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Micromechanics and Instabilities of Soft Architectured Composite Materials

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Micromechanics and instabilities of soft architectured composite materials

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Soft microstructured materials enable modifications of material properties and functionalities through applied deformations, or other external stimuli, for example, electric, or magnetic fields [1]. The deformation induced tunability is mainly due to controllable changes of the microstructural arrangements, on par with material nonlinearities [2]. Moreover, the microstructures can be designed to be prone to elastic instabilities giving rise to dramatic microstructure transformations, and switchable functionalities such as cancelling certain frequency ranges of elastic waves (through induced band gaps). In the presentation, we will show our numerical and theoretical results for multiphase deformable composite materials including deformable layered materials, bio-inspired nacre-like structures [3], periodic 3D fibre composites, and periodically structured particulate materials. These numerical and theoretical results will be illustrated by the experimental observations on 3D printed multiphase composites subjected to finite deformations. Finally, the ways of material properties modifications via application of external magnetic and electric fields will be explored. In particular, magnetorheological elastomers (MRE) [1] and soft dielectric elastomers (DE) with periodic microstructures will be examined, and the coupled magneto- and electro-mechanical stability of these active architectured materials will be analysed.

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References

[1] Goshkoderia, A., Rudykh, S. 2017. Stability of magnetoactive composites with periodic microstructures undergoing finite strains in the presence of a magnetic field. *Composites Part B* **128**: 19-29.
[2] Galich, P.I., Fang, N.X., Boyce, M.C., Rudykh, S. 2017. Elastic wave propagation in finitely deformed layered materials. *Journal of the Mechanics and Physics of Solids* **98**, 390-410.
[3] Slesarenko, V., Kazarinov, N., Rudykh, S. 2017. Distinct failure modes in bio-inspired 3D-printed staggered composites under non-aligned loading. *Smart Materials and Structures* **26**, 035053.