

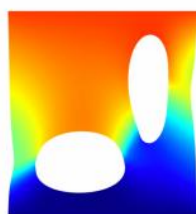
# Laura De Lorenzis

## “EUCLID: Efficient Unsupervised Constitutive Law Identification and Discovery”

We propose a new approach for data-driven automated discovery of constitutive laws in continuum mechanics. The approach is unsupervised, i.e., it requires no stress data but only displacement and global force data, which can be realistically obtained from mechanical testing and digital image or volume correlation techniques; it can deliver either interpretable models, i.e., models that are embodied by parsimonious mathematical expressions, or black-box models encoded in artificial neural networks; it is one-shot, i.e., discovery only needs one experiment in principle - but can use more if available. The machine learning tools which enable discovery are sparse regression, leading to the automatic selection of a few relevant entries from a potentially very large model space, as well as Bayesian regression, which allows for the discovery of several constitutive laws along with their probabilities. After discussing the basics of the methodology, the talk illustrates its first applications to hyperelasticity and plasticity, using both artificial and experimental data, and highlights the ongoing work on further applications.



Laura De Lorenzis received her Engineering degree and her PhD from the University of Lecce, where she first stayed as Assistant and later Associate Professor. In 2013 she moved to the TU Braunschweig as Professor and Director of the Institute of Applied Mechanics. There she was founding member and first Chair of the Center for Mechanics, Uncertainty and Simulation in Engineering. Since 2020 she is Professor of Computational Mechanics at ETH Zürich, where she currently serves as Head of the Institute of Mechanical Systems. She was awarded a Fulbright Scholarship at Massachusetts Institute of Technology, an Alexander von Humboldt Fellowship at the Leibniz University of Hannover, the RILEM L’Hermite Medal, the AIMETA Junior Prize, the IIFC Young Investigator Award, an ERC Consolidator Grant, two best paper awards and two student teaching prizes at the TU Braunschweig. She has authored or co-authored more than 120 papers on international journals on different topics of computational and applied mechanics.



Material model + Uncertainty

$$W = \frac{1}{2} (I_1 - 3) + \frac{3}{2} (J - 1)^2$$

or

EUCLID

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