Active Control of Vortex Induced Vibrations of a Tethered Sphere in a Uniform Air Flow

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VIV of two heavy tethered spheres ($D = 40$ mm, $m^* = m_{sphere}/\rho f V_{sphere} = 21$ and $67$, $L^* = L/D = 2.50$) were studied in a wind tunnel under uniform free stream velocities up to $U^* = U/f_n D = 15.9$, with and without acoustic control. Control was achieved using two speakers mounted on either side of the spheres and driven in-phase at $f = 35$Hz ($f^* = 22.3$). In the non-controlled case, the bifurcation map of transverse sphere oscillation amplitude, $A_y$, showed stationary motion as well as periodic and non-stationary oscillations with increasing $U^*$. For $m^* = 21$, $A_{y,\text{max}}$ was about twice as large as for $m^* = 67$. Acoustic control dampened $A_{y,\text{max}}$ in the periodic region ($m^* = 67$) and increased $A_{y,\text{max}}$ in the non-stationary region for both spheres. Sphere boundary layer dynamics in the three different bifurcation regions were studied using time resolved PIV with a horizontal laser sheet positioned at the center of the sphere. The field of view was $55 \times 55$ mm$^2$ containing one quarter of the sphere. Results will be presented on the vortex dynamics near the sphere’s surface with and without acoustic control.

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