ON OPTIMAL DESIGN OF TIME TABLES FOR LARGE RAILWAYS UNDER RESOURCE CONSTRAINTS

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Abstract

Timetables are pre-determined schedules designed to aid the customer and the train scheduler.

The proper design of timetables is the key to the maintenance of punctuality of trains. Timetables should be robust to minor perturbations and should allow minimum propagation of delays across trains and across the network.

Timetable design affects the planning process, at all levels- strategic, tactical and operational, and is of major consequence in deciding the bottom line of the railways. Suprisingly however, the aspect has received scant attention, so far as improving on the manual methods used at present.

The dissertation presents a framework for optimum design of timetables to maximise schedule robustness and minimise resource deployment, especially for large railway networks.

Research on the area of optimising crew and rolling stock deployment for a given timetable and construction of timetables using mathematical modelling on a very small scale have been reported. However, problem of timetable design, to optimize resource deployment and maximise schedule robustness has not been tackled so far, and this dissertation is a maiden effort in this direction.

Given the complete absence of research in the area of timetable design, the study identified the decision variables and their relationship to the decision criteria of the

timetable. Further metrics for quantification of the decision criteria were developed to enable the formulation of the problem in terms of a mathematical model.

Simulation, using C programs specifically developed for the purpose as part of the dissertation, has been used to derive relationships, in instan

computationally manageable proportions, and thus enable planners to undertake network-wide optimisation studies. The dissertation has thus demonstrated that the design of timetables can be spread over a canvas incorporating not only over the entire railway network, thus enabling study of the mutual interactions across the network, but also involving the optimisation of vital resources like crew and rolling stock in the purview of the model. This can thus emulate the planning process more truthfully, wherein piecemeal optimisations are of little import.