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Design of Reconfigurable Cellular Manufacturing Systems with Alternative Routing

Cellular Manufacturing Systems (CMSs) have become one of the most studied topics in the literature and successfully adopted by the industry. These systems allow reduction of production time, set-up efforts, work-in-process, and an increase in productivity by grouping machines and products into cells and families, respectively. However, these systems are struggling to adapt to recent market trends, which have fluctuating demands and volumes and frequent product introductions. As a response, a new manufacturing paradigm, Reconfigurable Manufacturing, has been proposed. Reconfigurable Manufacturing Systems (RMSs) can adjust their capacity and functionality by reconfiguring the system and its components on hardware and software levels. The key components of these RMSs are so-called Reconfigurable Machine Tools (RMTs) which have a modular structure that provides machine scalability and convertibility, i.e., they combine different modules providing a variety of functionalities. Merging CMSs and RMSs results in the concept of Reconfigurable Cellular Manufacturing Systems (RCMSs). In our work, we propose an ILP model to solve a multi-period RCMS design problem under consideration of alternative part routings while minimizing inter-cellular transportation, processing, and (re)configuration costs. The problem consists of allocating RMTs and their tools to the cells and the RMTs respectively, deciding part routings, and planning reconfiguration of the RMTs, concurrently.