Synchronous Flow Shop Scheduling Problems

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Abstract: A synchronous flow shop is a variant of a non-preemptive permutation flow shop where transfers of jobs from one machine to the next take place at the same time. The processing is organized in synchronized cycles which means that in a cycle all current jobs start at the same time on the corresponding machines. Then all jobs are processed and have to wait until the last one is finished. Afterwards, all jobs are moved to the next machine simultaneously. As a consequence, the processing time of a cycle is determined by the maximum processing time of the operations contained in it. Furthermore, only permutation schedules are feasible, i.e., the jobs have to be processed in the same order on all machines. The goal is to find a permutation of the jobs such that the makespan is minimized.

Motivated by a practical application, we investigate special cases where the processing times of the cycles are determined by a subset of so-called dominating machines. Besides complexity results we present exact MIP formulations and heuristic solution algorithms. Furthermore, we consider problems with additional resources and setup times. Computational results are presented for real-world data and adapted benchmark instances for classical flow shop problems.

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