Bifurcation of a spherical balloon under air inflation and electric activation

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Abstract

It is previously known that under inflation alone a spherical rubber membrane balloon will bifurcate into a pear shape when the tension in the membrane reaches a maximum. It is shown in this work that the same bifurcation condition is valid when a dielectric elastomer spherical balloon is subjected to the combined action of inflation and electric activation. The bifurcation condition is then used to show how electric activation affects the appearance of the pear-shaped configuration. It is further shown that whenever a pear-shaped configuration is possible it has lower total energy than the co-existing spherical configuration.

Keywords: Dielectric elastomer, Bifurcation, Instability, Spherical balloons, Nonlinear elasticity

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