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Technical Comments

Brief discussion of previous investigations in the aerospace sciences and technical comments on papers published in the Journal of Aircraft *are presented in this special department. Entries must be restricted to a maximum of 1000 words, or the equivalent of one* Journal *page including formulas and figures. A discussion will be published as quickly as possible after receipt of the manuscript. Neither the AIAA nor its editors are responsible for the opinions expressed by the correspondents. Authors will be invited to reply promptly.*

Comment on "Navier–Stokes Computations of Limit-Cycle Oscillations for a B-1-Like Configuration"

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FIGURE 6 of Ref. 1 shows that the Navier–Stokes computations[1] predict the general experimental data trend[2] in regard to the measured rapid loss of damping when $\alpha = 8$ deg is approached. The discrepancy is the huge underestimation of the measured loss of damping, which would result in underpredicting the experimental limit-cycle amplitude[2] by one order of magnitude. According to Ref. 3, this would be the expected result when not considering the effect of the hugely different leading-edge radius on the inner, fixed wing glove and the outer wing with its variable leading-edge sweep. The larger leading-edge radius of the inner wing glove delays the start of the formation of a leading-edge vortex more than the lesser leading-edge radius of the outer wing.[4] This causes the leading-edge vortex formation to be similar to that for a double-delta wing, where the larger effective sweep angle of the inner wing causes its vortex formation to lag behind that of the effectively less swept outer wing. It is discussed at length in Ref. 3 how this interaction between inner and outer wing leading-edge vortices started to occur when $\alpha = 8$ deg was approached. The undamping effect of this vortex interaction was the result of the sensitivity of the spanwise location of the vortices not only to the streamwise angle of attack but also to the rate and direction of the angular change.

It should be of great interest to find out why the full Navier–Stokes equations were not able to predict the large effect that the difference in leading-edge radii had on the vortex generation of the inner, fixed and outer, moveable portions of the wing.

References

[1]Hartwich, P. M., Dobbs, S. K., Arslan, A. E., and Kim, S. K., "Navier–Stokes Computations of Limit-Cycle Oscillations for a B-1-Like Configuration," *Journal of Aircraft*, Vol. 38, No. 2, 2001, pp. 233–247.

[2]Dobbs, S. K., Miller, G. D., and Stevenson, J. R., "Self-Induced Oscillation Wind-Tunnel Test of Variable Sweep Wing," AIAA Paper 85-0739-CP, April 1985.

[3]Ericsson, L. E., "Vortex-Induced Bending Oscillations of a Swept Wing," *Journal of Aircraft*, Vol. 24, No. 3, 1987, pp. 195–202.

[4]Ericsson, L. E., and King, H. H. C., "Effect of Leading-Edge Geometry on Delta Wing Unsteady Aerodynamics," *Journal of Aircraft*, Vol. 30, No. 5, 1993, pp. 793–795.

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Reply to Comment on "Navier–Stokes Computations of Limit-Cycle Oscillations for a B-1-Like Configuration"

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ERICSSON offers an intriguing interpretation of the limit-cycle oscillation (LCO) phenomenon observed for the B-1 aircraft at transonic maneuver. He contends that the oscillatory motion of the outer wing is strictly in response to an aerodynamic phenomenon. This aerodynamic phenomenon is described as the interaction of a fully formed leading-edge vortex on the outer wing panel with a nascent leading-edge vortex over the inner fixed-wing glove. This explanation implies that any aerodynamics/structures interaction the LCO phenomenon is of secondary if any relevance. This contention is different from the explanation of the B-1 LCO phenomenon as a fluids/structure interaction offered in the article in question.[1] Ericsson concludes his Comment with his expectation that future solutions to the full Navier–Stokes equations (as opposed to the thin-layer approximation employed in the referenced article) will be required to capture the vortex interaction he suspects to be the causative agent of the B-1 LCO.

The authors of the subject paper wish to respond as follows. Consider the computational flow visualization of surface and off-surface flow shown in Figs. 1 and 2 (also Figs. 1 and 2 in Ref. 1). These transonic ($M_\infty = 0.975$) solutions were computed for a simplified B-1 configuration at an angle of attack of 7.38 deg, with and without a static aeroelastic response, respectively. Neither solution indicates an impending formation of a leading-edge vortex over the inner wing glove. These flow-visualization images are considered representative for the 30 flow solutions computed for angles of attack between 7.38 and 9 deg in an attempt to pinpoint the LCO solution among a multitude of dynamic aeroelastic solutions for which the four leading structural modes were carried. As for the accuracy of

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