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Adjoint Sensitivity Computation for Unsteady, Periodic Fluid Flows STEVEN GOMEZ, QIQI WANG, Massachusetts Institute of Technology — Adjoint sensitivity analysis is an important computational method to assist in engineering design and optimization problems, and can be used to efficiently compute the sensitivity of an objective function with respect to many parameters simultaneously. While these methods are popular for steady problems, there are issues when extending them to periodic and chaotic systems. Some techniques, such as windowing, have made progress at computing time average sensitivities for periodic systems; however, they do not provide a time accurate representation of the desired sensitivity. We propose a new method of adjoint computation for periodic systems that produces a time accurate sensitivity by computing and correcting two adjoint systems simultaneously. By decomposing input perturbations into components that produce pure phase shifts and no phase shifts, we derive the governing equations for the time accurate adjoint. We then propose an algorithm for computing this adjoint solution with the added overhead of storing and computing one additional adjoint variable. This algorithm is tested on the Van der Pol oscillator and a CFD simulation of vortex shedding behind a cylinder. Possible extensions to chaotic systems, such as turbulent fluid flows, will also be examined.

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