Approximate dynamic programming for an energy-efficient parallel machine scheduling problem

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In this paper, we propose an approximate dynamic programming approach for an energy-efficient unrelated parallel machine scheduling problem. In this scheduling problem, jobs arrive at the system randomly, and each job's ready and processing times become available when an order is placed. Therefore, we consider the online version of the problem. Our objective is to minimize a combination of makespan and the total energy costs. The energy costs include cost of energy consumption of machines for switching on, processing, and idleness. We propose a binary program to solve the optimization problem at each stage of the approximate dynamic program. We compare the results of the approximate programming approach against an integer linear programming formulation of the offline version of the scheduling problem and an existing heuristic method suitable for scheduling problem with ready times. The results show that the approximate dynamic programming algorithm outperforms the two off-line methods in terms of solution quality and computational time.

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