be pointed out that the former is inherently exact since it satisfies directly the boundary conditions of unconfined flow. The method was demonstrated using an incompressible wind tunnel flow and therefore is not limited to small perturbations in this Mach number regime. At high subsonic Mach numbers the method still applies as long as the inner region contains at worst weak shocks. Performing flowfield calculations in inner and outer regions at these Mach numbers would be significantly more complicated and require much more computer time. It is not clear to the writer just how drastically it would change the description of the model. If the flow in the inner region were nearly linear the iterations could still be performed using increments to boundary conditions. The extension of the writer's methods to these higher Mach numbers is being studied. The extension of the computer programs to make more detailed wall correction calculations at the model also has not yet been done. At this point, then, it appears that the two methods would be comparable at high subsonic Mach numbers but the Sears method would be more accurate for low speed wind tunnels.

Comment on "Improved Solutions to the Falkner-Skan Boundary-Layer Equation"

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THE author of Ref. 1 is to be commended for his efforts to improve the solution to the Falkner-Skan boundary-layer equation. The results shown in the paper are, however, a little bit misleading. It seems that the author did not thoroughly take into consideration the effects of η_∞ used in the calculation on the value of $f''(0)$, whose accuracy he was trying to improve. The method stated in the paper: "For $-0.1988377 \leq \beta \leq -0.03$ the computed results are given to $\eta = 10.00$" will not yield the value of $\beta = -0.1988377$ for $f''(0) = 0$ and $\eta_\infty = 10$. Instead, the value of $\beta = -0.1988448$ under the above-mentioned conditions. When η_∞ is increased to 12 and 14, both calculations will yield $\beta = -0.1988378$ for $f''(0) = 0$. For $\beta = -0.1987686895$ ($m = -0.0904$), the values of $f''(0)$ are found to be 0.0072985, 0.0049750, and 0.0047700 for $\eta_\infty = 9.0$, 10.0, and 12.0, respectively. When η_∞ is increased to 14.0, the value of $f''(0)$ remains the same and is equal to 0.0047700. Therefore, the value of $f''(0)$ has an error of 0.000205 for $\eta_\infty = 10$. However, the value of $f'(\infty)$ will converge to 1 within the accuracy of 10^{-7} for the case of $\eta_\infty = 10.0$ and $m = -0.0904$ provided that $0.0049750 \leq f''(0) \leq 0.0049790$. All of these calculations are based on the double-precision algorithms. It will never converge to the above-mentioned accuracy if $f''(0)$ is set equal to 0.0047700 and $\eta_\infty = 10.0$.

It is found to be adequate to have $\eta_\infty = 10.0$ for $\beta = -0.06185567$ ($m = -0.03$). But it is found to be unsatisfactory to have $\eta_\infty = 7.5$ for $\beta = -0.02$. In this instance, the values of $f''(0) = 0.3112713$, 0.3112578, and 0.3112577 for $\eta_\infty = 7.5$, 9.0, and 10.0, respectively. The value of $f''(0)$ remains the same for $\eta_\infty = 10$ and 11.

The boundary-layer thickness where $u/U_\infty = 0.999$ will remain accurate to the second digit when the outer edge, where $u/U_\infty = 1.0$, is sufficiently large. Figure 1 shows the effects of the flow shape factor $m = \beta/(2-\beta)$ on the above-defined

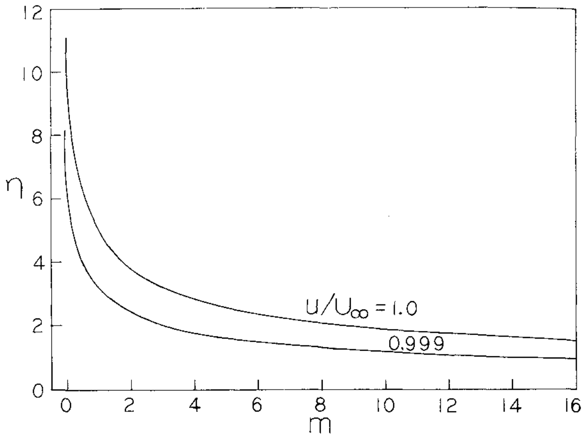

Fig. 1 Boundary-layer thickness vs flow shape factor.

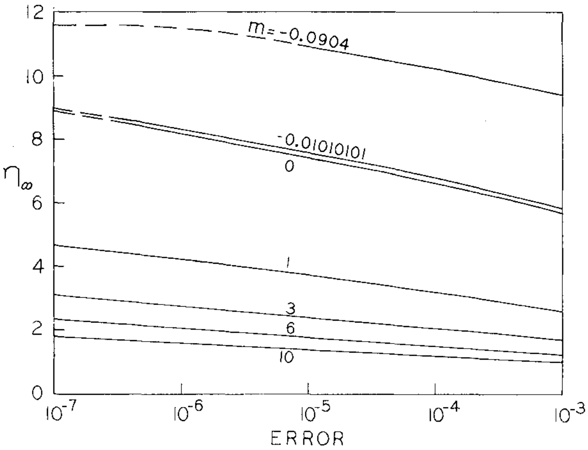

Fig. 2 Error in the dimensionless shear due to the outer edge location.

thickness and the least outer edge which must be used in the profile integration. There are, however, some exceptions. When $m = 6$, the least outer edge is 2.7, which yields $f''(0) = 2.9383650$. The outer edge from Fig. 1 is 2.4, which yields $f''(0) = 2.9383651$. The difference here is due to the roundoff effect. The thickness where $u/U_\infty = 0.999$ remains the same at 1.5 for both calculations. Figure 2 shows the effects of the outer edge location on the accuracy of $f''(0)$ for the cases where the value of $f'(\infty)$ converges to 1 within the accuracy of 10^{-7}. The error defined as the difference between the value of $f''(0)$ at the given η_∞ and the convergent value as the outer edge approaches infinity. As mentioned before, the last two digits are not very accurate for $m = -0.0904$ and the values of $0.0047700 \leq f''(0) \leq 0.0047730$ will yield a solution with $\eta_\infty \geq 11.75$. If $f''(0) = 0.0047700$ is used, a satisfactory solution can be obtained with the outer edge as low as 11.1. However, it is accurate to seven digits for all others where $m > 0$. The percent error increases with decreasing m as the value of $f''(0)$ also decreases. Blottner[2] used the fourth-order finite difference scheme with various η_∞ and obtained a very accurate result for $m = 0$ with only 81 grid points for $\eta_\infty = 7$ and a convergence accuracy of 10^{-10}. In comparison with the above results, the fourth-order Runge-Kutta method needs to integrate at least up to $\eta_\infty = 9.5$ for $m = 0$ and a convergence accuracy of 10^{-7}. The former method seems to yield more accurate results for the skin friction with fewer grid points than the latter.

Equation (5) is inaccurate in the neighborhood of the point of flow separation, $f''(0) = 0$. At the flow separation point, the value of β should be equal to -0.1988378 ($m = -0.0904286$). Again, accuracies of Eqs. (5) and (6) are very poor. For example, Eq. (5) yields $\beta = -0.103823$ while

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Eq. (6) yields $\beta = -0.107134$ for $f''(0) = 0.3112577$. Actually the value of $f''(0)$ considered here corresponds with $\beta = -0.02$ mentioned in the previous paragraph.

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ERRATA

- "Simplified Implicit Block-Bidiagonal Finite Difference Method for Solving the Navier-Stokes Equations," Vol. 23, No. 7, 1985, pp. 1130-1132. The second author's name is V.S.V. Iyer.

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