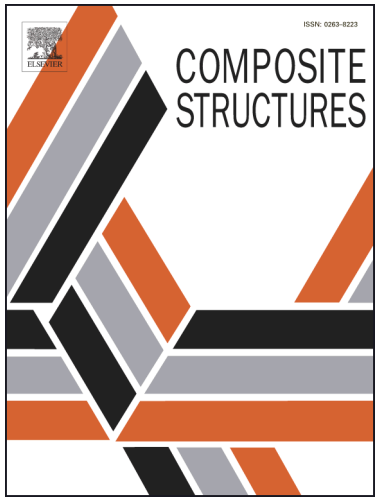

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Parameter Optimization to Avoid Propeller-induced Structural Resonance of Quadrotor type Unmanned Aerial Vehicle

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Abstract

Structural resonance in Unmanned Aerial Vehicle (UAV) is one of the major challenges that impose malfunctioning of the UAV sensor thereby degrading maneuverability. Vibration in quadrotor UAV is induced, mainly, due to the rotation of its motor-driven propellers. The constructive interference between the excitation frequencies of the propellers and fundamental frequencies of the UAV structure causes structural resonance. To avoid this structural resonance, the lowest fundamental frequency of the whole UAV structure has to be higher than the maximum working excitation frequencies of the propellers. The fundamental frequency of the quadrotor UAV structure depends on the parameters such as dimensions and stiffness of motor-supporting arms and landing gears as well as the mount location of the landing gears on the arms. The surrogate model that approximates functional dependency of the first fundamental frequency of the quadrotor UAV structure on the mentioned parameters is developed. Using the developed model and a non-linear sequential quadratic programming algorithm, the optimal values of the parameters at which the first fundamental frequency of the structure can be maximized are obtained. The adequacy of the developed surrogate model to approximate the functional form of the first fundamental frequency is verified through various statistical and experimental methods.

Keywords: Unmanned Aerial Vehicle, Quadrotor, Vibration, Optimization, Design Parameters, Radial Basis Function

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