The prediction of planform in meandering rivers using Machine learning models

La prédiction de la forme du plan dans les rivières sinueuses à l'aide de modèles d'apprentissage automatique

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RÉSUMÉ

Les rapides progrès du domaine de l'apprentissage automatique ont amené ce domaine à différentes applications telles que les études environnementales et l'ingénierie fluviale. À ce jour, cette technique n'a pas été employée pour l'étude des fleuves à méandres sinueux. Dans l'étude ici présente, l'utilisation de différents modèles d'apprentissage automatique tels que la « Régression linéaire », le « Réseau de neurones à propagation avant », « Machine à vecteurs de support » ainsi que l' « XGBoost » ont été utilisés pour prédire le taux de migration de la rivière sur un lapse de temps. Ensuite, après validation du modèle à l'aide du lapse de temps, l'étape suivante a été donnée à la machine sous forme de données inédites pour la prédire. XGBoost (gradient extrême) a les meilleures performances en termes de prédiction, précision et de régression linéaire.

ABSTRACT

The rapid progress in the machine learning domain brought this field into different domains such as environmental studies and river engineering. To the best of our knowledge, this technique has not yet done meandering river investigations. In this study, using different models of machine learning such as “Linear regression,” “Feedforward neural network,”,“Support vector machine,” and “XGBoost” have been employed to predict the planform of the meandering river for a time step(Planform evolution). Then after validation of the model using the time step, the next step has been given to the machine as unseen data to predict it. XGBoost (Extreme gradient) has the best performance in the prediction and accuracy and Linear regression.

KEYWORDS

Machine learning, meandering rivers, Planform evolution, migration rate, XGBoost, Support vector machine, Linear regression

1 INTRODUCTION

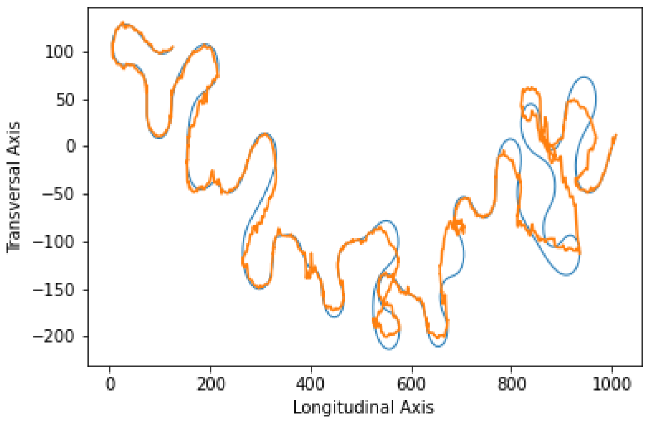
River meandering is the natural process that many lowland rivers undergo as a consequence of the alternation of bank erosion and accretion, which leads to the signature sinuous shape of the so-called meandering rivers. Recently, the increasing interest of the scientific community in the study of meander dynamics has led to a handful of approaches. (M. G. Kleinhans, 2010)(Bogoni, 2017; Gary, 1976; Hooke, 1980; Ikeda et al., 1981; Maarten G. Kleinhans & van den Berg, 2011; Lanzoni & Seminara, 2006; Leopold & Wolman, 1970; Federico Monegaglia et al., 2018; Seminara, 2006; Zolezzi & Seminara, 2001a)) Due to the lack of employing new techniques such as data science methods, these approaches (Analytical and numerical solutions) have been influential infield and the only progress that they faced was an acceleration in the speed of computation while in the new era of producing a huge amount of data like remotely sensed data, it does worth to use new methods. Only very recently has the growing, transdisciplinary field of artificial intelligence (AI hereafter) been considered in the context of meandering river morphodynamics(Amini , Hossein. Monegaglia , Federico. Zolezzi , Guido. Olivetti Emanuele. Tubino, Marco, 2021).

2 MATERIAL AND METHODS

The input data for feeding machine comes from a semi-analytical model which was developed by (bogoni et al 2017). Also the ML models that have been considered were Linear regression, feedforward neural network and XGBoost. It should be pointed out that, for FFNN and XGBoost, different combinations of the hyper parameters have been considered and the results are according to the best output.

3 RESULT AND DISCUSSIONS

The results based on the complexity of input data and the model that was used differs. The Root mean squared error as a metric for evaluating the model illustrates the accuracy for test dataset in XGBoost is less than the others which means the better result in comparison with the rest of models.



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