Mortar discretization for dynamical thermomechanical contact problems with friction

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The numerical simulation of dynamical nonlinear contact problems with friction plays an important role for a wide range of technical appplications. For such problems, non-conforming domain decomposition techniques such as mortar methods provide a powerful and flexible tool. In this talk we present the formulation and the discretization of such type of problems with the mortar approach. To solve the arising nonlinear equations we use primal-dual active set strategies which can be interpreted as a semi-smooth Newton method. We focus on the treatment of Coulomb friction in the three-dimensional case and investigate a full Newton method which shows a superior convergence behavior in contrast to the widely used fixed point approach. To avoid the spurious oscillations in the Lagrange multiplier modeling the contact stresses over time, we use a modified mass matrix. This matrix results from a different integration formula on the elements near the possible contact zone. Furthermore, we extend this approach to the case where thermo-mechanical effects are involved. We especially consider the formulation, the discretization and algorithmic aspects of dynamical thermomechanical effects such as frictional heating and thermal softening at the contact interface. In addition we focus on the Robin-type interface condition for the heat and its treatment by the mortar method.To solve the arising nonlinear conditions at the contact interface we extend semi-smooth Newton methods for the purely mechanical problem to the thermo-dynamical case.In the last part we consider the extension of the primal-dual active set method to the case of large deformation contact problems. Numerical examples both in the two-dimensional and the three-dimensional setting illustrate the flexibility, robustness and efficiency of the proposed algorithms.

References:

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