# A Comparative Study of Wavenet and XGBoost for traditional direct wave propagation and seismic inversion using horizontal layer models

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## Abstract

The application of machine learning in Geophysics has steeply increased in the last decade, with the quality of their results varying according to the type of seismic problem in focus and employed computational method. Deep learning methods are reaching impressive results in this area, but we note that there is still a lack of certainty on whether classical machine learning methods could or not provide similar results. In the present work, we report on a comparison of a method based on Wavenet network for direct wave propagation and the seismic inversion of 2D horizontally-layered models, presented in 2020 by Monseley et al (2020), against a traditional XGBoost method. We used a dataset consisting of 20,000 instances, each one represented by a depth velocity profile with 236 values and a seismogram with 11 traces of 600 samples each, provided by the author. We also used the Wavenet code with its tuning parameters as the authors provided. The XGBoost was fine-tuned using the first 3,000 instances (1,000 for training and 2,000 for testing) for both the direct propagation and seismic inversion problems, separately. Then, for the two problems, the Wavenet and the XGBoost were trained using the first 18,000 instances and tested on the remaining instances of the dataset. The overall results show that the Wavenet reaches lower MSE between predicted and correct outputs than the XGBoost's outcome. Nevertheless, the results of XGBoost are not negligible as they are between 1.5 to 2.0 times larger than the Wavenet's results in a scale of $1x10^{-4}$. Furthermore, by adopting a compact representation of the velocity profile in the direct propagation problem and combining it with a reflective profile (this last one already used by the Wavenet as well), we could improve the result of the XGBoost towards the Wavenetś superior. This suggests that including other features we may further improve the prediction of the XGBoost. One challenge yet not dealt with is that the Wavenet can train well in GPU, but did not succeed in doing the same with the XGBoost, due to the amount of data to be processed.