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Modelling of flow in open and closed conduits

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Abstract

In this paper a general algorithm for modelling flow in open and closed conduits is presented. The two models (for the free-surface flow and for the pressurized flow) are written in single formulation by introducing a common set of variables and solved utilizing Time Splitting Projection Method (TSPM). Then Double Sweep Method is implemented to model flow in pipe and river networks. The proposed model is validated by comparing the numerical results with some benchmark analytical examples. Comparisons prove the efficiency of the model for simulating flow in both open and closed conduits without using higher order accurate techniques.

Keywords: numerical modelling, one dimensional model, open conduits, closed conduits.

Introduction

Transient flow in open and closed conduits occurs accidentally or intentionally due to sudden change in water demands and water usage. Flood in the rivers, streams and lakes caused by snow-melt, opening or closing of control gates and waves in a river or a reservoir created by a dam break and starting or stopping the pumps or mechanical failure of devices are some examples of transient condition that can happen intentionally or accidentally. This phenomenon has been responsible for numerous losses. Thus, giving careful attention to this problem is of great importance. To investigate the effect of this phenomenon on flow in networks researches have derived and proposed various models by different approaches (Cunge et al, 1980, lai, 2002) some of the methods include Method of Characteristics (MOC), Wave Characteristics Method (WCM) and Finite Difference Method (FDM). In this paper a simple technique called Time Splitting Projection Method (TSPM) (Niroomandi et al, 2012) is implemented to solve the governing equations of the problem. The advantages of this technique are simplicity and faster execution time. This method has been used as an efficient means of solving the incompressible Navier-Stokes equations. On the other hand, when