A New Constraint Programming Model and Solving for the Cyclic Hoist Scheduling Problem

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Abstract. The cyclic hoist scheduling problem (CHSP) is a well-studied optimisation problem due to its importance in industry [1]. In its simplest form, the problem requires one to specify the operation of an industrial hoist which operates along a linear track above a set of tanks. The hoist must move a fixed, repeating sequence of items to be processed through the tanks.

When many items are simultaneously in process, the hoist or hoists have to be available to complete all the moves between items. Moreover, each hoist must itself travel from the end of the last move that it performed to the start of the next move. Thus hoist availability is a complex resource constraint. The challenge is to find a feasible schedule that minimises the cycle time, which is termed its *period*. The central disjunctive constraint in the CHSP connects the period with the temporal decisions about hoists [4].

Despite the wide range of solving techniques applied to the CHSP and its variants, the models have remained complicated and inflexible, or have failed to scale up with larger problem instances.

This paper re-examines modelling of the CHSP and proposes a new simple and flexible constraint programming formulation [3]. We compare current state-of-the-art solvers on this formulation, and show that modelling in a high-level constraint language, MiniZinc [2], leads to both a simple, generic model and to computational results that outperform the state-of-the-art previous models. We benchmark on standard and new problem instances against results reported in the literature, using integer programming, constraint programming and lazy clause generation solvers.

We further demonstrate that combining integer programming and lazy clause generation, using the multiple cores of modern processors, has potential to improve over either solving approach alone.

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