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FINAL REPORT

SHOCK WAVE PROPAGATION AND DIFFRACTION

1 May 1967 - 31 August 1968

AERO-D PROPOSAL 6553-E*

Contract DAHC04 67 C 0044

by

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Our work under this contract was directed towards the accurate numerical solution of certain problems in high-speed gasdynamics which are difficult to treat by conventional numerical methods. Specifically, we have studied the steady axisymmetric supersonic flow about a blunt body and the transient flows which result when a smooth blunt body, either at rest or in supersonic motion, is struck by a shock wave such as might be created by an explosion. In each case our approach has been to find the solution in the form of a Taylor series in two or three independent variables, with the coefficients determined so as to satisfy the exact equations and boundary conditions of inviscid gasdynamics. The region of space and time for which the solution is useful is limited to some region near the center of the expansion. We extend this region beyond the natural region of convergence by recasting the series into continued-fraction form.

In each of the cases to which the method was applied, the results obtained were far less complete than could be found by, say, finite-difference methods. This is partly because the region in which the continued-fraction expansion are useful is limited, not so much by occurrence of singularites (though this sometimes is the case), but by the size of the computer employed, which limits the number and accuracy of the coefficients determined. Also, in the unsteady problems we have treated, the nature of the boundary conditions required changes qualitatively with time as the shock waves interact with one another and change their reflection patterns. However, where the method does yield results,

they turn out to be highly accurate. Since the finite-difference methods tend to be more inaccurate where the present approach is successful, the two methods complement one another.

Publications prepared during the course of this contract were as follows:

"Initial Stages of Axisymmetric Shock-on-Shock Interaction for Blunt Bodies", by John P. Moran (submitted to AIAA Journal; final decision still pending).

"Diffraction of a Plane Shock by an Analytic Blunt Body", by John P. Moran and William K. van Moorhem (accepted for publication in Journal of Fluid Mechanics).

Professor Moran was Principal Investigator throughout the course of the contract, which has been continued as DAHC04 69 C 0031 at his present address, the University of Minnesota. Mr. van Moorhem was employed as a Research Assistant for 8 months.

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13. ABSTRACT

Work was directed toward the accurate numerical solution of certain problems in high speed gasdynamics which are difficult to treat by conventional numerical methods. Mainly studied was the steady axisymmetric supersonic flow about a blunt body and the transient flows which result when a smooth blunt body, either at rest or in supersonic motion, is struck by a shock wave such as might be created by an explosion. In each of the cases to which the method was applied, the results obtained were far less complete than could be found. Since the finite-difference methods tend to be more inaccurate where the present approach is successful, the two methods complement one another.

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