Multivariate Dynamic Inferential Sensor Development for Multi-step Forecasting of Process Quality Variables

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Hard-to-measure quality variables in real time significantly impedes the effective operations in process industries leading to several losses. Hence, the development of inferential sensors which can handle relatively large measurable process variables is imperative for timely estimations and quick decision making. In this study, an integrated LSTM inferential sensor which captures the dynamics and non-linear relations in process variables is developed to provide real-time quality prediction and a couple of forecasts into the immediate future. The model employs multi-head and multi-tail strategies for efficient extraction of process dynamics from the multivariate data based on feature trend similarities. To demonstrate the model's accuracy, it was implemented on Tennessee Eastman Process to predict product stream compositions which take several hours to measure at the lab. Furthermore, it was compared with a partial least squares model that uses latent variables for performance analysis. Apart from the model's ability to infer quality variables from input features, it can be utilized as a base forecasting model for process monitoring, optimization and control.