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FLOW-INDUCED VIBRATION: ITS BENEFITS AND CATASTROPHES

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ABSTRACT

Flow-induced vibration (FIV) is a fundamental fluid–structure interaction phenomenon encountered across a wide range of engineering and natural systems, including offshore structures, heat exchangers, bridges, wind turbines, and bio-inspired propulsion systems. Traditionally regarded as a detrimental effect due to its association with structural fatigue, noise, and catastrophic failure, FIV has also emerged in recent years as a promising mechanism for beneficial applications such as energy harvesting, flow sensing, and propulsion enhancement. This minisymposium aims to provide a comprehensive platform to discuss both the destructive and constructive aspects of FIV, bridging the gap between fundamental physics and emerging engineering applications. The session will cover recent advances in understanding vortex-induced vibration (VIV), galloping, flutter, and wake-induced oscillations in both confined and unconfined flows, with emphasis on bluff and streamlined bodies of various geometries. Particular attention will be given to the role of key governing parameters such as Reynolds number, mass ratio, damping ratio, reduced velocity, and geometric confinement in dictating the transition between stable and unstable responses.

On the detrimental side, the minisymposium will address vibration suppression strategies, structural reliability, and mitigation techniques aimed at minimizing fatigue damage and performance degradation in engineering systems. On the beneficial side, emerging research on harnessing FIV for renewable energy applications will be discussed, including piezoelectric, electromagnetic, and hydroelastic energy harvesters. The interplay between flow physics and energy conversion efficiency, as well as design optimization strategies for maximizing power output, will be key themes. In addition, the minisymposium will encourage contributions employing experimental, numerical, and theoretical approaches, including high-fidelity simulations such as large eddy simulation (LES) and advanced measurement techniques. Multidisciplinary perspectives integrating fluid mechanics, structural dynamics, and control strategies are particularly welcome.