DEVELOPMENT OF A NUMERICAL MODEL FOR ESTIMATION OF INLET TEMPERATURE OF A DUCT WITH BACKWARD FACING STEP

A dissertation submitted in partial fulfillment of requirement for the award of the degree of Master of Technology in Thermal Engineering by MITHUN TELANG (2010MET3027)

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CERTIFICATE

This is certify that dissertation entitled "Development of a Numerical Model for Estimation of Inlet Temperature of a Duct with Backward Facing Step" submitted by Mithun Telang to the Department of Mechanical Engineering, Indian Institute of Technology, Delhi, in partial fulfillment of the requirement for the award of the degree of Master of Technology in Thermal Engineering, is a record of student's original bonafide work done under my supervision and guidance. The matter embodied in this thesis has been submitted in part or full to anywhere for the award of any degree or diploma or for any other purpose.

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ABSTRACT

In the present work, a two dimensional forced convection heat transfer problem is considered. The main aim of work is to develop an algorithm for solving inverse heat transfer problems using the finite volume method (FVM) and conjugate gradient method (CGM). The objective is to predict the inlet temperature of the fluid flowing through a 2-D duct. Two different ducts are considered. The first one is a simple 2-D parallel plate channel and the second one is a duct with backward facing step. Formulation of the inverse heat transfer problem and discretization of the steady state governing equation are done using CGM and FVM respectively. The momentum equations for the rectangular duct are solved by an in house CFD code FASTED-3D and for duct with backward facing step; stream function-vorticity approach is used. A code in C language is developed to determine the temperature distribution inside the solution domain with known inlet temperature. These temperature distributions obtained are assumed as temperature measured by thermocouples to solve the inverse heat transfer problem. Another code in C language for a two dimensional geometry is developed to estimate the inlet temperature for the rectangular duct and duct with backward facing step. Results shows that satisfactory estimation of the inlet temperature can be obtained for the different test cases considered in this work.

**Keywords:** inverse heat transfer, finite volume method, inlet temperature estimation, conjugate gradient method, forced convection, backward facing step.
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