VANDERBILT
School *of* Engineering

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

Friday,

October 31

1:30 pm

FGH 110

"NUCLEATION AND PROPAGATION OF FRACTURE IN VISCOELASTIC ELASTOMERS: A COMPLETE PHASE-FIELD THEORY"

DR. OSCAR LOPEZ-PAMIES

COLONEL HARRY F. &
FRANKIE M. LOVELL PROFESSOR
CIVIL & ENVIRONMENTAL ENGINEERING
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

ABSTRACT

In this talk, I will present a macroscopic theory, alongside its numerical implementation, aimed at describing, explaining, and predicting the nucleation and propagation of fracture in viscoelastic materials subjected to quasistatic loading conditions. The focus will be on polymers, in particular, on elastomers. To this end, I will start by summarizing the large body of experimental results on how elastomers deform, nucleate cracks, and propagate cracks when subjected to mechanical loads. Directly guided by these results I will then introduce the theory by extending the phase-field theory initiated by Kumar, Francfort, and Lopez-Pamies (J. Mech. Phys. Solids 112 (2018), 523--551) for elastic brittle materials to seamlessly incorporate the additional complexities of the dissipative and time-dependent deformation, strength, and toughness in viscoelastic elastomers. I will close by illustrating the descriptive and predictive capabilities of the theory via simulations of prototypical experiments dealing with nucleation of fracture in the bulk, nucleation of fracture from a pre-existing crack, and propagation of fracture in different types of elastomers under various types of loading conditions.

BIOGRAPHY

Oscar Lopez-Pamies is the Colonel Harry F. & Frankie M. Lovell Professor in the Department of Civil and Environmental Engineering at the University of Illinois Urbana-Champaign, which he joined in 2011. He received his B.A. degree in Mathematics and B.S. and M.S. degrees in Mechanical Engineering from the University of Maryland Baltimore County in 2001 and 2002, and his Ph.D. degrees in Applied Mechanics from the University of Pennsylvania and Ecole Polytechnique (France) in 2006. His research focuses on the development of mathematical theories and associated numerical methods to describe, explain, and predict the mechanical and physical behavior, stability, and failure of solids. He is the recipient of a number of academic honors, including the Young Scientist Prize from the European Mechanics Society in 2009, the NSF CAREER award in 2011, the Journal of Applied Mechanics award in 2014, and the Young Investigator Medal from the Society of Engineering Science in 2017.