DEVELOPMENT OF REAL-TIME MONITORING SYSTEM AND DATA-DRIVEN DIGITAL TWIN MODELS FOR FORECASTING MULTI-STEP AHEAD CELL CULTURE PERFORMANCE

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Key Words: Bioprocess digital twin, Raman spectroscopy, Real-time monitoring, Machine learning, Deep learning

Raman spectroscopy is a powerful in-line analysis solution for real-time monitoring and control of key performance indicators in bioprocess digital twin (DT) platform. However, due to the complexity of operational conditions during cell culture in a bioreactor, one of the current technical challenges is to measure critical process parameters (CPP) and relevant critical quality attributes (CQA), and build reliable Raman chemometric models. Herein, we developed in-house Raman monitoring system for detecting multi-attributes simultaneously and applicable model algorithm by overlapping spectral regions deconvolution, thus characterizing the unique features of target compounds. As a proof-of-concept, the algorithm was applied to twenty amino acids in CHO cell cultures. In addition, with the data generated from real-time monitoring via open platform communications (OPC) system, various data-driven artificial intelligence (AI) algorithms and prediction strategies were evaluated and selected for forecasting the culture performance such as cell growth and productivity. In this work, our current efforts on Raman-based monitoring system and data-driven modeling are presented with open discussion on the current challenges within bioprocess DT platform. [The research was supported by the Korea Innovation Foundation grant (2021-DD-UP-0369) funded by Ministry of Science and ICT, and the National Research Foundation of Korea (NRF) grant (No. 2022R1A4A5032720) funded by MSIT.]