

## COMPUTATIONAL CONTACT HOMOGENIZATION TECHNIQUES

The ability to convey information across length and time scales is essential for a better understanding of the sources of physical behavior observed on higher scales. Employing hierarchical models of materials and interfaces, homogenization techniques constitute a class of robust tools that are suitable for this purpose. In this talk, computational contact homogenization techniques will be presented in the context of (i) inelastic granular interface models, and (ii) thermal contact conductance characterization.

Dry granular third bodies are frequently encountered at multiple scales of contact interfaces in contexts that range from mechanical problems of tire traction and semiconductor manufacturing to biological problems of wear debris generation and mobility in implant joints [1]. In this talk, the consequences of a viscoelastic contact boundary layer that sustains damage due to highly localized deformation in the vicinity of the particles will be discussed extensively within a fully nonlinear computational setting that accounts for incompressibility. The effective coefficient of friction that is induced by the homogenization methodology as the fundamental macroscale observable is found to be of a non-Amontons as well as a non-Coulomb type.

On the other hand, rough contact interface topographies are potential sources of large thermal energy dissipations within a variety of modern engineering applications ranging from micro-electromechanical systems and microprocessors to general microelectronics and electronic packaging. From an engineering point of view, the overall macroscopic reflection of the microscale physics at the interface is conveniently characterized within a continuum thermomechanics setting by a thermal contact conductance parameter [2]. In this talk, a method for deriving this parameter will be presented within a multiscale approach for the finite deformation regime where arbitrarily rough surface topographies can be accounted for.

The proposed analysis frameworks respect thermomechanical consistency through the scale transitions and are amenable to a multiscale implementation within a coupled micro-macro approach. In this sense, they form a suitable basis for the establishment of robust computational tools that are need for the investigation of similar heterogenous interfaces.

**Keywords:** computational mechanics, contact homogenization, granular media, effective coefficient of friction, rough surfaces, thermal contact conductance.

### References:

- [1] I. Temizer, P. Wriggers (2008): A Multiscale Contact Homogenization Technique for the Modeling of Third Bodies in the Contact Interface. *Comput. Methods Appl. Mech. Engrg.* 198:377-396.
- [2] P. Sadowski, S. Stupkiewicz (2009): A Model of Thermal Contact Conductance at High Real Contact Area Fractions. *Wear* (in press: doi:10.1016/j.wear.2009.06.040).

### Biographical Sketch:

Ilker Temizer received his B.S. degree (2001) from Bogazici University and his M.S. (2003) and Ph.D. (2005) degrees from the University of California, Berkeley in Mechanical Engineering. Subsequently, he joined the Institute of Continuum Mechanics at the Leibniz University of Hanover in Germany as a postdoctoral fellow, where he is working toward habilitation in addition to holding teaching and research responsibilities. His research interests are focused on the theoretical and numerical aspects of computational mechanics that are associated with multiscale-multiphysics modeling strategies for heterogeneous materials and interfaces.