tinuity condition was replaced by an additional control point located on the body surface near the juncture. Calculated surface pressure coefficient distributions were quite smooth and agreed well with experimental results at zero[3] and nonzero[4] angle of attack, as seen in Fig. 1 taken from Ref. 4. Comparisons are made with experimental results of Ref. 7. Solutions obtained using the piecewise linear source singularity for this class of axisymmetric bodies oscillated wildly when the source strength was forced to remain continuous across a jump in body curvature. Also, the source strength distributions obtained for the accurate flowfield representation (no continuity requirement at the juncture) displayed a discontinuous jump at the juncture from positive (source) within the nose to negative (sink) within the cylinder. This jump in strength was apparently necessary to turn the flow to be tangential to the cylindrical portion of the body just downstream of the juncture. It is expected that elimination of these continuity requirements for the linear axial source method used for the second example in Ref. 1 should lead to significant improvements in accuracy. However, it must be noted that these comments support the basic conclusion of D'Sa and Dalton, that axial-singularity methods are less reliable than a surface-singularity formulation, since accurate axial-singularity results appear to require relatively higher numerical precision and, at times, insight into the appropriate choice of element size distribution.

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Reply by Authors to J. M. Kuhlman

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WE have reservations about several issues raised by J. M. Kuhlman in his Comment on our paper.[1] First, Kuhlman is reminded that the "exact" representation of an ellipsoid of revolution by linear variation of sources between the foci is valid only under a certain "simplifying condition."[2] Even though the ellipsoid of revolution may represent an "exact solution" when the foci represent the element endpoints, this situation does not apply to our calculations because the foci did *not* represent the element endpoints. We used empirically determined distances of 2 and 98% of the body length to begin and end the element distributions. Not using the foci as element endpoints generates a numerical solution, which can represent a test case for comparison to the exact solution. In addition, it is probably true that Kuhlman's CDC calculations contributed significantly to the small errors that he reports.

The authors are puzzled by what Kuhlman means when he suggests the superposition of his line-doublet singularity distribution with a surface-singularity method to represent a body at angle of attack. When a surface-singularity method is used, it is not necessary to augment it to represent an angle-of-attack flow.

Second, Kuhlman suggests representing complex body shapes by imposing specific conditions that are far from simple on the distribution of the axial sources. Even though Kuhlman used the abutting singularity elements at the nose-cylinder or tail-cylinder junctures, there is no mathematical basis for choosing any particular adjacent elements to effect this condition. The question then becomes a matter of where the discontinuity in source strength is allowed to occur in the source distribution. This condition seems to be based purely on computational experience, especially since the axial-singularity solution is not unique.

The authors are also puzzled by Kuhlman's comment concerning a curvature discontinuity in our second example. We do not see this body as having a discontinuous curvature.

In conclusion, we understand that Kuhlman is attempting to improve the accuracy of the axial-singularity method by placing restrictions on how the axial singularities are located and distributed. Kuhlman suggests improved numerical precision, and we certainly agree. Kuhlman is reminded that simplicity of formulation and application is the strength of the axial-singularity method. With the modifications suggested by Kuhlman, the method loses some of its simplicity in formulation and becomes more of an art in application. The second test case of D'Sa and Dalton, the "complex" body shape, was the true application we sought to make. The more complex the body, the more innovative one needs to become to implement the axial-singularity method. In essence, the more complex the body, the more the method loses its simplicity. This tends to lead the user back to the surface-singularity method, which we observed to be the superior method.

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Comment on "A Ring-Vortex Downburst Model for Flight Simulation"

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IN Ref. 1, Ivan has improved on the numerical calculation method given in Ref. 2 for computing the velocity at an arbitrary point in a simulated downburst. The essence of his method is to use the closed-form solution for the stream function of a ring vortex, which is exactly equivalent to that of the

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