Readers' Forum

Brief discussions of previous investigations in the aerospace sciences and technical comments on papers published in the AIAA Journal *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 "Approximate Calculation of Vortex Trajectories of Slender Bodies at Incidence"

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IN Ref. 1, Professor Weihs presents a simple method for predicting the radial position of a symmetric body vortex pair on the leeside of a body of revolution at high angle of attack. An expression is derived for the radial position r of the symmetric vortices as a function of axial distance x, angle of attack α and an empirical parameter Λ. His equation is

$$2\Lambda x \tan\alpha = r - \frac{1}{r} - \frac{1}{r^3} + \frac{1}{r^5}$$

where $x=\bar{x}/a$, $r=\bar{r}/a$, and a is the body radius. The only comparison of his prediction with experimental results is the "limiting case," i.e., as $x\to\infty$, and here he concludes the theory is in good agreement with experiment.

The purpose of this Comment is to show that 1) his comparison with experimental data is erroneous, and 2) with a proper comparison with experiment, his prediction is in error by a factor of four to ten.

Letting $x\to\infty$ in the above equation, Weihs forms the ratio (assuming $\Lambda=0.5$)

$$\left[\frac{\tan\xi}{\tan\alpha}\right]_{\text{theor}} = 0.866$$

where ξ is the angle between the body centerline and the vortex path. He compares this result with the experimental result of Thomson and Morrison,[2]

$$\left[\frac{\tan\xi}{\tan\alpha}\right]_{\text{exp}} \approx 0.8$$

and concludes that the theory is "within less than 10% of the experimental value." This comparison and conclusion is wrong for two reasons. First, the ratio does not define the vortex radial location, but only the angle at which the vortices move away from the body. That is, the angle is correct, but the point at which the vortices leave the body is incorrect, leading to large errors in radial location. Second, the assumptions of the theory are clearly inconsistent with the experimental data referenced. The experimental value of Thomson and Morrison was measured from Schlieren photographs of the *asymmetric, multiple,* vortex wake. This wake flow is distinctly inconsistent with the assumptions of a single symmetric vortex pair in the theory.

A valid comparison between Weihs' prediction and experimental data for vortex radial distance vs scaled axial distance ($\Lambda=0.5$) is shown in Fig. 1. The experimental data are for incompressible flow[3] and supersonic flow.[4] Figure 1 demonstrates that the accuracy of the theory is not as stated by Professor Weihs.

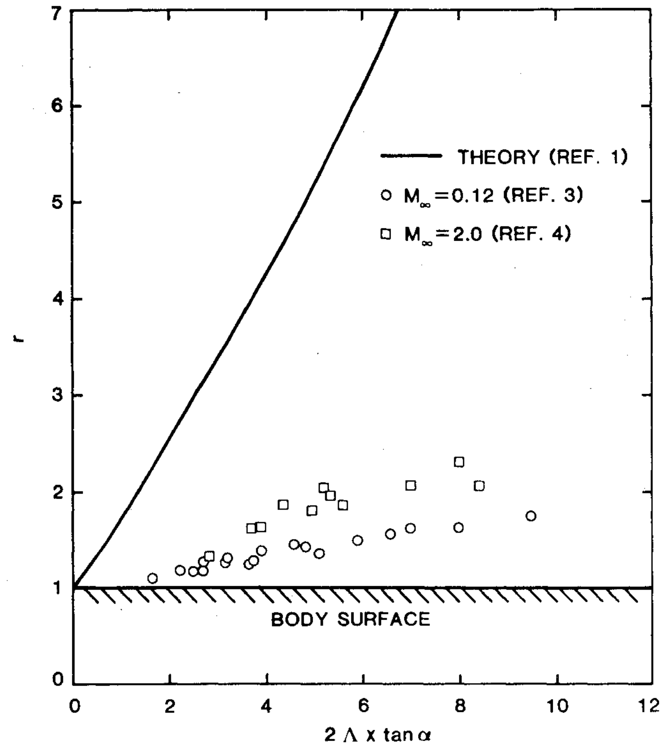

Fig. 1 Vortex radial distance vs scaled axial distance.

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[1]Weihs, D., "Approximate Calculation of Vortex Trajectories of Slender Bodies at Incidence," *AIAA Journal*, Vol. 18, Nov. 1980, pp. 1402-1403.

[2]Thomson, K. D. and Morrison, D. F., "The Spacing, Position and Strength of Vortices in the Wake of Slender Cylindrical Bodies at Large Incidence," *Journal of Fluid Mechanics*, Vol. 50, Pt. 4, 1971, pp. 751-783.

[3]Grosche, F. R., "Wind Tunnel Investigation of the Vortex System Near an Inclined Body of Revolution with and without Wings," AGARD Conference *Aerodynamic Interference*, AGARD-CP-71-71, Jan. 1971.

[4]Oberkampf, W. L. and Bartel, T. J., "Symmetric Body Vortex Wake Characteristics in Supersonic Flow," *AIAA Journal*, Vol. 18, Nov. 1980, pp. 1289-1297.