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Experimental investigation of frequency lock-on in separated flow[1] JOHN GRIFFIN, LOU CATTAFESTA, University of Florida, JONATHAN TU, CLANCY ROWLEY, Princeton University, EHSAN ARAM, RAJAT MITTAL, Johns Hopkins University — Separated flow is a complex phenomenon comprised of several flow dynamics. Recent experimental and computational investigations propose that, depending on flow conditions, the nature of flow separation is governed by three dominant mechanisms: the shear layer, separation bubble, and wake instabilities. The nonlinear interactions of these instabilities provide potential for separation characterized by various lock-on states. This study provides an experimental investigation into the lock-on type dynamics for separated flows from various two-dimensional airfoil shapes, Reynolds numbers, and angles of attack. Two simultaneously sampled hot-wire probes are used to acquire velocity in two of the three regions of interest. The data quantify nonlinear coupling between the instabilities observed in the shear layer, the wake, and, in the case of mean flow reattachment, the separation bubble. The locations of these phenomena are determined with simple two-component particle image velocimetry. The coupling is assessed via higher-order spectral and moment analysis. Several of the cases that demonstrate resonant behavior are included for discussion.

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