Local Scour Prediction Model

Introduction

Welcome to the Local Scour Prediction Model manual. This document provides you with a comprehensive guide on how to use the Local Scour Prediction Model, which employs the powerful XGBoost algorithm and Interpretability techniques to predict local scour in various scenarios. Local scour refers to the erosion of sediment around structures like bridge piers or abutments due to flowing water.

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1. Overview

The Local Scour Prediction Model is designed to predict local scour depths around structures in water bodies. It utilizes the XGBoost algorithm, a state-of-the-art machine learning technique, and Interpretability (IML) techniques to provide accurate predictions and insights into the model's decision-making process.

2. Prerequisites

Before you begin using the model, ensure you have the following:

- Python installed (recommended version: 3.6+)
- Required libraries (XGBoost, Shapley, Pandas, Scikit-learn, Matplotlib, Seaborn, etc.)

3. Data Preparation

The model requires input data containing parameters that influence local scour. Prepare a CSV file with the following columns:

- b/d_{50}: Ratio of sediment diameter to structure width
- y/b : Ratio of flow depth to structure width
- Fr : Froude number
- V/V_c : Ratio of flow velocity to critical velocity

Ensure the CSV file is named `"inputdata.csv"` and located in the same directory as your script.

4. Model Training

- The model uses the XGBoost algorithm with carefully tuned hyperparameters for optimal performance.
- Data is split into training and test sets using `train_test_split`.
- The model is trained using the training set and evaluated on the test set.
- Evaluation metrics include RMSE, NMSE, I, SI, NSE, R2, B, and Se.

5. Model Interpretation

- Interpretability techniques (SHAP) are employed to understand feature importance and the model's decision-making process.
- SHAP values provide insights into how each feature contributes to model predictions.
- Various SHAP plots, including force plots, summary plots, and dependence plots, are generated.

6. Using the Model

To make predictions using the model:

1. Run the script and provide the necessary inputs when prompted.
2. Enter the number of predictions you want to make.
3. Input values for b/d_{50}, y/b, Fr, V/V_c for each prediction.
4. The model will provide predicted local scour depths for each input.

7. Conclusion

The Local Scour Prediction Model powered by XGBoost and Interpretability techniques offers accurate predictions and valuable insights into the factors influencing local scour. Whether you're an engineer, researcher, or water resource professional, this model can help you make informed decisions related to the protection of structures in water bodies.

Disclaimer

This model provides predictions based on the available data. While efforts have been made to ensure accuracy, the predictions should be validated against actual field data before making critical decisions.