Temporal Evaluation of Scour Hole Dimensions Due to Plain Wall Jets in Non-Cohesive Sediments Using Soft Computing Approach: White-Box vs. Black-Box Modelling

Reza Barati[1], Mojtaba Mehraein[2], and Mohammad Javad Alizadeh[3]

[1]Tarbiat Modares University
[2]Kharazmi University
[3]Water Research Institute

October 15, 2023

Abstract

This study analyzed the temporal variation of scour hole dimensions caused by a plain wall jet, which is one of the most hazardous issues faced by hydraulic structures. The study employed two recently developed artificial intelligence-based models, Extreme Learning Machine (ELM) and Multi-Gen Genetic Programming (MGGP), to predict scour hole dimensions and identify effective parameters. Both models accurately predicted the scour hole dimensions, with MGGP outperforming ELM for both training and testing data. MGGP presented four equations that can be used by designers to predict the temporal variations of scour hole dimensions with high accuracy. The non-dimensional form of the scouring time was found to be the most effective parameter, while the channel width ratio and standard deviation of sediments had negligible effects on the accuracy of the models. The study found that the effectiveness of the densimetric Froude number should be considered for predicting the temporal variation of scour hole dimensions due to plain wall jets. The proposed equations from both models had higher accuracy than previous empirical models. Overall, this study provides valuable insights into predicting and mitigating jet scour problems in hydraulic structures.

Hosted file

`Final manuscript.docx` available at https://authorea.com/users/673412/articles/672204-temporal-evaluation-of-scour-hole-dimensions-due-to-plain-wall-jets-in-non-cohesive-sediments-using-soft-computing-approach-white-box-vs-black-box-modelling