November 1970

Brief 70-10597

NASA TECH BRIEF

Digital Program Analyzes Supersonic Flow Field Within Bell-Shaped Rocket Nozzles

A digital computer program was written and developed for computing and analyzing the supersonic flow field within an axisymmetric, bell-shaped rocket nozzle for specified gas properties, nozzle geometry, and input or starting line.

This program determines the flow parameters throughout the nozzle for an ideal gas with a specified specific heat ratio γ; or for a reacting gas composition (frozen or shifting) for which the dynamic and thermodynamic properties are tabulated functions of Mach number. The program uses the axisymmetric method of characteristics for steady, irrotational, supersonic flow, and computes the wall pressure profile, nozzle thrust coefficient, and vacuum thrust efficiency.

The method of characteristics is used for the solution of a set of hyperbolic partial differential equations in steady supersonic, axisymmetric flow. The vector equations may be written which express continuity of flow, the potential or energy of flow, and irrotationality of flow. These vector equations (approximately 71) are used in this program, and may be expanded to a set of hyperbolic partial differential equations describing flow in the supersonic flow field. The partial differential equations can be further reduced to yield the total differential equations for the characteristic surfaces throughout the flow field.

Notes:

1. This program is written in FORTRAN II for the IBM 360 computer.
2. Inquiries may be made to:

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   Reference: B70-10597

   Source: J. J. Elliott and R. R. Stromsta of North American Rockwell Corp. under contract to Marshall Space Flight Center (MFS-14292)

Category 09