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Linearizing Convolutional Neural Networks for Performance Evaluation and Optimization of Stochastic Flow Lines

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Abstract

Simulation is widely used for evaluating stochastic manufacturing systems, due to its adaptable modelling capacities and the absence of exact or even approximate analytical solutions. Solving decision problems with integrated simulation models can be time-consuming, due to the need for many replications and the combinatorial nature of many problems. To increase the speed of the evaluation of the performance measures of a manufacturing system, the existing literature suggests replacing simulation with Artificial Neural Networks pretrained with simulation results. We train a Convolutional Neural Network (CNN) with flowline feature data to predict the throughput of a flowline configuration. We then solve optimization problems, by linearizing the trained CNN, thereby transforming the non-linear problem into a mixed-integer linear problem (MILP), which is tractable by standard solvers. Furthermore, the impacts of different sampling methods for generating training data and regularization methods are investigated.