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A revisit of the low-frequency flapping mechanism in an open cavity shear layer flow[1] XIAOFENG LIU, JOSEPH KATZ, Johns Hopkins University — Causes for low-frequency flapping in an open cavity shear layer flow are revisited using correlations among experimentally obtained time-resolved velocity and pressure distributions. Interactions of the shear layer with the downstream corner cause substantial local variations in pressure and velocity, but correlations show little evidence that these phenomena affect the flow around the upstream corner. Instead, it seems that the flapping occurs due to changes in the streamwise pressure gradients ($\partial p'/\partial x$) associated with vertical motion of the shear layer in the vicinity of the upstream corner. When the highly correlated initial part of the shear layer and the boundary layer upstream of the corner are thin, $\partial p'/\partial x$ increases. The elevated adverse pressure gradients increase the thickness of the boundary layer, causing a downstream propagating increase in shear layer elevation. As the shear layer rises, $\partial p'/\partial x$ around the upstream corner decreases, causing thinning of the boundary layer. This process persists at $St=fL/U_\infty$ of 0.052, an order of magnitude lower than that associated with transport of shear layer vortices. Oscillations in the vertical velocity along the upstream cavity wall are weakly correlated with the flapping except for a small separation bubble near the corner.

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Xiaofeng Liu
Johns Hopkins University

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