Name: Kiyoumars **Surname:** Roushangar

Title: Mathematical modeling of open channel flow with movable bed using artificial intelligence.

Supervisor: Dr.Y.Hassanzadeh & Dr.M.A.Keynegad
Counselor teacher: Dr.M.T.Alami & Dr.D.Farsadizadeh

Education level: ph.d **Field:** Civil Engineering
Faculty: Civil Engineering **University:** Tabriz
Date of graduation: **No. of pages:**
Key words: Saint Venant Exner-coupled –uncoupled-GA-GP-Manning coefficient

Abstract:

In this research, a mathematical model is presented for studying unsteady flow, aggradations and degradation in alluvial channels. One- dimensional, unsteady, gradually varied flow equations (Saint-Venant equations) and sediment continuity equation, are solved numerically by the second- order accurate, explicit finite difference two steps scheme developed by Richtmeyer and Mac cormack. All three governing equations are solved simultaneously during any step so that the water – flow equations and sediment continuity equation are coupled. At first the simulation of flood flow in Badalan interval located at the Aland river (a coarse bed river) is considered. Results show that, this model is capable to simulate unsteady flow, aggradation and degradation satisfactorily.

Then new laboratory experiments were performed in a mobile –bed flume for both of steady an unsteady flow to validate the proposed model .For improving the simulation , firstly , the role of sediment transport formulas, coupled / uncoupled approaches and simplification in the mass continuity equation are investigated .Compares between experimental data and model performance highlight the advantage of coupled method over the uncoupled method, domain role of sediment transport model in the bed morphological simulation and inaccuracy of aggradation processes due to simplifying the mixture continuity equation. Secondly the importance of changing alluvial roughness is established by testing the model with calibrated and optimized friction factors. The inverse problem of estimating alluvial flow roughness is solved using a genetic algorithm optimization model coupled with alluvial flow model. The study demonstrates that application of GA in the search for optimal values of roughness coefficients can significantly reduce computational errors and improve the computed water stage hydrographs. Role of the choice of the objective function is mentioned.

In next stage, Genetic programming is used for modeling Manning Roughness of movable bed. For this purpose, some experiments are done in CNRS hydraulic laboratory (Caen university). Results show high accuracy of GP in simulation of movable bed roughness coefficient. According to statistical parameters, water surface slope is an important parameter in determination of friction factor and elimination of Reynolds number will increase error of modeling. Results of GP show that objective function and kind of functions have important effect in simulation procedure.