Reinforcement Learning for Quality-Oriented Production Process Parameter Optimization Based on Predictive Models

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Abstract : Producing faulty products can be costly for manufacturing companies and wastes resources. To reduce scrap rates in manufacturing, process parameters can be optimized using machine learning. Thus far, research mainly focused on optimizing specific processes using traditional algorithms. To develop a framework that enables real-time optimization based on a predictive model for an arbitrary production process, this study explores the application of reinforcement learning (RL) in this field. Based on a thorough review of literature about RL and process parameter optimization, a model based on maximum a posteriori policy optimization that can handle both numerical and categorical parameters is proposed. A case study compares the model to state–of–the–art traditional algorithms and shows that RL can find optima of similar quality while requiring significantly less time. These results are confirmed in a large-scale validation study on data sets from both production and other fields. Finally, multiple ways to improve the model are discussed.

Keywords : reinforcement learning, production process optimization, evolutionary algorithms, policy optimization, actor critic approach

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