

Abstract Submitted
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Tomo-PIV measurements of tethered sphere VIV onset while crossing the Hopf bifurcation¹ RENE VAN HOUT, LIOR ESHBAL, DANIEL KOVALEV, DAVID GREENBLATT, Technion-Israel Institute of Technology — Here, for the first time we examine the transient evolution of the vortical structures in the wake of a tethered sphere as the uniform upstream velocity is slowly increased and the tethered sphere (diameter D) dynamics passes through the Hopf bifurcation. Tomo-PIV experiments (at 15Hz) were performed in a closed-loop water tunnel. The volume of interest ($4.5 \times 6.5 \times 2.5D^3$) was located immediately downstream of the sphere. The reduced velocity, $U^* = U/(f_N D)$, was stepwise raised from 2.2 to 4.5 in 100s ($dU/dt = 4.36 \times 10^{-4} \text{m/s}$), where U is the free-stream velocity, and f_N is the natural frequency of the tethered sphere. Large coherent structures resembling two streamwise oriented, longitudinal “legs” were observed at $U^* = 2.5$ while the sphere was stationary. Approaching $U^* = 3$, hairpin vortices, having a vertical plane of symmetry, were shed, alongside weaker induced hairpins that strengthened with increasing U^* . While vertical symmetry was sporadically disturbed, the onset of VIV occurred around $U^* = 3.7$, peaking at $U^* = 4.4$, as the plane of symmetry was shifted to the horizontal.

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