« Research Note »

Numerical Simulation of Pressure Flushing Process in Sefid-Roud Dam

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Abstract

Use of water and soil conservation activities to control the soil erosion in Ghezel-Ozan and Shahroud watersheds is almost infeasible and therefore the Sefid-Roud reservoir sedimentation should be addressed by other ways. In this direction, it seems that the only applicable, successful and feasible way is to flush the deposited sediments out of reservoir. In the present study, the filed measured data of reservoir desiltation process are analyzed. Regarding that the numerical simulation of desiltation process can lead to a practical way to optimize the flushing operation by adjusting the bottom outlet gates maneuver rule, output hydrograph, reservoir water level fluctuations, in this paper a one dimensional model has been applied to the pressure flushing process. At the end, using computed results, some useful practical approaches to maximizing the next flushing operations are presented.

Keywords: Flushing, Numerical Model, Flushing Efficiency, Unsteady Flow, Chasse.

Automatic Calibration of Groundwater Models Using Constrained Optimization

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Abstract

Various optimization techniques for automatic calibration of groundwater models have been used effectively over past recent years. The present study is another attempt in the same direction through which a new computer model, developed on the basis of optimization technique, is discussed. Throughout the model, the well-known Finite Element Method (FEM) is utilized to discretize and solve the governing equations of groundwater flow. For the optimization part, Augmented Lagrange Multiplier Method (ALMM) is used to convert the constrained problem to an unconstrained problem, first. Then Davidon-Fletcher-Powell (DFP) optimization technique is utilized to solve the resulted unconstrained problem. The capabilities of the developed model are illustrated by employing an example. The results show fairly good performance of the model, although some limitations still exist.

Keywords: Groundwater, Modeling, Auto-Calibration, Optimization.

Simulation of Urmia Lake Level Changes and Its Uncertainty and Sensitivity to Water Budget Components

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Abstract

This research work is an attempt to simulate and analyze monthly water level changes in Urmia Lake. To this end, water budget, multiple regression and artificial neural networks (ANNs) approaches have been investigated, using monthly data of effective components of water budget equation such as input discharge, average rainfall and average evaporation. Furthermore, uncertainty and sensitivity analysis were employed to compare the simulation methods capabilities. The results suggested that ANNs model using monthly discharge, rainfall and evaporation as inputs gave best results with less sensitivity, but greater uncertainty.

Keywords: Urmia Lake, Simulation, Artificial Neural Networks (ANNs), Uncertainty, Sensitivity.

Evaluation of Geometrical Characteristics of Rock Joints on Hydraulic Behavior and Seepage through the Abutments of Concrete Arch Dams

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Abstract

Limitation of water flow and seepage from upstream to downstream through the abutments is a major factor in design of concrete arch dams. In practice, due to the intensive loading imposed on abutments, the concrete arch dams are usually constructed on the rocky abutments with high degrees of strength and stiffness. However, the hard rocks have always contained some discontinuities because of their intrinsic brittle manner. Since these discontinuities are the main ways through which most of seepage is occurred and thus tend to instability of foundation, their hydraulic and mechanical effects must be fully considered. In this paper the effects of geometrical parameters such as joints orientation and initial aperture are studied on hydraulic behavior and seepage through abutments. In addition, the effect of hydraulic initial aperture which is a hydraulic parameter is treated on the safety of abutments. The results show that the geometrical parameters have dominant influence on the seepage through abutments and can also endanger the stability of foundation.

Keywords: Concrete Arch Dam, Jointed Rock Mass, Seepage, Discontinuity.

Implicit Numerical Algorithm on Curvilinear Coordinates for Simulation of Free-Surface Flows

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Abstract
Numerical solution of flows with a freely moving boundary is of great importance in practical application such as ship hydrodynamics. Details are given of the development of a two-dimensional vertical numerical model for simulating unsteady and steady free-surface flows on a non-staggered grid in curvilinear coordinates, using a non-hydrostatic pressure distribution. In this model, Reynolds equation and the kinematic free-surface boundary condition are solved simultaneously, so that the water surface elevation can be integrated into the solution and solved for, together with the velocity and pressure field. In the computational space, the Cartesian velocity components and the pressure are defined at the center of a control volume, while the volume fluxes are defined at the mid-point on their corresponding cell faces. Detailed numerical results are presented for the wave generation above an obstacle and small amplitude Stokes waves. The results show that the numerical algorithm described is able to produce accurate predictions and is also easy to apply.

Keywords: Free Surface, Numerical Simulation, Non-Staggered Grid, Time Splitting Method, Unsteady Flow.

Real-Time Flood Forecasting Using Hybrid Neural Networks

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Abstract

Hybrid models which are based on methods which divide a complex simulation problem to several simple local models and combine the results, potentially could result in different output. The input space in this method is divided into subspaces, and then some single models are assigned to each specific region of the space. In this research by using some floods generated by a hydrologic model, advantages of hybrid models in real-time flood forecasting compared to global models was investigated. To do this, the results of a global ANN model which simulates whole of the flood processes using a single model, are compared with that of two hybrid models, one consisting of a 4 ANN and the other consisting of 8 ANN. The results shows that hybrid models have significantly better results in flood forecasting specially in forecasting time and amount of peak discharges. This is very important in flood forecasting in flood warning systems because of their important role in flood mitigation activities.

Keywords: Flood Forecasting, Real-Time, Hybrid Neural Networks, Rainfall-Runoff, Fuzzy Clustering.