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Higher Harmonic Forces in Purely Crossflow Vortex-Induced Vibrations YAHYA MODARRES-SADEGHI, BANAFSHEH SEYED-AGHAZADEH, University of Massachusetts, Amherst, REMI BOURGUET, Institut de Mécanique des Fluides de Toulouse, GEORGE KARNI-ADAKIS, Brown University, MICHAEL TRIANTAFYLLOU, MIT — In vortex-induced vibrations (VIV) of flexibly-mounted rigid cylinders free to oscillate both in the inline and crossflow directions, higher (3rd) harmonic forces have already been observed in the crossflow direction. In the present work, we report higher harmonic force components for a flexibly-mounted rigid cylinder with only one degree of freedom in the crossflow direction. We show that the inline displacement is not necessary to observe higher harmonic components in the crossflow force spectrum. Due to the relative velocity of the cylinder with respect to the oncoming flow, the lift and drag forces make an angle with respect to the crossflow and inline directions, and the contribution of the components of each of these forces in the crossflow direction results in a 3rd harmonic force component. These higher harmonic components have been observed in self-excited VIV experiments, performed in a water tunnel for a Reynolds number range of $Re=400-1000$, as well as in numerical simulation results at $Re=100$. We also find that the maximum ratio of the 3rd harmonic to the 1st harmonic occurs when the phase between the crossflow force and displacement changes from 0 to 180 degrees, resulting in a small first harmonic component.

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