COUPLING THERMOMECHANICAL FRICTIONAL CONTACT WITH INTERFACIAL FLUID FLOW AT SMALL AND LARGE SCALES

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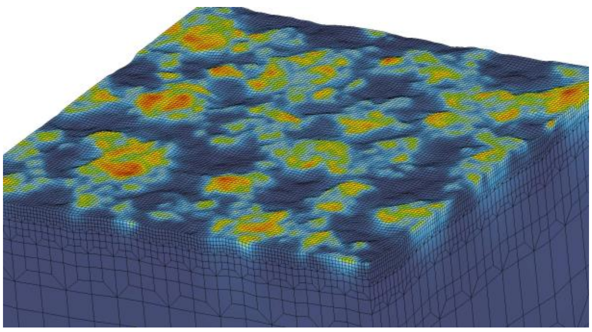

- Real natural and industrial surfaces are always rough
- Contact determines fluid flow and heat exchange in the interface
- Thermal and fluid pressure fields have impact on contact problem
- We develop monolithic coupling in the finite-element framework

Abstract:

Natural and industrial surfaces always have roughness under certain magnification, and the contact occurs on separate patches corresponding to asperities of the surfaces. The evolution of the real contact area under increasing external load determines essential contact properties and strongly affects heat and mass transport in and through contact interfaces. At the same time, solution of the contact problem in turn is influenced by fluid pressure and thermal fields. We develop a monolithic approach to incorporate this strong coupling in the finite-element framework. Taking into account roughness of contacting solids at micro scale enables us to construct new advanced models of the considered multi-physical processes at the macroscopic scale relevant for industrial applications. The implementation of the thermo-mechanical coupling for contact problem will allow us to simulate the heat production due to the frictional dissipation and the heat exchange between the contacting parts, permitting us to critically analyze existing macroscopic constitutive laws for the contact heat transfer. Industrial applications include aircraft and vehicle engines, brake systems, as well as large-scale problems like friction within geological faults and basal sliding of glaciers. The coupling between the fluid flow and the mechanical contact will enable us to work on problems of sealing and lubrication. The former one is essential for aeronautic, automotive and nuclear industries, and these applications demand generalization of the solution of the coupled problem at the microscopic scale for the macroscopic scale using the roughness-dependent leakage laws. The mixed lubrication is crucial for systems in which either relative sliding velocity between the components can be rather low (starting of rotation in gear boxes, bearings, turbines, etc.) or can reverse (e.g. in pistons), or the external pressure is sufficiently high (metal forming).