Prediction of the Future State of Photobioreactors Using Time Series Prediction Algorithm

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Abstract

Time series prediction techniques can predict the future state of a system and play an important role in the intelligent control of bioreactors. Considering the unique operational characteristics of cyanobacteria bioreactors, this study evaluates the predictive performance of various time series forecasting algorithms on critical parameters (e.g., biomass, CO2 concentration), providing a theoretical and technical basis for developing an efficient and stable intelligent control system. The results show that LSTM, Bi-LSTM and CNN-LSTM algorithms can accurately predict the future data of the reactor, while Transformer and Autoformer algorithms are unable to realize the prediction function due to insufficient data. Among them, CNN-LSTM has the best prediction results and its MAPE can reach 0.78%. In addition, since bioreactor datasets often have the problem of insufficient data, this study also investigates the prediction performance of the algorithms in the case of small sample size, and finds that the CNN-LSTM can still achieves accurate prediction, and its MAPE can reach 0.95% using a training set of 400 samples. The results of the study show that the CNN-LSTM has the best prediction result in the bioreactor prediction problem.