IE Decision Systems Engineering Fall '19 Seminar Series

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Energy-aware Scheduling of Jobs on Batch Processing Machines

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Abstract

In this talk, we start by identifying typical scheduling problems for batch processing machines (BPMs) that arise in semiconductor manufacturing. A batch is a set of jobs that are processed at the same time on the same machine. We describe typical parallel batching problems in wafer fabs and semiconductor backend facilities. In the second part of the talk, we discuss a bi-criteria scheduling problem for parallel identical BPMs. Only jobs belonging to the same family can be batched together. The performance measures are the total weighted tardiness and the electricity cost where a time-of-use (TOU) tariff is assumed. Unequal release dates of the jobs and non-identical job sizes are considered. A Mixed Integer Linear Program (MILP) is formulated. We analyze the situation where all jobs have the same size, all due dates are zero, and the jobs are available at time zero. Properties of Pareto-optimal schedules for this special case are shown. The design of heuristics based on grouping genetic algorithms that are embedded into a non-dominated sorting genetic algorithm (NSGA) II framework is discussed. Several solution representations are proposed that allow for selecting start times of the batches to take into account the energy consumption. Moreover, a heuristic is proposed that improves a given near-to-optimal Pareto front. Computational experiments are conducted based on randomly generated problem instances. The -constraint method is used for the MILP formulation to determine the true Pareto front. For large-sized problem instances, the GAs are applied. High-quality solutions are provided by some of the GAs.

Biography

Lars Mönch is a Professor for Enterprise-wide Software Systems in the Department of Mathematics and Computer Science at University of Hagen. He received a master's degree in mathematics with minor in computer science, a Ph.D. in the same subject from the University of Göttingen, and a habilitation degree in Information Systems from the Technical University of Ilmenau. He worked two years for Softlab GmbH, Munich in the area of software development. His current research interests are in information systems for manufacturing and logistics, production planning and control for complex manufacturing systems, especially semiconductor wafer fabrication facilities, scheduling, and artificial intelligence applications in manufacturing and logistics. He serves as an Associated Editor of the European Journal of Industrial Engineering, Business & Information Systems Engineering Journal, IEEE Transactions on Automation Science and Engineering, and IEEE Transactions on Semiconductor Manufacturing. His research was funded by companies like Infineon Technologies AG, GLOBALFOUNDRIES, X-FAB Semiconductor Foundries AG, Airbus, the German Government, and the European Commission.

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