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Letter to Editor Open Access

In Civil Engineering, an Overview of Physics-Based Machine Learning

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Introduction

Civil engineering is a branch of civil engineering that deals with the even academics who construct ML models don't comprehend how variables are integrated to produce predictions because they're created straight from data by an algorithm. Even when given a list of input variables, black-box predictive ML models can be so complicated that no one can understand how the variables are related to arrive at a final forecast. For instance, ML models that fail to forecast structural damage and are related to processes that aren't well understood have a hard time meeting high data requirements. As a result, they have a large data need, difficulties producing physically consistent results, and a lack of generalizability to out-of-sample events. To test ML and DL models [1]. Large, curated data sets with well-defined, accurately labelled categories are used. For these issues, DL works nicely.

In civil engineering applications such as seismic risk mitigation, irrigation management, structural design and analysis, and structural health monitoring, physics-based numerical simulations have become vital. Thanks to the advent of high-performance computers, civil engineers and scientists may now use complex models for real-world applications, with ultra-realistic simulations involving millions of degrees of freedom[2]. However, such models are too time-consuming in the civil engineering sector to be completely integrated into an iterative design process. While most design procedures rely on simpler models, they are frequently limited to the final validation and certification stages. Accelerating complicated simulations is a critical issue to solve since it will make it simpler to use numerical tools in the design process[3]. Numerical techniques for quick simulations would also be developed.

Description

Since the year 2000, machine learning has progressively gained traction in civil engineering, and it now plays a larger role in the development of automated technologies [4-5]. However, due to their huge data needs, difficulty to deliver physically consistent findings, and lack of generalizability to out-of-sample events, even the most advanced black-box ML models have had little success in civil engineering.

Conclusion

The key difficulties are obtaining high-quality data and mitigating the effects of the site environment. Following a thorough review of the literature on the subject, this study proposes that many teams might collaborate to create an enormous and complete database using the same annotation criteria to alleviate the data collecting challenge. ML is now being used mostly as a technique by civil engineering researchers.

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