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Marek Vlk's thesis entitled "Optional Activities in Scheduling" and submitted for the degree of Doctor of Philosophy of the Charles University – referee's report

The manuscript addresses the concept of optional activity and proposes three different problem scenarios to show how the optional activity concept can be not only effectively applied for solving scheduling problems but can also be an original approach to explicitly model (and solve) a larger class of combinatorial optimization problems.

The aim of the work is to model real world applications typically involving the use of limited resources and requiring scheduling decisions. The first proposed scenario focuses on the production of water tubes, such that machine reconfigurations imply sequence-dependent setup times between consecutive tasks that must be performed by a single operator that can only serve one machine at a time. Five different constraint programming (CP) models are proposed; the experimental evaluation shows that among the proposed exact approaches, the CP model that uses optional activities improves performance over a reference ILP formulation. The second problem scenario is the Multi-agent Path Finding (MAPF) problem, the goal of which is to find paths for agents given an input graph. The proposed CP approach uses a scheduling methodology, where nodes and edges are represented as resources. The major contribution is an extension of the traditional MAPF formulation where the edges' capacities and lengths could be greater than one. Finally, the thesis addresses the problem of joint routing and scheduling of time-triggered (TT) traffic in communication networks. A novel CP formulation is presented and an experimental evaluation against commonly used ILP and SMT formulations shows the superiority of the proposed CP model.

The manuscript spans over four chapters and is very clearly written. The candidate is clearly aware of the state-of-the-art in the CP and scheduling research areas. In each chapter of the manuscript (from Chapter 2 to Chapter 4), the candidate presents new original algorithms and compares them against previous work. I would like to particularly stress that each of the new proposed algorithms can be considered to the best of my knowledge as an advancement over the state-of-the-art in its respective class.

For all these reasons, the thesis deserves to be considered for the achievement of the PhD title and proves the candidate's ability for creative scientific work. The analysis carried out in this manuscript is neatly structured, and is clearly the result of a truly remarkable amount of work, as is demonstrated by both the number and the quality of the publications that accompany the manuscript. The drawn conclusions are well motivated, and the obtained results significantly contribute to the issue of constrained-based optimization with the possibility of solving a larger class of optimization problems with applications in other domains like space or transportation.

Please feel free to contact me should you need any further information about the content of this report.

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