Master Thesis at SimPlan AG

Optimised trainset scheduling for operation and maintenance
Development and assessment of algorithms

In order to provide a safe and reliable service to customers, train operators have to ensure operation that meets the schedule and on-time quality maintenance for their train fleets. Due to economic reasons, the number of spare trainsets and maintenance depot capacity are limited and have to be used efficiently.

The train schedule is defined by diagrams, which are train travel schedules for one day. A trainset will be assigned to each of the diagrams for each day. Each diagram has a unique id and can be marked to be applied on specific days only, or to be exempt on specific days. A diagram can consist of several legs, which is a trip from one end station or depot to another. Each leg features a departing and an arrival time. Assignments may have to be changed on short notice due to operational reasons, such as weather conditions, disruptions or defects. As a mean to deal with unexpected changes, trainset can be ordered to swap assignments with another trainset during the day.

Maintenance operations are usually executed in maintenance depots along the route. Maintenance operations can be categorized in 3 types: mileage-based preventive maintenance, time-based preventive maintenance, and corrective maintenance. The frequency of maintenance operations is defined in a maintenance regime for a fleet. Maintenance is carried out mainly overnight, but some trainsets can be kept in depots during the day in order to schedule multi-day exams or extensive corrective maintenance. Each depot features specific capabilities, capacities, and constraints („depot rules “) on the maintenance operations it can offer.

In this thesis, algorithms shall be developed and assessed, that assign trainsets to diagrams and depots. The target is to have assignments that meet schedules and depot constraints while maximising the utilisation of allowed mileage or time between maintenance operations. Stability of the resulting plan regarding unexpected changes is an additional objective.

For implementation of this work, the simulation software AnyLogic 7 will be deployed. A model has been developed as part of an EU research project for Alstom, a company that provides maintenance service for a fleet of trainsets in the UK. This model will be used as a basis and has to be extended with a scheduling algorithm.

The following aspects have to be considered:

- Familiarisation with the existing simulation model of trainset operation and maintenance
- Extension of the simulation for the assessment of the algorithms.
- Assessment and description of scheduling procedures
- Implementation of the chosen algorithm
- Execution of suitable experiments with the simulation to show algorithm performance
- Presentation of results

SimPlan AG will supervise the thesis in cooperation with the university. Data and information on the test system used in the existing simulation will be provided by SimPlan AG. The thesis will remain property of the two cooperating institutions. Publications disclosing details need to be aligned with SimPlan.

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