« Research Note »
Investigation of the Free Surface Profile of a Steady Flow around a Cylindrical Pier Using Numerical Model

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Abstract

A numerical model has been developed to evaluate the profile of free surface flow around a cylindrical bridge pier. The Reynolds equations of the shallow waters have been discredited using the finite difference method. The resulting equations were then solved using the explicit MacCormack's technique. For the closed boundary conditions, the free-mirror condition has been imposed with non-uniform grids. The numerical model results were then verified against experimental data and the agreement between them was fairly good.

It was also found that for the small values of the Froude number, the model could predict the experimental data reasonably well, whereas for the large values of this number, there were some discrepancies between model results and measured data.

Key Words: Cylindrical Pier, Finite Difference Method, Maccormack's Technique, Froude Number.

Comparison of Deterministic and Stochastic Criteria for the Initiation of Sediment Motion in Tidal Basins

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Abstract

Current study is refinement and application of a two-dimensional horizontal numerical model to predict geo-morphological changes in tidal basins. An ADI finite difference algorithm has been used for solving the governing equations, which consist of the conservation of mass and momentum for the hydrodynamics, the transport equation for suspended sediment fluxes and the sediment mass conservation equation for bed level changes. The model includes three criteria for the initiation of motion (i.e. Shields (1936), Kolahdoozan (1999) and Zanke (2003)). Since the flow is turbulent, its components have a random nature and sediment transport processes can be expressed by stochastic approaches. In this study both deterministic and stochastic methods were included in bed load computations. Verification of model results have been carried out by an experimental study cited in the literature. Comparisons of results for different criteria for the initiation of motion shows that the unsteadiness parameters of current have a major effect on the bed level changes in comparison with turbulence structure of the flow.

Key Words: Initiation of Sediment Motion, Numerical Modeling, Sediment Transport, Stochastic Modeling, Deterministic Modeling.

Numerical Simulation of Bed Evolution in 180 Degree Alluvial Channel Bend

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Abstract

The river bed evolution in 180 degree alluvial channel bend is numerically simulated using FLUENT based on Eulerian two-phase model that implements Euler–Euler coupled governing equations for fluid and solid phases and a modified k–ε turbulence closure for the fluid phase. This two-phase model predicts sediment transport from more fundamental dynamical equations, thereby avoiding the use of purely empirical sediment transport formula. Such formulas have been found to be case-dependent, thus limiting their general use to cover a broad range of flow configurations. Both flow–particle and particle–particle interactions are considered in the model. During the simulations, the interface between sand and water is specified using a threshold volume fraction of sand, and the evolution of the bed form is studied in detail. The predictions of bed form evolution are in good agreement with previous laboratory measurements. In addition, the computational results indicate the presence of a new mechanism in sediment transport that can be called 'Laminated Load' hereafter.

Key Words: Bed Evolution, Channel Bend, Two-Phase Model, Numerical Simulation.

Hydraulics of Air-Water Flow in a Pressurized Pipeline Model Using Image Processing

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Abstract

The study of two-phase fluid flow is of great importance in tunnels and pressurized pipelines, due to the disturbances caused by pressure fluctuation, bubble bursting, energy release and erosion. The gas releases from the water as the pressure reduces, and, hence, trapped in water pipelines. This effect has been observed and found to be detrimental.

The image processing technique is applied for estimating different parameters such as; void fraction and length, period and celerity of unstable two-phase slug flow, using Photoshop and Matlab software, based on experimental model. Necessary images were collected using two digital cameras. It is shown that, the image processing technique can be used as a good tool for determination of two-phase flow characteristics. Results show that the slug flow characteristics including length, frequency and celerity have significant effects on void fraction. By increasing the air/water discharge ratio the void fraction increases and by in creasing the slug frequency the void fraction decreases.

Key Words: Two-phase flow, Air-water, Image processing, Void fraction.

Performance Assessment of two Applied Algorithm Controls in the West Main Canal of Dez Irrigation Network

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Abstract

Automating the irrigation networks is one of the new approaches for making a proper water management decision to improve the efficiency of these systems. In the present study, two robust control systems of the Local Upstream PI Feedback Control with Filters and Centralized Distant Downstream PI Feedback Control with Filters and Decouplers were designed and applied for the west main canal of Dez irrigation network. The control algorithms programmed in MATLAB m-files and connected to the SOBEK Canal Flow module through the SOBEK Real Time Control module. To evaluate the efficiency of the control algorithms, the performance criteria of the Maximum Absolute Error, Integral Absolute Error and Steady State Error were considered during the simulations of one month with regard to the real off takes schedule with the highest variations within the cropping season. The results indicated that the applied control algorithms have considerable potential to closely match the discharge at the downstream check structures with those ordered by water users while maintaining the water level throughout the length of the canal. It was also concluded that the centralized control system has more efficiency compared to local control system which provides flexible, demand oriented and accurate operation procedure. Considering that local upstream controller may be considered as an option, either as the main control system or as the backup system for the canal system automation.

Key Words: Hydrodynamic Model, Local control, Control Algorithm, Dez Irrigation Network.