A Probabilistic Approach to Multivariate Time Forecasting in Industrial Processes

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Abstract: Industrial processes contain a massive amount of monitoring data that can be exploited to reveal hidden time losses in the system, leading to enhanced accuracy of maintenance policies and, consequently, increasing the effectiveness of the equipment. In this work, we propose a method for one-step probabilistic multivariate forecasting of time variables based on a Hidden Markov Model with covariates (IO-HMM) that accounts for the correlation of the predicted variables with its past values and additional process measurements. The probabilities within the discrete Markov Chain are updated using Bayesian principles, while the parameter estimates for the continuous model are recursively computed through an adaptive algorithm. This approach permits the integration of new samples into the estimation of unknown parameters, computationally improving the efficiency of the process. We evaluate the performance of the method using a real data set obtained from a company in the food sector; however, it is a versatile technique applicable to any other company. The results show a consistent improvement over a persistence model, which assumes that future values are the same as current values, and over univariate versions of our model.