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ISOGEOMETRIC ANALYSIS AND THERMOMECHANICAL MORTAR CONTACT PROBLEMS

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In the present contribution we focus on variationally consistent discretisation techniques in space and time for fully coupled thermomechanical contact problems. The thermomechanical framework rests on the fundamental first law of thermodynamics, representing the global energy balance law. The second law is of constitutive nature, consistently represented in the definition of the constitutive laws. Stating that both laws have to be valid for the inner energy at the local contact area as well, we can derive the balance laws across the contact interface, see [1]. Additionally, we define a set of constitutive contact laws. In particular, Coulomb's friction law is considered in tangential direction, whereas the dissipated friction energy represents an energy source term for the thermal field, to be distributed on both surfaces. Eventually, pressure dependent conductivity terms at the interface have to be taken into account.

Within the framework of Isogeometric Analysis (IGA), a spline-based interpolation is considered. On the contact boundaries, the weak form of the arising interface terms are discretised as well, where we use the underlying discretisation within the Mortar integrals, see [2, 3]. A unified Mortar framework for both, Lagrangian as well as NURBS based shape functions is introduced, utilising linear shape functions for the Lagrange multiplier space. This approach leads to a simplified and fast Mortar framework for IGA. The mechanical field can then be dealt with in the usual fashion, including a Mortar based friction law in tangential direction, whereas newly developed triple Mortar integrals are introduced for the thermal field. This ensures a correct transfer of energy between the different fields. The introduced conduction and the frictional dissipation are constructed such that the interface terms obey the second law of thermodynamics for the semi-discrete system.

To summarise, a fully coupled, variationally consistent contact formulation for thermo-mechanical contact problems is considered and discretised in space using IGA and Mortar methods. The newly developed framework can be applied to a variety of applications.

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