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EDITORIAL

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Scheduling and control of automated manufacturing systems

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Most manufacturing industries have increasingly used automated manufacturing and assembly systems. To remain competitive in a global economy, manufacturing enterprises seek to meet diverse customer desires by the development of top-quality products and to achieve productivity gains through flexible automation and computer control of manufacturing processes. This in turn requires much more sophisticated scheduling and control technologies to exploit the full capabilities of modern, advanced automated manufacturing equipment.

There are many unique issues and challenges in modeling, analyzing, and optimizing scheduling and control decisions for modern automated manufacturing systems. OR methodology has received considerable attention to address these issues and challenges because operations in automated manufacturing systems are systematic, automatic, and complicated. However, recent technological advances in automated manufacturing systems increasingly require new ideas and challenges based on OR for leading-edge efficiency and competitiveness.

The primary objective of this special issue of *OR Spectrum* is to address these critical needs and to examine new research issues. From 16 submissions, 6 papers have been selected for publication.

The first paper by *James R. Morrison and Donald P. Martin* analyzes the performance of photolithography cluster tools utilized in the production of semiconductor wafers by means of queueing models. Photolithography cluster tools are typically the most expensive tool set in semiconductor production and

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often constitute a bottleneck of the entire production system. The proposed modeling framework allows to evaluate the cycle time and throughput rate of these bottleneck resources.

A detailed scheduling model for oxide–nitride–oxide stacked film fabrication in semiconductor manufacturing is developed by *Chen-Fu Chien and Chien-Hung Chen*. They consider specific features arising in real industrial settings such as waiting time constraints and frequency-based setups. To solve this complex scheduling problem, a genetic algorithm for batch sequencing is proposed and combined with a novel timetabling algorithm.

In their paper, *Naiqui Wu and Mengchu Zhou* address a real-time deadlock-free scheduling problem for a track system in semiconductor manufacturing. They develop an effective modeling tool based on colored timed resource-oriented Petri nets. The proposed methodology includes a controller tool for deadlock avoidance and heuristic rules for real-time scheduling.

In the subsequent paper, *Ada Che and Chengbin Chu* analyze a cyclic hoist scheduling problem in large real-life electroplating lines. They provide a formal analysis of the problem and develop a branch-and-bound scheduling algorithm. Numerical results show that the proposed algorithm is very efficient for scheduling large electroplating lines.

The problem of designing a unidirectional flow path for an automated guided vehicle system is addressed by *Yoonho Seo*, *Chulung Lee*, *and Chiung Moon*. They develop a tabu search algorithm to obtain near-optimal solutions in reasonable computational time. In their numerical study, the authors demonstrate the superior performance of the proposed algorithm both in terms of solution quality and computational time.

Dongsheng Xu, *Ning Shi*, *and Raymond K. Cheung* consider an automated storage/retrieval system in which cargo moves through a single automated vehicle loop. They show that, in addition to dispatching rules, also the loop configuration has a major impact on the cargo waiting time. Analytical models and simulation tools are proposed to evaluate different loop configurations.

This special issue is complemented with two additional papers on “Two very large-scale neighborhoods for single machine scheduling” by *Tobias Brueggemann and Johann L. Hurink* and on “An efficient GRASP algorithm for disassembly sequence planning” by *Belarmino Adenso-Díaz*, *Santiago García-Carbajal*, *and Sebastián Lozano*.