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Bifurcation analysis of an oscillating cylinder wake[1] MATTHEW CHU CHEONG, JONATHAN TU, CLARENCE ROWLEY, Princeton University — The flow past a transversely oscillating cylinder gives rise to distinct vortex patterns in the wake, with the particular pattern depending on Reynolds number, Strouhal number, and reduced frequency. In this work, we perform a numerical bifurcation analysis of the transitions between 2S, P+S, and disordered wakes at Reynolds numbers 100. Due to the high dimensionality of fluid flow simulations, standard tools such as AUTO are not applicable. Instead, we turn to Krylov-subspace-based algorithms. The coherent wake patterns (2S, P+S) are stable periodic orbits whose common period is that of the forced oscillation. To identify bifurcations, we perform stability analyses of the Poincare map by stroboscopically sampling the flow. We find the following bifurcations as the reduced frequency is held constant and the Strouhal number is increased : (1) the transition from a 2S wake to a P+S wake is a supercritical pitchfork bifurcation, (2) the transition from a P+S wake back to a 2S wake is another supercritical pitchfork bifurcation, and (3) the transition from a 2S wake to a disorganized wake is a torus bifurcation. Consistent with these bifurcations, we confirm the existence of unstable 2S wakes at Strouhal numbers where P+S and disordered wakes are observed.

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