contact problem

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Abstract- *This work presents a parallel iterative method for numerical solving frictionless contact problem for two elastic bodies. Each iterative step consists of a Dirichlet problem for the one body and a Neumann problem for the other in order to enforce the contact boundary conditions.*

I. Introduction

Contact problems deal with the deformation of separate bodies which interact when they come in touch. They take an important place in computational mechanics. Usually, they are formulated as constrained minimization problems which may be solved using optimization techniques such as penalty method, Lagrange multipliers, augmented Lagrangian method, etc [1]. When using an implicit scheme, this approach requires the construction of the so-called contact elements, which incorporate the contact constraints in the global weak form. In most cases, the use of contact elements requires the update of the mesh graph in a fixed number of time steps. On the other hand, some of the optimization techniques increase the number of degrees of freedom in the problem, by introducing Lagrange multipliers as unknowns [2].

II. Model

Domain decomposition techniques provide a powerful tool for the numerical approximation of partial differential equations [3]. Based on these techniques, we introduce an HPC-based algorithm for the numerical solution of a nonlinear contact problem between two deformable bodies. In this algorithm there are no contact elements involved and there is no need to increase the degrees of freedom of the problem. The boundary data transfer at the contact zone and the parallel implementation are the main aspect of this algorithm. We perform a two-way coupling, where in each step we solve a boundary value problem for one body using the boundary condition at the contact zone imposed by the second body. This boundary condition will be Dirichlet or Neumann. The algorithm is implemented in HPC machines and runs using several processors.

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