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PROCEEDINGS

Optimal Design of Energy Harvester with Wind-Induced Bluff Body Flexural Electric Cantilever Structure

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ABSTRACT

This study focuses on the widespread utilization of environmental wind energy to power electronic devices and wireless network sensor nodes with low energy consumption characteristics. It explores the influence of relevant geometric parameters of wind-excited bluff body flexible electric cantilever structures on energy harvesting systems, aiming to enhance effective wind energy collection over a wider range of wind speeds. Through numerical analysis, considering the effects of flexible electric cantilever beam dimensions and rectangular cross-sectional bluff body dimensions on the critical flutter wind speed of the energy harvester, optimal structural parameters of the rectangular cross-sectional bluff body flexible electric cantilever structure are obtained to achieve efficient wind energy collection and electrical energy conversion. This provides important reference for the structural parameter optimization design of rectangular cross-sectional bluff body flexible electric cantilever structure energy harvester systems in practical engineering applications. Additionally, to meet the stable power supply needs of wireless sensor network nodes, this study combines the large strain gradient scale effect of flexible electric materials to successfully develop an array of cantilever beams with elastic support and rectangular cross-sectional columns to enhance the flexible electric effect of the energy harvester. The influence of the relative positions of rectangular cross-sectional columns in crosswind fields on the array's energy collection efficiency was studied using a wind tunnel test system. The results indicate that staggered arrangement contributes to improving energy collection efficiency, while straight-line arrangement reduces energy collection efficiency due to inhibiting the formation of shear flow and shedding of vortices, resulting in weakened vibrations. Therefore, the rational selection of column spacing is crucial for improving energy collection efficiency. This study not only enriches the theoretical system of wind energy collection technology but also provides an effective solution for the stable power supply of wireless sensor network nodes.

KEYWORDS

Flutter; flexural electric cantilever structure; energy harvester; rectangular cross-sectional bluff body; energy harvester array

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