

Constraint-Based Task Scheduling with Sequence Dependent Setup Times, Time Windows and Breaks

Armin Wolf

Fraunhofer FIRST, Kekuléstr. 7, D-12489 Berlin, Germany
armin.wolf@first.fraunhofer.de

Production or maintenance scheduling is still an attractive field for researchers and practitioners. Researchers are interested in better approaches for those in general NP-complete scheduling problems, while practitioners are interested in successful applications of modeling-pruning-search combinations in their problem domains. In production and maintenance the computation of feasible and even good schedules that are fast and easily adaptable in the case of disturbances are addressed.

In this article constraint-based scheduling of non-preemptive tasks on exclusive resources (i.e. single machines) with *sequence dependent setup times* and *time windows* is considered. Besides working tasks, work breaks are considered, too. The reason for distinguishing work breaks from working tasks is that breaks do not require any setup time however they have to be performed within time windows, e.g. due to legal requirements. – To the best of one’s knowledge, this is the first time that work breaks are considered in this scheduling context.

The presented work mainly focuses on the sophisticated modeling of such scheduling problems in CP and its adequate support using existing pruning algorithms in combination with a new pruning algorithm. The impact of the presented modeling-pruning approach is shown by experimental examinations on job shop scheduling benchmark instances where branch & bound optimization is performed on top of a search method developed and presented for job shop scheduling without any setup times. Benchmark examinations show that the introduced modeling and pruning approach is comparable with another state-of-the-art constraint-based approach. Within these examination the optimality of a lower bound of one benchmark instance, namely of t2-ps09, is proven – to the best of one’s knowledge – the first time.

An important practical application of scheduling with sequence dependent setup times and time windows is *field workforce scheduling* e.g. of maintenance tasks in telecommunication networks or water distribution networks. There, the objective is the reduction of travel times and finally the reduction of the according costs.