

## Computing an Incompressible Viscous Fluid Flow Using Neural Network Based on Modified Adaptive Smoothing Errors

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**Abstract.** An Adaptive Neural Networks (ANN) with Modified Adaptive Smoothing Errors (MASE) based on back-propagation algorithm are presented in this paper to investigate an incompressible viscous flow represents by stream line function ( $\psi$ ) through symmetrical double steps channels. Numerical simulation of fluid flow is complex and inappropriate in situations where rapid calculations are needed. The alternative proposal is used to construct learning system by enforcing two stages run simultaneously, the first stage concerns to construct FEM employing a new concept named adaptive incremental loading to selected patterns effectively while the second stage pertains to ANN based on MASE. The proposed training system is fast enough and the simulation results of the learning system are in good agreement with the available previous works.

**Key Words:** learning system; neural networks; incompressible flow; partial differential equations; finite elements; Adaptive smoothing error.

### 1. Introduction

Computer simulation of everyday problems has become the most common and effective tool of design and planning. The numerical algorithm to find the solution of Partial Differential Equation (PDE) that governing the fluid flow is not easy to solve specially for high range of Reynolds numbers and the solution needs a long time to get the approximate results. It is also very expensive with respect to the storage if mesh points refinement is used [1], [2]. Navier-Stokes Equations (NSE) is one good example. These equations have the widest of application as they govern the motion of every fluid, being a gas or liquid or a plasticized solid material acted upon by forces causing it to change the shape. The popular methods for the numerical solution of PDE's are Finite Difference Method (FDM), Finite Element method (FEM), Boundary Element Method (BEM) and Finite Volume Method (FVM) [3]. The earliest solution of NSE used non-simultaneous solver through FEM to implement stream line and vorticity ( $\psi-\omega$ ) formulation [3]. Zhenquan 2003 [4], [5] also applied a non-simultaneous solver using FEM and proposed an iterative technique. Modeling the dynamics of Turbulent Floods by using numerical simulation through FEM was studied by Z. Mei et. al. 2002 [6]. More recently, are envisioned neural networks approaches as an effective way of developing such models and incorporating them in feedback control algorithms [7]. This approach is based on many types of architectures, such as an artificial