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A-Posteriori Study of the Sensitivity Equation Method and Complex-Step Differentiation in Capturing Coherent Structures in the Sensitivity Field of a Planar Mixing Layer MOHSEN ZAYERNOURI, MEREDITH METZGER, University of Utah — The performance of two techniques in computational sensitivity analysis, the sensitivity equation method (SEM) and complex-step differentiation (CSD), has been evaluated for the incompressible, two-dimensional, temporal mixing layer. This a-posteriori study aims to discover how well these two approaches capture the coherent structures in the sensitivity field, where the quantity of interest is the sensitivity of vorticity to changes in the Reynolds number, Re_{δ_0}. In SEM, the governing equations are first differentiated with respect to the parameter of interest, in this case Re_{δ_0}, then discretized and solved numerically to obtain the sensitivity coefficients. In CSD, the governing equations are treated as complex; and, the sensitivity coefficients are estimated by dividing the imaginary part of the velocity field by a small perturbation in the parameter of interest. In this manner, CSD avoids subtractive cancellation errors associated with finite difference approximations. Simulations were run at a baseline test case of $Re_{\delta_0} = 200$ using an unsteady finite-volume-based fractional step algorithm. The results show that CSD has many advantages over SEM including ease of implementation, faster performance, and higher accuracy at a same resolution.

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