A TABU-SEARCH BASED REACTIVE PROCEDURE FOR THE RCPSP WITH STOCHASTIC RESOURCE AVAILABILITIES

Olivier Lambrechts, Erik Demeulemeester and Willy Herroelen
Katholieke Universiteit Leuven
Department of Applied Economics
<first name>.<last name>@econ.kuleuven.ac.be

Abstract We consider an extension of the RCPSP in which uncertainty is introduced by means of stochastic resource breakdowns. These breakdowns can cause schedule infeasibilities that can be resolved by postponing one or more activities. In order to repair the disrupted schedule we developed a reactive approach based on tabu search that tries to minimize the weighted deviation from the original baseline schedule.

Keywords: project scheduling, resource breakdowns, tabu search

Introduction

A project consists of a set of precedence related activities that have to be executed within a given timeframe. Each activity has a fixed duration and requires a fixed amount of a given resource type per period. The planned execution of such a project is described by a baseline schedule. This baseline schedule indicates when each activity starts and has to be precedence as well as resource feasible. Resource feasibility implies that there exists no time period in which the cumulative resource requirements of all active activities exceed the resource availability. We will consider the case where these resource availabilities can vary due to unforeseen resource breakdowns. Such breakdowns can lead to resource infeasibilities that can be solved by postponing one or more activities. Starting from the current schedule, our goal is to find a new feasible schedule that deviates as little as possible from the original baseline schedule. The objective we try to minimize is the project instability, defined as the sum of the weighted deviations between planned and observed activity starting times. Avoiding these deviations is important because often work is subcontracted or executed by resources that do

not belong exclusively to the current project. A change in the starting times of subcontracted or similar activities could lead to global infeasibilities (resource conflicts on the multi-project level) or to penalties in the form of higher subcontracting costs.

1. Reactive Policies

In order to reschedule the unfinished activities we developed a tabu search heuristic (Glover and Laguna, 1993). Our algorithm is based on a tabu search procedure for solving the deterministic RCPSP (Pinson et al., 1994). Solutions are represented by means of the priority list representation scheme and can be decoded again into a feasible schedule by using the serial scheduling scheme. The procedure starts from the priority list representation of the disrupted schedule. The solution neighbourhood is defined as those solutions that can be obtained by swapping two activities in the priority list of the current solution. In each step the procedure evaluates each solution belonging to this neighbourhood and selects the non-tabu move with the best value for the objective function. After a given number of iterations the procedure terminates with the currently best solution to the rescheduling problem. In order to diversify the search and to avoid local optima, frequency based penalties are included.

2. Computational Results

We test the performance of our tabu search algorithm by means of simulation for the 30-activity networks of the PSPLIB set of problem instances (Kolisch and Sprecher, 1997) using various proactive strategies for setting the baseline schedule. The approach is then compared to some simple reactive policies based on priority rules. Preliminary results show that the tabu search procedure strongly outperforms the best priority rule policy and this as well for protected as for unprotected baseline schedules.

References

Glover, F. and Laguna, M. (1993). *Tabu Search*. Blackwell Scientific, Oxford. In C. Reeves (Editor): Modern Heuristic Techniques for Combinatorial Problems.

Kolisch, R. and Sprecher, A. (1997). PSPLIB - a project scheduling library. *European Journal of Operational Research*, 96:205–216.

Pinson, E., Prins, C., and Rullier, F. (1994). Using tabu search for solving the resource-constrained project scheduling problem. In *Fourth International Workshop on Project Management and Scheduling*, pages 102–106. Euro Working Group on Project Management and Scheduling.