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EXPLORATION ON IMPROVING ENERGY HARVESTING PERFORMANCE OF DIELECTRIC ELASTOMER GENERATORS

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Abstract

As a typical type of electroactive polymers, dielectric elastomers (DEs) can convert mechanical energy from different sources (such as ocean waves and winds) into electrical energy. Energy harvesters or generators based on DEs have recently attracted much attention from the research community due to their flexibility and high energy density. From experimental studies, dielectric elastomer generators (DEGs) can achieve energy densities more than ten times higher than those of piezoelectric and electromagnetic generators. Although these testing results of DEGs are very promising, there is still much room to improve their energy harvesting performance according to theoretical analysis. In fact, the harvested energy and conversion efficiency of DEGs are influenced by energy harvesting schemes, as well as multiple failure modes and material viscoelasticity. Particularly, the material viscoelasticity of the DEG could lead to high energy dissipation. Therefore, it is essential to account for all the above-mentioned factors when designing DEGs. This work develops a theoretical framework to comprehensively evaluate the harvested energy and conversion efficiency of DEGs with the consideration of finite-deformation viscoelasticity and possible failure modes. Also, different possible energy harvesting schemes have been explored in this work. The simulation results reveal possible avenues to improve the energy harvesting performance of DEGs, leading to better design and optimization of these devices for practical applications.

Keywords: Dielectric elastomers; Energy harvesting; Viscoelasticity; Finite deformation

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