Structural Engineering Seminar Series

CEE 595 S

Computational Fracture Mechanics Using the Phase Field Method

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Abstract:

The phase field method (PFM) has been widely adopted due to its ability to handle crack initiation/propagation, and complex crack topologies without the need for explicitly tracking fracture surfaces. I will discuss several advances in the PFM corresponding to brittle and ductile fracture. In the first part I will present a novel PFM for modeling bone fracture. While bone fracture injuries are common in the elder community and those who suffer from traumatic collisions, there are almost no validated computational methods that can accurately model these fractures. To this end, we have proposed a power-law relationship between bone mineral density and critical energy release rate. The PFM method, implemented on high performance computers, is used to quantitatively predict the complex 3D brittle fracture of the bone and is shown to be in good agreement with an in-vitro experiment.

The second part of the presentation will focus on dynamic fracture of metals that often result in brittle/ductile fracture, or shear localization, depending on loading rates, geometry and material type. I will present a temperature-dependent viscoplastic model coupled to the PFM that can simultaneously capture the different failure processes. Finally, I will discuss ways to reduce computational costs, and other ongoing efforts that employs the PFM.

Bio:

Haim Waisman is an Associate Professor of Civil Engineering and Engineering Mechanics at Columbia University. His research interests are in computational fracture mechanics, for which he develops advanced finite element methods for modeling and design-optimization of structures under extreme conditions. Dr. Waisman obtained his Bachelor and Master degrees in Aerospace Engineering from the Technion-Israel Institute of Technology, and a Doctorate in Civil Engineering from Rensselaer Polytechnic Institute in 2005. He was a post-doctoral fellow at the Scientific Computing Research Center (SCOREC) at RPI and at the Mechanical Engineering department at Northwestern University, before joining Columbia University in 2008. Dr. Waisman is the recipient of the 2012 Department of Energy Early Career Award, the 2014 Leonardo Da Vinci Award from the Engineering Mechanics Institute of ASCE, and several best paper awards. He is currently serving as an associate editor of the ASCE journal of Engineering Mechanics, the executive council US Association for Computational Mechanics, and is the past chair of the ASCE-EMI computational mechanics committee.

More information is available at: http://www.columbia.edu/cu/civileng/waisman/index.html

Monday, April 12th, 2021 4:00 – 5:00 p.m. (CDT)

Join us: https://go.cee.illinois.edu/Seminar-by-Dr-Waisman