HDM

HRVATSKO DRUŠTVO ZA MEHANIKU

ZAGREB - OSIJEK - RIJEKA - SL. BROD - SPLIT

Predavanje u HDMu:

EXPLICIT ANALYTICAL SOLUTIONS AND EVOLUTION MECHANISMS OF 3-DOF FLUTTER FOR TYPICAL STRUCTURES

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SAŽETAK

Flexible structures such as long-span bridges, bundled conductors, cable-supported photovoltaic modules, wind turbine blades, and long bridge hangers confront flutter problems due to aerodynamic instability, but their dynamic properties are significantly different. Accordingly, their flutter mechanisms and evolution laws require further clarification. In this paper, a unified explicit analytical solution for vertical-lateral-torsional 3-DOF flutter problems was established based on matrix perturbation methods. A dimensionless order analysis method was proposed to quantitatively evaluate and compare the contribution levels of factors such as aerodynamic damping, aerodynamic stiffness, mass eccentricity, and frequency detuning in various frequency scenarios. The flutter mechanism and evolution laws were summarized and verified through numerical examples. The results show that the systems with close vertical and torsional frequencies or with close three frequencies have higher flutter risks under significant conditions, and they are not sensitive to frequency detuning and structural damping parameters. The flutter risks of systems with close translational frequencies or separated frequencies are relatively low. The flutter influence of eccentricity is closely related to the degree of frequency proximity, aerodynamic force magnitude, and the degrees of freedom involved in coupling. For vertical-torsional close-frequency systems with large H_3^* conditions, if H_3^*<0,

eccentricity on the windward side will suppress flutter, while eccentricity on the leeward side will promote flutter; when H_3^*>0, the opposite is true. The proposed explicit analytical solution framework and conclusions of flutter evolution laws in this paper can provide references for flutter studies and design of various engineering structures.