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# Advances on magnetorheological elastomers: modelling, experiments and applications to haptic sensing

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## Abstract

Most current magnetorheological elastomers (MREs) are broadly categorized into hard(h-MREs) and soft(s-MREs) depending on the magnetic properties of the underlying particles. The former consist of particles exhibiting strong magnetic dissipation (e.g., NdFeB), while the later are purely energetic (e.g., carbonyl iron). In this talk, I will provide a broader overview of the advances made in those materials both from the modelling and experimental point of view. Critical findings on their large strain and magnetization response will be discussed. The talk will close with a novel vision of such materials in the context of haptic sensing. In particular, I will discuss a family of novel mechanically-soft and magnetically-hard magnetorheological foams that, upon deformation, lead to robust and measurable magnetic flux changes in their surroundings. This allows to infer qualitatively and even quantitatively the imposed deformation and, eventually from that, an estimation of the stiffness and average stress on the sample even in complex loading scenarios involving combinations of uniform or nonuniform compression/tension with superposed shearing in different directions.

## Keywords:

Magnetorheological elastomers Magnetoelasticity Haptic sensing Coupled active materials Finite strain modeling Magnetization