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Flow-induced vibration study by exploiting inherent nonlinearity of structure[1] BANAFSHEH SEYED-AGHAZADEH, HAMED SAMANDARI, Miami University — Elastically mounted prismatic structures placed in flow can undergo Flow-Induced Vibration (FIV). Flow forces acting on these structures consist of a main frequency, close to the natural frequency of the system, as well as its higher harmonic components. Mostly in FIV studies, the structural stiffness is provided through linear springs. The linearity of the structure limits occurrence of potential large amplitude oscillations at higher harmonics of the main frequency. In this study, we propose implementing an inherently nonlinear structure in FIV study of a prismatic structure. Through this unique design, excitation of higher harmonics and coupling between those and natural frequencies of the system can be achieved. A square cross-section prism was mounted on the upstream tip of an elastic beam with inherent nonlinearity and was placed in the test-section of a subsonic wind tunnel. The tests were conducted in a Reynolds number range of $150<Re<20{,}000$. Dynamic response of this configuration was examined for a range of prismatic tip mass aspect ratios, inertia and bending stiffness of the beam. The results show that large amplitude, low frequency galloping type oscillation is accompanied by large contributions from the higher harmonics in the frequency content of the oscillations. Numerical simulation using Differential Quadrature Method was conducted to identify the optimum structural configurations for coupling between the higher harmonics and natural frequencies of the system.

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