Tuning Machine Learning Models for Geological Uncertainty Accuracy and Precision

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ABSTRACT

Machine learning hyperparameter tuning relies on minimizing the prediction error and maximizing the accuracy at withheld testing data locations. However, due to limited data veracity, data sparsity, and feature heterogeneity in the subsurface geological prediction models, the accuracy of a single estimate is insufficient. Instead, we require an accurate and precise uncertainty distribution.

Various machine learning algorithms integrate uncertainty in their predictions, yet there is no metric to evaluate the goodness, precision, and accuracy of the trained and tuned uncertainty models. To generate accurate and precise uncertainty models, we propose a novel method to compare the entire uncertainty model based on the prediction realizations and withheld known values with a cross-validation framework to calculate the uncertainty model goodness metric.

Our proposed method tunes machine learning model hyperparameters to provide good machine learning-based uncertainty models for any subsurface prediction problem, essential for the broad application of machine learning in the geological context.

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