The magneto-mechanical response of mechanically-soft hard magnetorheological elastomer foams

Zehui Lin*[1], Zahra Hooshmand-Ahoor[1,2], Laurence Bodelot†[1], and Kostas Danas‡[1]

[1]Laboratoire de mecanique des solides, École polytechnique – Laboratoire de Mécanique des Solides, CNRS, Ecole Polytechnique, Institut Polytechnique de Paris – France
[2]Department of Engineering, Cambridge University – United Kingdom

Abstract

Hard magnetorheological elastomers (h-MREs) are two-phase composite materials comprising micron-scale particles with significant remanent magnetization properties that are embedded in a soft elastomer matrix. In this work, we extend our work to h-MRE foams with soft mechanical response (Young's modulus in the order of a few kPa). In this study, we analyze the magneto-mechanical behavior of h-MRE foams by combined modeling and experimental testing. In particular, we study the change of the magnetic field surrounding the h-MRE foams under compressive mechanical loads. A qualitative continuum modeling of the h-MRE foam guides a set of experimental tests, which allows in-turn to calibrate the model parameters. Additional numerical simulations permit to probe further the response of such foams under non-trivial loading conditions and design potential sensing devices by exploiting the surrounding magnetic changes. This study allows for a better understanding of h-MRE foams, providing fundamental insights for their future applications like soft force sensors.

*Speaker
†Corresponding author: laurence.bodelot@polytechnique.edu
‡Corresponding author: konstantinos.danas@polytechnique.edu