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NASA TECH BRIEF

Computer Program Analyzes and Designs Supersonic Wing–Body Combinations

A computer program has been designed which formulates a geometric description of the wing body configuration under study; optimizes wing camber shape; determines wing shape for a given pressure distribution; and calculates pressures, forces, and moments on a given configuration.

The complete program consists of five sections: geometry definition, geometry transformation, geometry paneling, aerodynamics, and flow visualization.

Geometry definition defines geometrically a wing, a body or a wing–body combination, writing the definition on a tape that is read by the next section of the program.

Geometry transformation reads the tape definitions, transforms the body and wing to a new coordinate system, orients the wing planform parallel to the x–y plane in the transform system, and finds the intersections of wing percent chord lines with the body surface. The configurations of wing alone, body alone, or wing–body combination can be handled and the results written on tape.

Geometry paneling does not act on the body-alone case. For the wing–body and wing-alone cases, this section combines the tape definition with the input data for body and/or wing cutting planes. The paneling description and the additional geometric data are written on an output tape for printout purposes and on a scratch tape for use in the next section.

Aerodynamics computes velocity components due to the various singularities and stores them on tape. Given the capability to carry out the above operation, the following basic types of problems can be solved:

(1) After optimization of the wing camber surface shape for minimum drag with either wing lift or lift and pitching moment constraints, the pressure distribution over the wing and body and the associated forces and moments on the airplane are calculated.

(2) The pressure distribution and forces and moments are obtained for a given configuration geometry (i.e., the solution to the direct problem).

(3) The wing camber and twist are found to produce a given wing pressure distribution (i.e., the solution to the indirect problem).

Flow visualization provides a method of analyzing the flow about the given configuration. Field velocity components, local flow vectors, and pressure coefficients in the field are calculated and presented along with the streamlines. An examination of the flow at points on a two or three-dimensional grid, or a flow analysis at individual field points, can be carried out.

Notes:

1. This program is written in Fortran IV and MAP for use on the IBM 7090/94 computer.
2. The program will be useful to anyone involved in aeronautical design or analysis.
3. Inquiries concerning this program may be made to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
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Patent status:

No patent action is contemplated by NASA.

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