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Geomorphological hazards assessment using machine learning and data fusion

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Turbulent flows may destabilise riverbeds and banks, transporting sediment or underscouring hydraulic infrastructure built near water bodies. For example, scour is a significant challenge that can affect the stability of bridge foundations as the transport of sediment around a bridge pier may cause structural instabilities and catastrophic failures. The aim of this study is to use machine learning techniques & data driven algorithms to predict how energetic turbulent flow events can result in the removal of individual sediment grains, resting on the bed surface or on the protective armour layer around built infrastructure.

The flume experiments involve flow and particle motion data gathering campaigns [1]. Turbulent flow data are collected upstream the exposed target particle using acoustic Doppler velocimetry. Particle's motion data are gathered using novel micro-electro-mechanical sensors embedded within its waterproof casing, for a range of flow conditions. The obtained data are fed into neural networks having distinct algorithmic complexity (inputs, levels and neutrons). A comparison of the performance of the various model architectures, as well as with past ones [2], is conducted to identify the optimal predictive algorithm for the configuration tested. Sensor data fusion combined with artificial intelligence techniques are shown to provide a unique tool for live and robust data-driven predictions to help tackle significant engineering problems, such as geomorphological activity and scouring of infrastructure (eg bridge piers and embankments) due to turbulent flows, which become increasingly more challenging, under the scope of climate change and intensifying extreme weather hazards.

References

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