Reply by Author to W. L. Oberkampf

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I WOULD like to thank Dr. Oberkampf for his interest in my Note.[1] However, it seems that his comments are, at least in part, a result of some misunderstanding.

First, the axial distance x is measured from the point of detachment of the vortex, and not the leading tip as in the Comment.[2] This was stated twice in my Note, but seems to have escaped Dr. Oberkampf's attention. This results in a shift of the "theory" line in Fig. 1 of the Comment toward the experimental data.

Another point raised is that the asymptotic angle is obtained only for asymmetric vortex wakes. However, in Refs. 3, 4, and others, symmetric wakes are also shown to separate from the body. The reference to Thomson and Morrison's[5] work was a) for the definition of ξ, and b) to show that this approach holds also for some of the more complex cases mentioned in my Note.[1]

The choice of data for Fig. 1 of the Comment[2] is somewhat surprising. The analysis is for incompressible flow, so the squares are of no relevance. On the other hand, for incompressible flow, Mendenhall and Nielsen[6] have a large collection of data. Their Figs. 5b and 5c have composite curves from various experimental results for vortex location. This can be adapted by my[1] Eq. (9) by calculating r from the horizontal and vertical positions for one point along the axis, and calling it r. For example, taking the point Ref. 6 calls

$$\bar{x} = \frac{x - x_s}{r_n} \sin\alpha = 2$$

one obtains $r/a = 1.37$. From Eq. (9), this value of r/a leads to $x = 0.46$, i.e., a factor of $x = 0.23\,\bar{x}$ is required, where x is the coordinate in Fig. 1, and $\bar{x}$ is the axial coordinate in Ref. 6. This step is required for calibration of the abscissa as vortex separation points are not clearly defined.

One then obtains the broken line in Fig. 1, which shows agreement to within 20% for the entire range of available data. Reference 6 includes compilation of data from a wide range of sources, so that the compression of the axial coordinate required ($x/\bar{x} = 0.23$) will probably be rather accurate for most cases.

Finally, it should be recalled that the theory presented in Ref. 1 is extremely simplified and thus cannot, and should not be expected to, give very accurate predictions for vortex shedding. For example, Reynolds number effects on shedding position and vortex strength appear only indirectly. This method should be seen ony as an initial rapid estimation technique to help in the first iteration of more accurate numerical calculations of the flow around slender bodies at angles of attack, as mentioned previously.[1]

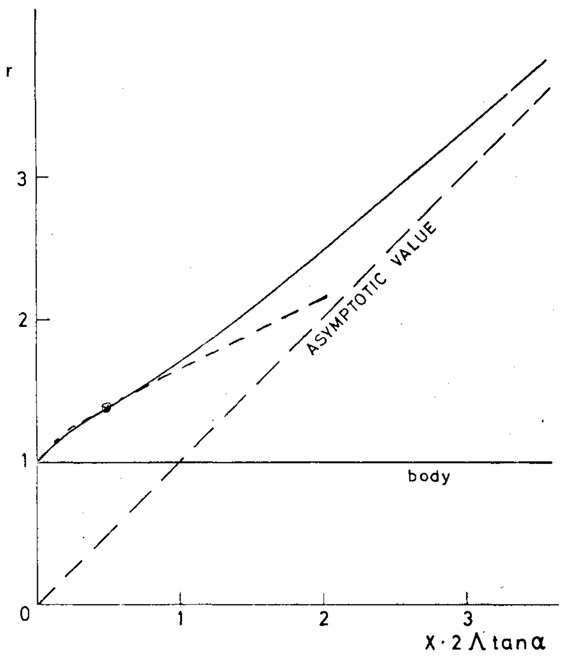

Fig. 1 Nondimensional distance of vortex from body centerline vs weighted nondimensional distance along centerline. Full line is theoretical prediction from Ref. 1 while broken line is composite experimental curve from Ref. 6. Circle indicates point used for calibration of the abscissa. Experimental data are available only for the range given.

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References

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

[2] Oberkampf, W. L., "Comment on "Approximate Calculation of Vortex Trajectories of Slender Bodies at Incidence," *AIAA Journal*, Vol.

[3] Nielsen, J. N., "Nonlinearities in Missile Aerodynamics," AIAA Paper 78-20, Jan. 1978.

[4] Clark, W. H., "Body Vortex Formation on Missiles in Incompressible Flows," AIAA Paper 77-1154, Aug. 1977.

[5] 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, 1971, pp., 751-783.

[6] Mendenhall, M. R. and Nielsen, J. N., "Effects of Vortex Shedding on the Longitudinal Aerodynamic Characteristics of Wing-Body-Tail Combinations," NASA CR-2475, Jan. 1975.

Comment on "Finite Elements for Initial Value Problems in Dynamics"

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IN a recent paper,[1] Simkins made an attempt to formulate time finite elements based on Hamilton's "Law of Varying Action." It appears that, due to several misconceptions, the direct formulation of Ref. 1 "fails to yield a convergent sequence of solution." Consequently some mathematical manipulations have been introduced to achieve a solution. Thus, it is pertinent to make some comment referring to our

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