The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

MODELING AND ANALYSIS OF ELECTRO-MAGNETO-ELASTIC MEMBRANE STRUCTURES

Awantika Mishra[1], **Yadwinder S. Joshan**[1] **and Sushma Santapuri**[1]

[1] Department of Applied Mechanics, Indian Institute of Technology Delhi, New Delhi, India 110016, ssantapuri@am.iitd.ac.in.

Keywords: *Electro-Magneto-Elasticity, Membranes, Snap-Through Instability, Dielectric Elastomers, Magnetorheological Elastomers*

Soft active materials like magnetorheological elastomers (MREs) and electroactive polymers (EAPs) undergo large deformation in response to externally applied electrical/magnetic fields. These materials have the potential to be applied towards design of sensor and actuator devices in the emerging field of soft robotics. However, it is often challenging to develop computationally tractable models for these materials owing to their inherent geometric and material nonlinearities. To aid device design and enhance computational efficiency, in this work, we develop a 2D electro-magneto-elastic membrane model starting from the 3D governing equations [1]. The membrane model is applied to actuators of cylindrical and circular geometries under axisymmetric loading. The membrane model is further utilized to study the onset of instabilities in MREs and dielectric elastomers (DE). Particularly, the effect of external electric/magnetic field on the onset and reversal of limit point (snap-through) instability and wrinkling is analyzed (Fig.1).

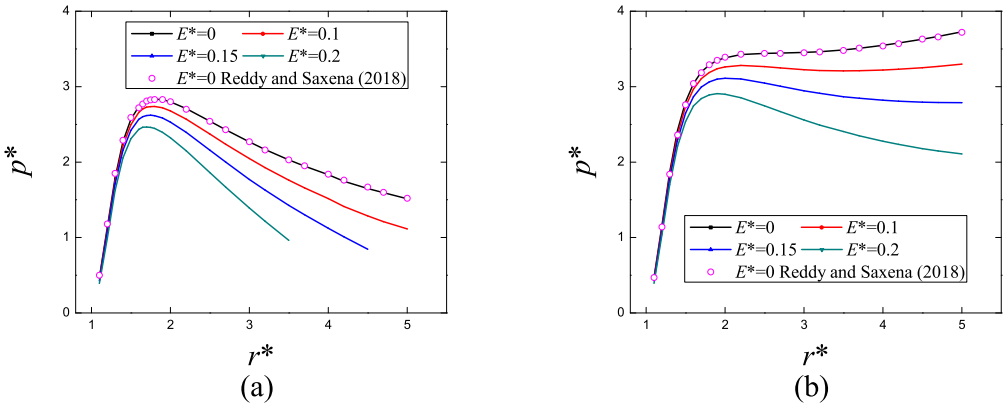

Figure 1: Pressure versus deformed radius plots of cylindrical DE membranes in the presence of external electric field for (a) Neo-Hookean material (b) Mooney-Rivlin material. Snap-through instability is characterized by the loss of monotonicity in these plots.

REFERENCES

[1] Ali, M. N., Wahi, S. K., & Santapuri, S. Modeling and analysis of a magnetoelastic annular membrane placed in an azimuthal magnetic field. *Mathematics and Mechanics of Solids*, Vol. 26(11): 1614–1634, 2021.