Ensemble Learning for bioprocess dynamic modelling and prediction

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Abstract

Machine learning techniques have been successfully used to simulate and optimise bioprocesses. This study explores the feasibility to apply Gradient Boosting, an emerging Ensemble Learning algorithm, which combines weak learners to generate better predictions for bioprocess dynamic modelling and prediction. A thorough procedure was presented for Gradient Boosting based data-driven model construction. Different case studies were employed including fermentation and algal photo-production processes. Given that generating a large size of experimental data for model training is time consuming and challenging to many bioprocesses, this work launched a first investigation on the data efficiency of Gradient Boosting by comparing its predictive capability against the predominantly used artificial neural networks. By carrying out a series of experimental verifications over a broad spectrum of process operating conditions, this study concluded that Gradient Boosting may have several advantages in small experimental datasets and can outperform artificial neural networks for bioprocess predictive modelling, indicating its potential for future bioprocess digitalisation and optimisation.

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