User–Solver Interplay in Highly Constrained Truck Loading Optimization

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Overview

DENC is developing a software tool for loading of freight containers. The tool is intended to assist human operators in designing container loadings, for a client of DENC that is a supplier to hardware (DIY) stores.

In a first project, an automated solver based on a Self-adaptive Genetic Algorithm [Kruisselbrink et al., 2011] was developed [Van Rijn et al., 2015]. It uses an indirect solution representation that relies on a building function to obtain an actual solution, for evaluation and presentation to the end-user. The building function takes a lot of constraints and preferences into account, defined manually in consultation with the client.

In a follow-up project, this approach was extended by an informed mutation operator derived from user-accepted solutions [Leuven et al., 2015]. Instead of randomly, it uses statistics concerning types of boxes that were placed on top of each other to govern the probability of a certain mutation to occur.

This project was extended into a master’s thesis [Leuven, 2015], introducing an informed building function that takes the statistics into account in compiling an actual solution from the indirect representation. Furthermore, a correction for the fitness function, a weighted sum of several penalty functions, was implemented that takes the implicit preferences reflected in user-accepted solutions into account for reshaping the weights of the penalties. The original weights were defined in consultation with the client.

In the current state, the solver is able to fit all boxes in the container in a lot of test cases and obtains fitness results on par with the user-generated solutions. However, the generated solutions are not at a level where they can be used in practice. This is partly due to an inaccurate fitness function. As described, first steps where taken in improving this fitness function. Furthermore, the method of applying user-derived information in the mutation operator and building function has to be strengthened.

This Project

Utilizing interplay between end-user and automated solver: The automated solver proposes a solution, after which the end-user checks and corrects this solution where necessary. This speeds up the planning process for the end-user and the direct user-feedback is useful in correcting the user-derived rule set.

• How to use the system when little is known yet
• Dealing with direct user-feedback efficiently to speedup the learning process
• Dealing with conflicting preferences between end-users
• Deal with introduction of new box types, these get implicitly penalized in using statistics

Agreement and Company Profile

Work will be carried out at DENC in Den Haag, for minimally two days per week. The exact number of days per week and the overall time frame are open to negotiation, taking the preferences of the
student into account. The student will receive a monthly internship compensation fee, depending on the number of days per week.

DENC — Design Engineering Contracting — is a multi-disciplinary service company in the field of building architecture, accommodation, and real estate, see denc.nl and denc.com. Our focus is mainly, but not exclusively, on logistics, e.g., designing the exterior of warehouses as well as the logistics chain inside. In our advisory role, clients approach us with IT-related requests such as the project described. DENC employs approximately 60 people at three locations.

References


