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TRANSIENT THERMOMECHANICAL CONTACT PROBLEMS

Christian Hesch[1] & Maik Dittmann[2]

[1] Karlsruher Institute of Technology, 76131 Karlsruhe, Germany, christian.hesch@kit.edu
[2] University of Siegen, 57076 Siegen, Germany, maik.dittmann@uni-siegen.de

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Thermomechanical problems arise in a variety of applications. Here, we focus on large deformation contact problems within a consistent thermomechanical framework, which obey the first and the second law of thermodynamics. Postulating, that these fundamental laws have to be valid at the contact interface as well, we define a local Helmholz energy function, representing the energy balance law across the contact interface. This can be used to derive consistently the mechanical as well as the thermal contact balance laws, incorporating the constitutive friction contributions (Coulomb's friction law) in both fields. Additional constitutive laws to describe the contact heat flux, additively split into the frictional dissipation as well as the thermal conductivity terms, are taken into account.

Structure preserving time integration schemes have already successfully been adapted to frictionless contact problems. For frictional problems, we focus on the algorithmic conservation of total angular momentum, since this ensures a robust integration in time. A specific augmentation technique has been applied to standard Node-To-Segment (NTS) methods, to enforce algorithmically conservation of angular momentum, see [1]. It can be shown, that the subsequently applied Null-Space projection recovers the original NTS kinematic, whereas the discrete Null-Space counterpart conserves the mentioned balance laws. Finally, the consistent linearisation is extremely simplified.

In the context of Mortar methods, structure preserving energy-momentum schemes for frictionless contact can be established by using augmentation techniques as well, see [2]. For the frictional case, conservation of angular momentum crucially depends on the construction of the returnmapping scheme; here we consider several possibilities for the construction of the scheme. The frictional dissipated energy can be transfered consistently into the thermal field using triple Mortar integrals, which can be used for the pressure dependent thermal interaction law as well. The triple Mortar integrals can be considered as a straight forward extension of the original Mortar integrals and thus, we can reuse the technical framework for, e.g., the segmentation without modifications.

To conclude, a fully coupled, variationally consistent contact formulation for thermomechanical contact problems is considered and discretised in space with newly developed NTS and Mortar methods, whereas structure preserving time integration schemes are considered for the temporal discretisation.

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