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Computational multiscale modeling of multifunctional materials

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PUBLICATIONS

GOOGLE SCHOLAR PROFILE

Dr. Kiefer currently holds the full professor chair of Applied Mechanics – Solid Mechanics at the Institute of Mechanics and Fluid Dynamics of TU Bergakademie Freiberg, Germany. After completing a five-year mechanical engineering program at the Ruhr-University of Bochum, Germany, in 2001, he joined the Aerospace Engineering Department at Texas A&M University as a Graduate Research Assistant. There, he earned his Ph.D. degree in 2006 and was honored with the Distinguished Graduate Student Award for Excellence in Doctoral Research in 2007. After returning to his native Germany, Dr. Kiefer was first employed as a postdoctoral research fellow in the Civil Engineering Department at the University of Stuttgart and from 2010-2016 held the position of assistant professor in Mechanics of Functional Materials at the Institute of Mechanics at TU Dortmund, Germany.

Dr. Kiefer's research focuses on the computational mechanics-based modeling and simulation of coupling phenomena across length-scales, with applications in a broad range of modern engineering materials. Such couplings can arise from intrinsic multi-physics constitutive interactions, microstructural mechanisms, and coupled field equations. Dr. Kiefer was elected member of the ASME Aerospace Division, Adaptive Structures and Material Systems Branch in 2011, which he currently serves as Branch Secretary. In 2020 he was elected Fellow of the ASME. Dr. Kiefer has further organized about 25 research workshops and symposia at international conferences. He continues to enjoy engaging in fruitful research collaborations with colleagues from around the world.

Abstract

This seminar presentation gives an overview of current research activities our team is engaged in, to inspire potential collaboration. The computational mechanics of coupled multiscale problems is a common theme that connects most of the modeling challenges we address, motivated by a broad range of technological applications. Coupling phenomena in mechanics may arise for a number of reasons—e.g., due to mutually dependent field equations, or in the interplay of constitutive mechanism. The former is typically encountered in the context of multi-physics problems (thermo-, electro-, magneto- or chemo-mechanics) and other systems of coupled balance equations (diffusion-driven deformation, fluid structure interaction), but also in higher-order continuum formulations (micromorphic, phase-field). In terms of material response, the behavior of many advanced engineering materials crucially depends on the coupling of mechanisms such as plasticity, damage, and solid-solid phase transformations. Another example are the unique properties of smart, active and multifunctional materials, which are enabled by multi-physical constitutive coupling phenomena. Moreover, both the field equations and the constitutive equations often exhibit coupling across many length-scales.

In this context, we present our scientific work over the past years dedicated to establishing fundamental frameworks for the modeling and simulation of coupled material response, solving coupled field problems and for scale-bridging. With a focus on multifunctional materials, the specific application examples include the modeling of shape memory alloys, magneto-mechanical coupling (magnetostrictives, magnetic shape memory alloys, magneto-active polymers), electro-mechanical coupling (ferroelectrics) and mechanically communicated electro-magnetic coupling in multiferroic composites. Some key simulation tools, such as Abaqus User Materials, User Elements and visualization capabilities—many of which we share publicly—are also discussed.

Tuesday, May 11, 2021
11:00am – 12:00pm

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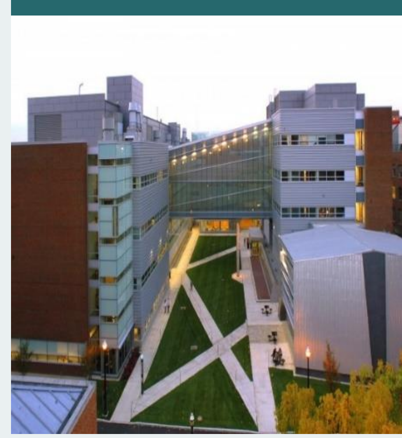

Hosted by Prof. Marcelo Dapino

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