The Robust Machine Availability Problem

Guopeng Song Daniel Kowalczyk Roel Leus
ORSTAT, Faculty of Economics and Business, KU Leuven
Naamsestraat 69, 3000 Leuven, Belgium
{guopeng.song, daniel.kowalczyk, roel.leus}@kuleuven.be

In planning and scheduling, two broad categories of optimization problems can be distinguished, namely *resource-driven* problems and *time-driven* problems. The resource-driven problems seek to optimize time-related performance measures with constrained resource capacity, while the time-driven problems minimize the costs of the resource capacity required to complete all work within a given time limit. In this work, we consider the time-driven setting in a parallel-machine environment, and define and solve the robust machine availability problem (RMAP), which aims to minimize the required number of identical machines that will still allow to complete all the jobs before a given due date. An uncertainty set describing possible deviations in the job durations is considered. A formulation for RMAP based on the uncertainty set is presented, which aims to preserve an adjustable robustness level.

For better computational performance, a branch-and-price procedure for RMAP is proposed based on a set covering formulation, with the robust counterpart formulated for the pricing problem. Zero-suppressed binary decision diagrams (ZDDs) are introduced for solving the pricing problem, in order to tackle the difficulty entailed by the robustness considerations as well as by extra constraints imposed by branching decisions. Computational results are reported, showing the effectiveness of the proposed pricing solver with ZDDs compared with a generic MIP solver.