Efficient numerical methods for the large-scale parallel solution of thermomechanical contact problems under consideration of mesh separation

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Our talk will treat two topics which will be joined in a model with the aim to simulate a deep hole drilling process. First we introduce a thermomechanical problem which describes elasto-plastic deformations with hardening coupled with a heat equation. After a brief introduction of the model and the variational equations we propose an integrated set of computational methods based on the finite element method for the large-scale parallel solution. Some results for three dimensional examples will demonstrate the efficiency of this approach. To discretize our problem we use piecewise linear or quadratic ansatz functions on a h-adaptive refined mesh.

In the second part we present an intuitive way to handle mesh separation e.g. caused by the cutting edge of the drill using a Discontinuous Galerkin (DG) method and reasonable physical criteria for the separation along an edge of an element. To enforce continuity between the DG elements as well as the Dirichlet boundary conditions we apply a Nitsche method. Of course this approach leads to a bigger amount of unknowns compared to a continuous approach but which can be reduced by using the DG elements only in a specific area around the separation zone. Since we treat the contact conditions with a primal dual active set method we have to think about if it is admissible to use DG elements along the contact boundary without losing the biorthogonality property. Finally we present some first results and an outlook.

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