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 "Wind Tunnel Wall Corrections Deduced by Iterating from Measured Wall Static Pressure"

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In Ref. 1 a method for calculating tunnel-wall interference from measurements of wall boundary conditions is described. This method relies on solutions for the flow both within the working section (the "inner" region) and in the "outer" region outside the tunnel, together with an iterative scheme based on a comparison between calculated and measured boundary conditions. A representation of the model is required for the calculation of the "inner" region flow. However, it is not made clear[1] how sensitive the corrections derived by this method are to model representation, and the method is only used to calculate wall-induced upwash.

In fact,[2] within the limitations of linearized theory, tunnel wall interference is completely defined by measurements of the wall boundary conditions, rendering a model representation unnecessary. The tunnel-wall corrections to both incidence and stream speed may be derived from Green's theorem applied to a closed surface surrounding the model.[2] For a surface that is close to the tunnel walls, the surface integrals contain the wall boundary conditions and may be integrated directly. As Dr. Moses points out,[1] it is necessary only to measure static pressures at the walls for tunnels with solid walls, the effect of the wall boundary layers on the normal velocity of the equivalent inviscid flow at the walls[2] generally being negligible.

It is relevant to note that methods of determining wall corrections from boundary measurements in two-dimensional wind tunnels have recently been reviewed in Ref. 3.

I would be interested to have Dr. Moses' views on the sensitivity of the corrections of his method both to model representation (e.g., number and disposition of singularities) and to the number and spacing of static-pressure measurements on the walls. I was particularly intrigued to note that Dr. Moses needed only four static-pressure taps in the sidewalls in his experiment, especially since he studied a lifting model with a relatively large span-to-tunnel-width ratio. Finally, Dr. Moses' views would be appreciated on whether he considers that his method offers any advantages over the method of Ref. 2.

References

[1]Moses, D.F., "Wind Tunnel Wall Corrections Deduced by Iterating from Measured Wall Static Pressure," *AIAA Journal*, Vol. 21, Dec. 1983, pp. 1667-1673.

[2]Ashill, P.R. and Weeks, D.J., "A Method for Determining Wall-Interference Corrections in Solid-Wall Tunnels from Measurements of Static Pressures at the Walls," *Wall Interference in Wind Tunnels*, AGARD-CP-335, Sept. 1982.

[3]Mokry, M., Chan, Y.Y., Jones, D.J., and Ohman, L.H. (eds.), *Two-Dimensional Wind Tunnel Wall-Interference*, AGARD-AG-281, Nov. 1983.

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Reply by Author to P.R. Ashill

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In his Comment, Dr. Ashill notes that in linear theory representation of the model is unnecessary. In the method reported on by the writer, the pressure distribution on the model is held constant during iteration to unconfined flow. This is equivalent to saying that there is no increment in model circulation from iteration to iteration and therefore the boundary condition for the inner flow description at the model is produced by having no model representation at all. However, in the equivalent case where model geometry is fixed, model representation would be required to obtain the impermeable surface boundary condition. The first case is preferable, to be sure. In this case, then, there would be no sensitivity of the method to model representation in calculating a lift correction. However, in extending the method to blockage correction this may be a concern.

The number and distribution of both singularity elements and flow parameter measurements (wall static pressure) are important concerns that will depend upon the detail and accuracy of the correction desired. Unfortunately these concerns could not be fully explored by the time of publication. These topics are being investigated; however, the writer is not ready to report results at this time. It was found, however, that increasing the number of singularity elements used to calculate the flowfields (beyond 140) produced a negligible effect on the wall correction results. It is felt that fewer singularities could be used, but the minimum number and the exact distribution have not yet been determined. More importantly, since the wall static-pressure distributions are rather smooth, an accurate lift correction would probably be obtained with significantly fewer measurements judiciously placed and concentrated near the model. Based on experiments so far, we may be able to limit measurements to half a model span upstream and downstream. Far upstream and downstream behavior could probably be represented analytically and matched to the particular extremity measurements of a given test. Of more importance, the writer feels, is the accuracy of flow parameter measurement. This forms the actual limit to correction accuracy. The relation between measurement error and resulting correction accuracy needs to be established when adapting the method to routine use.

The writer used only four side-wall measurements in his original experiment because that was the limit that could be installed in that particular wind tunnel and still maintain measurement accuracy. It is suspected that side measurements are unnecessary for symmetric tests, but this is still under investigation.

In comparing the Sears method of the writer with the method described in Ref. 2 of Dr. Ashill's Comment, it may

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