Investigation of first and higher order Finite Difference Schemes for selected 1D and 2D Fluid Flow Problems

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Numerical simulation nowadays has become an effective tool to obtain quantitative information of flow field (velocity, pressure, etc) in real life fluid dynamics applications. Simulation of free surfaces is an essential task in a wide variety of circumstances such as the description of dam break waves, tidal flows, weather predictions and flows around structures. In many such applications, the domain of interest is characterized by different geometric scales. In such situations, the shallow water models are highly applicable.

In this paper, different numerical experiments (simulations) are presented for different fluid flow problems, namely, one-dimensional wave equation, two dimensional shallow water equations with an arbitrary bottom surface and a ground-water flow model based on Darcy's law. In first stage, it was focused to observe the nature of first order and higher (second) order finite difference schemes for the propagation of a simple wave. In second example, Neumann and reflective boundary conditions are used to obtain averaged velocity vector field and streamlines of a shallow water flow. Finally, approximate solutions of the surface water flow around an obstacle and also for the penetration of water through the soil are presented by applying Forward Time Centered Space (FTCS) scheme.

Key words: *One dimensional wave equation, Shallow water equations, Finite difference schemes, Ground-water flow model*