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ALGORITHM FOR THE DETERMINATION OF CONDITIONS ON THE AXIS OF A CYLINDRICAL COORDINATE SYSTEM IN THE CALCULATION OF 3D VISCOUS JET FLOWS

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This paper addresses singularities in the calculation of 3D flow parameters in a multicomponent supersonic jet on the axis of a cylindrical coordinate system. This singularity is due to the presence of source-type terms in equations whose denominator has the radial coordinate, which becomes zero on the axis of a cylindrical coordinate system. The aim of this paper is to develop an algorithm for boundary condition determination on the axis of a cylindrical coordinate system in the calculation of a 3D supersonic jet in the "viscous layer" approximation. The "viscous layer" equations are solved by marching to give the flow field along the axis of the cylindrical coordinate system. The flow parameters at a node situated on the axis of the cylindrical coordinate system are determined by an explicit finite-difference scheme in a Cartesian coordinate system. The finite-difference discretization of the equations in the Cartesian coordinate system at a node on the axis of the cylindrical coordinate system is done by a cross scheme using the flow parameters at the nodes situated in the vicinity of the axis in the 0, /2, , and 3 /2 meridional planes. The flow parameters at the nodes in the vicinity of the axis in the meridional planes beyond the computation region are specified using the boundary symmetry condition in the boundary meridional plane. The obtained flow parameters on the axis in the new layer are used in boundary condition specification on the axis of the cylindrical coordinate system in all the meridional planes of the computational mesh. The proposed approach to singularity elimination in the calculation of flow parameters on the axis of a cylindrical coordinate system for 3D supersonic jet flows is new. Using this approach, one can rather simply generalize axisymmetric jet flow calculation algorithms to the case of arbitrary 3D non-axisymmetric flows in a jet. So an algorithm is developed for the calculation of a 3D asymmetric flow in a jet using a cylindrical coordinate system. The results obtained in this work may easily be introduced into 3D jet flow calculation algorithms.

Keywords: *cylindrical coordinate system*, *Cartesian coordinate system, jet axis, singularity, 3D flow, algorithm, boundary condition.*

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