Dynamic frictional sliding between elastically deformable plates

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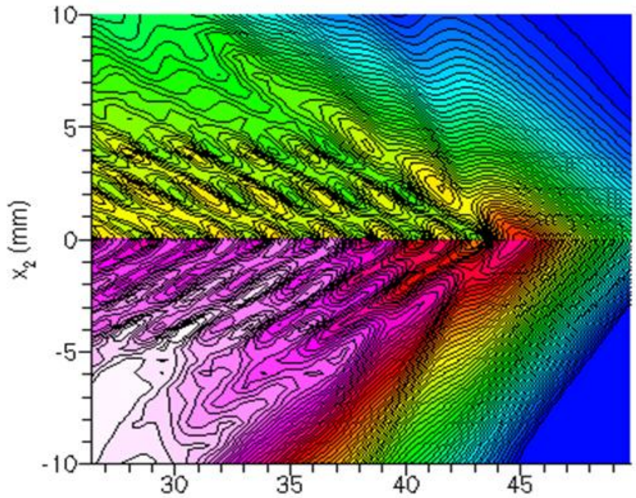

The phenomenon of frictional sliding between elastic materials is a dynamically and heterogeneously occurring phenomenon for both quasi-static and dynamic loading applications. The accurate prediction of the dynamics of frictional sliding requires the use of a realistic friction model and a method for modeling the propagation of discontinuities. In this presentation, finite element method is used to model the dynamic frictional sliding between two elastic plates with a straight and smooth interface where a rate- and state-dependent friction model is implemented within a cohesive element framework. The two plates are held together under a vertical compressive load and a horizontal impact velocity is imparted on the bottom plate. Simulations are carried out for varying compressive loads and impact velocities, using the parameters in the friction law obtained from experiments. The results show that relative sliding is a complex phenomenon, composed of three fundamental sliding modes: expanding crack-like, solitary growing self-healing pulses, and a train of steady self-healing pulses. A majority of the sliding consists of the evolution and combination of these three canonical modes with time and space. The rupture is found to propagate at speeds comparable to the speed of sound in the material, and in most cases super-shear speeds. Even though experimental observations of the first two modes of sliding have been shown by Rosakis and coworkers, the train of steady and stable self-healing slip pulses have so far eluded conclusive experimental confirmation.

Biography:

Dr. Demir Coker is an Assistant Professor at the Aerospace Engineering Department at the Middle East Technical University (METU) since 2009. He obtained his PhD degree in Aeronautics from California Institute of Technology in the area of dynamic failure of composites in 2001. He carried out post-doctoral research on computational modeling of friction and fracture at Brown University. He was an assistant professor at Oklahoma State University, Stillwater, Oklahoma before joining METU. He obtained his B.S. degree in Aerospace Engineering from METU and his M.S. degrees in Aerospace engineering from University of Dayton, and M.S. in Applied Mathematics from the Wright State University in Ohio. During his M.S. studies he was working as a research engineer at the Materials Laboratory, Wright Laboratories in Dayton, Ohio. His research interests include fatigue of composites, friction dynamics and tribology, dynamic fracture mechanics, experimental and computational mechanics, nanomechanics, delamination mechanics and composite materials.