Master Project

Application of do-calculus for the β-robust scheduling method for a one-machine job environment

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Context

Job scheduling has always been a crucial subject for companies in numerous industries. One can think of large car manufacturers, clothing manufacturers, or farmers working in the agricultural sector. Lely is a key player in the agricultural and robotics sector, producing state-of-the-art autonomous robot systems and automation software for the dairy industry. One of their robot systems is concerned with the distribution of feed for the farmers' cows. It is desired that a schedule is determined for which this feed distribution process is most likely to not exceed a given deadline, which is known as a β-robust schedule. When job scheduling is applied successfully, involved parties make more efficient use of their resources to reach their goals. This is a trait that may distinguish profitable competitors from losing counterparts.

Figure 1: Lely vector robot system

The focus of this master thesis is to optimize a job schedule for robustness where certain job process values are subjected to uncertainties. A synthetic data set of one job is available which encloses the measurements of all occurred events that together have a causal influence on its specific job duration value. We will identify the causal relations by applying the tools of causal inference on this data set which is assumed to satisfy strong constraints. Do-calculus will be applied based on these causal relations to make predictions on the effects on the job process values for specific variable interventions. These predicted scenarios will be incorporated in the robust scheduling decision-making process with the aim of finding a corresponding optimal job schedule that performs better than the original β-robust schedule.

Project tasks

This master thesis project is aimed at developing a data-driven approach to predict scenarios that correspond to a job schedule that outperforms the schedule for the nominal situation. Requirements set on the approach are:

1. Identify causal relations within a data set
2. Make predictions on the effects of variable interventions on the job duration, being the target variable
3. Compute additional objective values and solution stability radii based on predicted scenarios
4. Maximize the trade-off between the improvement on objective value and solution stability radii

This master thesis project is done in coorporation with Lely.