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NASA TECH BRIEF

Langley Research Center

Computer Program for Streamtube Curvature Analysis: Analytical Method

The problem:

The need for low-installed-drag and high-drag-divergence, Mach number nacelle installations is extremely critical to the success of the design of the NASA-developed supercritical wing.

The solution:

A computer program was developed to provide design information for low-drag, high-drag-divergence, Mach number isolated nacelles suitable for use with advanced high-bypass-ratio, turbofan engines. One element of such a program is the development of a method to predict the inviscid pressure distribution and flow field about an arbitrary axisymmetric ducted body at transonic speeds.

How it's done:

The inviscid solution technique is based on a streamtube curvature analysis. The computer program utilizes an automatic grid refinement procedure and solves the flow field equations with a matrix relaxation technique. The boundary-layer displacement effects and the onset of turbulent separation are included, based on the compressible turbulent boundary-layer solution method of Stratford and Beavers and on the turbulent-separation prediction method of Stratford.

This computer program has the capability of calculating the pressure distributions and flow fields, including viscous displacement effects, on a variety of internal and external shapes. The location of incipient turbulent boundary-layer separation is identified, if the calculated pressure gradients are sufficient to cause it. The predicted pressure distributions have been compared with the through-flow nacelle test results from the NASA-Langley 16-foot tunnel.

Notes:

1. This program was written in FORTRAN IV for the CDC 6000-series computers.
2. Inquiries concerning this program should be directed to:

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   112 Barrow Hall
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   Reference: LAR-11535

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