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Thermomechanics Modeling of Two Solids in Contact: Application to Total Hip Arthroplasty

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Friction is one of the most classical dissipative phenomenon. The mechanical power dissipated by friction is transformed into heat. Yet the thermomechanics of contact between two deformable solids is underdeveloped in comparison to continuum mechanics. In this study, a two-body thermomechanical contact theory is proposed together with approximate numerical methods for solving the resulting problems. The study consists in four parts. First, the governing equations of thermomechanical contact problrms are derived from the thermodynamics principles. Second, the tribological laws of unilateral contact, friction and heat transfer across the interface are developed. Third, numerical methods are proposed: the finite element one for spatial discretization, an augmented Lagrangian method for treating the contact and friction constraints and a generalized Newton method for solving the non-linearities. Fourth, for illustration, the model is applied to thermomechanical problem of heat propagation subsequent to cement polymerization during a Total Hip Arthroplasty in orthopedics.

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