**Title: Model-Free Data-Driven Computational Mechanics**

**Abstract:** I will present a model-free Data-Driven analytical and computational framework for problems in solid mechanics. The aim of the framework is to enable predictions and inferences of structural response directly from empirical material data, without the intermediate step of modeling the data by means of constitutive relations and priors. The data can be acquired experimentally or from micromechanical models of materials and is reusable over a broad range of boundary-value problems and loading conditions involving the same material. Solutions to deterministic boundary-value problems are obtained by minimizing a distance from the material data set to the set of admissible states or histories of the solid in the sense of equilibrium and compatibility. For materials exhibiting stochastic behavior, we show that inferences can be drawn directly from sampled random material data by minimizing a regularized Kullback-Leibler divergence, without the need to model priors or forward functions. The approximation schemes thus defined are shown to be convergent with respect to the data, i.e., to return exact predictions or inferences in the limit of data-set sequences providing an increasingly faithful representation of the unknown true material behavior. We demonstrate the framework by means of selected applications in elasticity, interatomic-potential-free molecular dynamics, *in vivo* patient-specific focused ultrasound neuromodulation,  multiscale modeling of granular media and lightweight space structures with random tensile strength.

**Bio**: Professor Ortiz received a BS degree in Civil Engineering from the Polytechnic University of Madrid, Spain, and MS and Ph.D. degrees in Civil Engineering from the University of California at Berkeley. From 1984-1995 he held a faculty position in the Division of Engineering of Brown University, where he carried out research activities in the fields of mechanics of materials and computational solid mechanics. In 1995 he became Professor of Aeronautics at the California Institute of Technology where he is Frank and Ora Lee Marble Professor Emeritus of Aeronautics and Mechanical Engineering since his retirement from teaching duty in August of 2020. He also holds a Bonn Research Chair in the Institute for Applied Mathematics of Bonn University, Germany, and is Adjunct Professor and Distinguished Timoshenko Fellow in Mechanical Engineering at Stanford University. He is a Fellow of the US Association for Computational Mechanics, elected Fellow of the American Academy of Arts & Sciences, elected Member of the US National Academy of Engineering and in 2018 he was inducted to the UCB CEE Academy of Distinguished Alumni. Professor Ortiz is the recipient of the 2002 IACM International Computational Mechanics Award, the 2007 Ted Belytschko Medal of the USACM, the inaugural 2008 Rodney Hill Prize conferred every four years by the IUTAM, the 2011 Zienkiewicz Prize of the Spanish Association for Numerical Methods in Engineering (SEMNI), the 2015 Timoshenko Medal of the ASME and the 2019 John von Neumann Medal of the USACM.



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