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NASA TECH BRIEF

Lewis Research Center

Program for Calculating Laminar and Turbulent Boundary Layers in Arbitrary Pressure Gradients

The problem:

Along any surface where air is flowing it is often necessary to predict the growth of boundary layers. This is especially true in turbomachinery where boundary layer growth directly affects blockage and losses.

The solution:

A computer program has been developed to solve the two-dimensional, compressible laminar and turbulent boundary layer equations in an arbitrary pressure gradient. Transition from laminar to turbulent flow may be predicted or may be forced at any point by the user. If separation occurs, it is predicted for both laminar and turbulent flow. Initial input may be laminar boundary layer at a stagnation point or may be values for displacement thickness and momentum thickness in either laminar or turbulent flow.

How it's done:

Two integral methods, the Cohen-Reshotko and the Sasman-Cresci, are used to calculate the laminar boundary layer and the turbulent boundary layer, respectively. The program solves the momentum and moment-of-momentum integral boundary layer equations numerically. Transition from laminar to turbulent flow is predicted by the Schlichting-Granville method. Separation is predicted in the laminar regime when negative skin friction occurs. Separation is predicted from turbulent flow when the level of incompressible form factor reaches a specified limit.

The program is written to allow a variety of initial conditions: laminar boundary layer at a stagnation point, laminar boundary layer on a sharp leading edge, laminar boundary layer with initial displacement or momentum thickness given, or turbulent boundary layer with initial displacement and momentum thickness given.

Notes:

1. This program is written in FORTRAN IV for the IBM-7094 computer.
2. Inquiries concerning this program should be directed to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B72-10111

Patent Status:

No patent action is contemplated by NASA.

Source: W. D. McNally
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
(LEW-11097)

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