Announcement of a BSc thesis/study project

with the topic

Critical review on the potential use of Artificial Intelligence in the identification of locations in rivers prone to geomorphic processes

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Motivation

Rivers are dynamic systems in which non-linear interactions occur between the water phase, fixed and erodible boundaries, moving sediment and debris, and vegetation. The modelling of hydro-morphodynamic processes in rivers, although essential, is challenging. It is crucial to understand where the main geomorphic changes may occur in a river for: risk management of the catchments (locations of rived bed scouring, bank collapse, etc); river ecology (for the application of river restoration measures) and to ensure a safe and reliable implementation of infrastructures. The characterization of the geomorphic trends (accretion of degradation) in the river network over a large scale (river basin) is an essential tool for river managers. Using shallow water numerical models to analyze large areas may prove too costly and Artificial Intelligence (AI) have the potential to overcome this.

The use of AI is common nowadays, from the most trivial human actions (going to the supermarket or taking the train) to the most complex applications (neuro surgery or visiting Mars). Examples of application of AI in river morphology problems exist already (Ara Rahman & Chakrabarty, 2020; Matos et al., 2018; Zhu & Piotrowski, 2020). However, this topic is still quite novel and its potential to identify critical areas prone to geomorphic changes in the catchment, using a combination of low to high resolution information (maps, photos, media, etc), is yet to be explored.

Research objective

With this research we intend the student to:

1. Describe and discuss what is AI and know the fundaments of the implementation of AI in engineering problems.

2. Identify the possible uses of AI in the identification of locations prone to consequent geomorphic change and the relevant data to be used.

3. Identify knowledge gaps and opportunities for further research in the application of AI to river morphology.

Methods

The work is mainly desk work, including critical reading of the state-of-the-art publications on the subject and consultation of available data. The student should also identify the correct networks of discussion of the topic, at the National and International level.

The student should use as reference a combination of historical and modelling data to be sourced to an AI model framework. WB-IWG has been developing work on the modelling of river processes for more than two decades, which provides an excellent context for this work. Other data to be considered for potential applications include online and freely available publications (satellite images, media coverage etc). The student should understand how a combination of historical data with numerical model results can be used to identify areas prone to geomorphic changes in the rivers network. The student is expected to provide a critical assessment of the potential of AI in the context of river modelling and to be able to discuss the possible applications of AI in the context of Hydraulic Engineering.

The final report should contain a literature review about AI, a state of the art on river morphology modelling approaches, a critical analysis of the potential use of AI for the identification of geomorphic changes in rivers, the identification of the main steps towards a platform for river morphology modelling based on AI, the identification of needs in terms of research and development for the use of AI in the identification of geomorphic changes in rivers. The final document is to be redacted in English and the discussions and presentations will also be done in English.

References

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