World Academy of Science, Engineering and Technology
International Journal of Industrial and Manufacturing Engineering
Vol:17, No:07, 2023

A Framework of Dynamic Rule Selection Method for Dynamic Flexible Job Shop Problem by Reinforcement Learning Method

Authors : Rui Wu

Abstract : In the volatile modern manufacturing environment, new orders randomly occur at any time, while the pre-emptive methods are infeasible. This leads to a real-time scheduling method that can produce a reasonably good schedule quickly. The dynamic Flexible Job Shop problem is an NP-hard scheduling problem that hybrid the dynamic Job Shop problem with the Parallel Machine problem. A Flexible Job Shop contains different work centres. Each work centre contains parallel machines that can process certain operations. Many algorithms, such as genetic algorithms or simulated annealing, have been proposed to solve the static Flexible Job Shop problems. However, the time efficiency of these methods is low, and these methods are not feasible in a dynamic scheduling problem. Therefore, a dynamic rule selection scheduling system based on the reinforcement learning method is proposed in this research, in which the dynamic Flexible Job Shop problem is divided into several parallel machine problems to decrease the complexity of the dynamic Flexible Job Shop problem. Firstly, the features of jobs, machines, work centres, and flexible job shops are selected to describe the status of the dynamic Flexible Job Shop problem at each decision point in each work centre. Secondly, a framework of reinforcement learning algorithm using a double-layer deep Q-learning network is applied to select proper composite dispatching rules based on the status of each work centre. Then, based on the selected composite dispatching rule, an available operation is selected from the waiting buffer and assigned to an available machine in each work centre. Finally, the proposed algorithm will be compared with well-known dispatching rules on objectives of mean tardiness, mean flow time, mean waiting time, or mean percentage of waiting time in the real-time Flexible Job Shop problem. The result of the simulations proved that the proposed framework has reasonable performance and time efficiency.

Keywords : dynamic scheduling problem, flexible job shop, dispatching rules, deep reinforcement learning
Conference Title : ICOPRMIE 2023 : International Conference on Operational Research, Management and Industrial Engineering
Conference Location : London, United Kingdom
Conference Dates : July 24-25, 2023