Bulging instability of a pressurized tube made of dielectric elasomter under electromechanical loading

† Tongqing Lu*, Jianguo Li, Tiejun Wang

State Key Laboratory for Strength and Vibration of Mechanical Structures, Xi'an Jiaotong University, Xi'an 710049, China

*Presenting author: tongqinglu@mail.xjtu.edu.cn
†Corresponding author: tongqinglu@mail.xjtu.edu.cn

Abstract

A membrane of dielectric elastomer undergoes large deformation when it is subject to a voltage through the thickness. Due to the high nonlinearity the voltage induced deformation suffers snap-through instability. For a tube of dielectric elastomer subject to internal pressure and voltage, however, the voltage induced steady bulging propagation is often observed in the experiment rather than a snap. We theoretically analyze the relation between the snap-through instability and the coexistent propagation. We find that snap-through instability always occurs under pressure control condition. While under volume control condition, bifurcation firstly sets in at the critical condition of snap-through instability. After a localized development of bulging, the pressure drops until the propagation becomes steady. The loading conditions significantly affect the way of electromechanical instability of dielectric elastomers.

Keywords: Dielectric Elastomer, Electromechanical instability, Bulging