NASA TECH BRIEF
Lewis Research Center

FORTRAN PROGRAM FOR GENERATING A TWO-DIMENSIONAL ORTHOGONAL MESH BETWEEN TWO ARBITRARY BOUNDARIES

The Problem:

To develop a computer program which computes and plots the coordinates for a two-dimensional orthogonal mesh in the region between the walls of a flow channel.

The Solution:

A computer program designed for a channel containing a solid body about which the flow passes and which spans the channel from one wall to the other.

How It's Done:

Finite difference solutions to partial differential fluid flow equations require that a finite difference mesh be placed upon the solution region. And in most cases, the terms in the finite difference equations will be simplified if this mesh is orthogonal. This program computes and plots coordinates for a two-dimensional orthogonal mesh in the region between the walls of a flow channel.

The input to the program is designed so that the mesh spacing can be varied in the regions upstream of the immersed blade row, in the general space occupied by the blade row, and downstream of it. In this way, a region of particular interest can be covered with a finer mesh than is used in the other two regions.

This "immersed body" feature of the program can be easily removed, however, since the only way the body geometry affects the generated mesh is by designating the points of separation of the three mesh-size regions. The resulting program would have wide application in many fields where finite difference solutions are desired between the walls of an arbitrarily shaped channel.

Input to the program consists primarily of spline points describing the channel walls and the edges of the submerged body. These arrays of points must be smooth enough that they are capable of being accurately fitted with cubic spline curves. Therefore, they cannot contain any sharp discontinuities in slope.

The program divides the space between the walls into equal increments across the channel. Spline curves are then fit through the resulting points to obtain the through flow, or streamwise or "horizontal," orthogonals. The normal, or "vertical," orthogonals are obtained by means of a simple "predictor-corrector" technique in which normals to adjacent orthogonal lines are used. This technique is analogous to the second-order Runge-Kutta method for solving ordinary differential equations known as the improved Euler method of Heun's method.

The program is restricted to channels which are essentially horizontal; that is, the channel walls should not be inclined by more than about 45° with the horizontal plane. For axial turbomachinery this is not a serious restriction. This limitation could be removed in a more general recoding of the program. The program could also be extended to two-dimensional geometries with walls having noncontinuous slopes, as well as to some three-dimensional geometries.

Output consists of printed coordinates of the generated orthogonal mesh points, as well as the angles of the mesh lines at these points with the horizontal plane. One of the program's subroutines generates a microfilm plot of the channel input geometry and of the calculated orthogonal mesh.

Notes:

1. This program is written in FORTRAN IV for use on an IBM-7094 or 360-67 computer.
2. The plot routine makes use of Lewis in-house subroutines and equipment and would require recoding at another facility.
3. Inquiries concerning this program should be directed to:

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