has blunt leading edge and blunt trailing edge. An empirical method is used for the location and shape of the detached bow wave, whereas the passage shock is successively corrected in the calculation until the flow quantities on the two sides of it satisfy the Rankine-Hugoniot relations. Computation for DFVLR DCA cascade with inlet Mach number of 1.14 and 1.34 takes about 10 min on a UNIVAC 1100 computer with a 90 x 20 mesh in the supersonic region and with a 13 x 40 mesh in the subsonic region.

The result of calculation by this method provides accurate detailed information about the flow through the blade cascade. The jumps of the flow variables across the shock are properly determined. From these results it may be concluded that, for an accurate determination of either direct or indirect problem of the transonic flow on an \( S_1 \) or \( S_2 \) stream surface, the jumps across the shock wave in the flow direction, stream sheet thickness, and angular momentum about the machine axis should be properly taken into account in the calculation.

The method presented can be easily applied to calculate the transonic flow in a nozzle or diffuser having an embedded shock. It may also be extended to the calculation of transonic flow on an \( S_1 \) surface of revolution or an \( S_2 \) surface with a single or two embedded shocks.

It is found that the arbitrary nonorthogonal coordinate system employed in the code for the subsonic flow region is very helpful. Not only the boundary of the blade but also the passage shock can be selected as coordinate lines. The calculation mesh can be formed proportionally and automatically. It is especially suitable in the process of correcting the passage shock. The passage shock obtained is clearly defined and agrees quite well with the experimental data.

References


DISCUSSION

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In this paper a method is presented to calculate the inviscid flow through transonic compressor cascades. This is a valuable step in the development of theoretical methods to predict the real flow behavior. However, the results are still far from reality because the neglected viscous effects are dominant in the subsonic regions of transonic cascade flows. This can be clearly seen in the Schlieren picture corresponding to the flow case of Fig. 9 and shown in Fig. 13. A severe boundary layer separation is caused by the passage shock which leads to a reacceleration and a second normal shock wave. The measured blade Mach number distribution and the exit flow conditions are therefore considerably different in the calculation and the experiment as shown in Fig. 14. Therefore, I do not agree with the concluding remark of the paper: "The result of calculation by this method provides accurate detailed information about the flow through the blade cascade." Theoretical solutions in this velocity range have to account for viscosity effects in order to be reasonably accurate.

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Fig. 13 Schlieren picture of the cascade DCA 2·8·10 at \( M_1 = 1.34 \) [10]
Fig. 14 Theoretical and experimental surface Mach number distribution of the DCA 2-8-10 cascade