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Institute for Transport Planning and Systems

Project Summary

Slot-Catalogue based Performance Enhancement

Institute for Transport
Planning and Systems

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Slot Catalogue-based Performance Enhancement

Background & Introduction

The major Class I railroads in the United States are privately-owned businesses that almost exclusively focus on freight transport services based on market conditions. This led to the abonnement of fixed pre-defined, by-the-minute schedules almost half a century ago and to a sole focus on operational flexibility. This system of manual train-by-train dispatching became the single way of operation claiming to be the most efficient one. Increasing traffic demands and higher reliability parameters, however, allow for a re-thinking of this current system, and instead introduce a slot catalogue-based approach on dense corridors. This approach is verified on a real case: the BNSF San Joaquin Rail Corridor in California, United States.

On this corridor, BNSF runs high priority transcontinental intermodal services (Z-train), a large variety of freight trains (F-train), and also hosts twelve daily Amtrak passenger services. All train movements between August 1st, 2014 and July 31st, 2015 are taken as an extensive data source for quantitative analyses.

Methodology & Results

First the corridor is divided into seven sections, comprised of on-line and terminal sections. This is necessary in order to extract delays that result from on-line, as opposed to terminal, operation. This poster illustrates the results for the 100-mile long on-line section between the two terminals: Riverbank and Fresno/Calwa. The study consists of two parts:

- Evaluate the current system of manual dispatching
- Create a slot catalogue for the same trains, and compare the two operational systems.

The running times and their distribution are calculated for each train-type category. This is used as the basis for the comparison studies (Figure 1). It reveals considerable variations in running times for F-trains, but also for the high-priority Z-trains. Different slots are created for each of these three train-type categories and merged into one slot catalogue. Next all trains from the dataset are assigned to these slots.

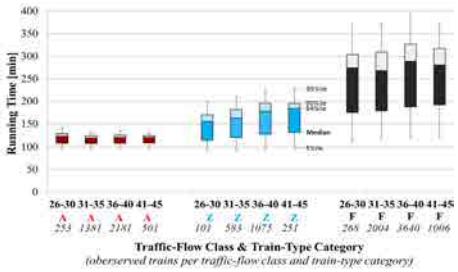

Figure 1: Running times of each train-type catogory

Each assigned Z- or F-train from the slot catalogue-based system is compared to the current system of operation. Amtrak services are not assigned, as these trains run on the slots according to their pre-defined schedule. Three measures for comparison are applied for each traffic-flow class. The formulas are exemplary for Z-trains:

- $Z\text{-}act_{\text{TrafficFlowClass}} = \frac{1}{m * n}\sum_{j=1}^{m}\sum_{i=1}^{n}(TravelTime\text{-}Slot_{i,j} - RunningTime\text{-}act_{i,j})$
- $Z\text{-}84_{\text{TrafficFlowClass}} = \frac{1}{m * n}\sum_{j=1}^{m}\sum_{i=1}^{n}(TravelTime\text{-}Slot_{i,j} - P_{84}(RunningTime\text{-}act_{i,j}))$
- $Z\text{-}90_{\text{TrafficFlowClass}} = \frac{1}{m * n}\sum_{j=1}^{m}\sum_{i=1}^{n}(TravelTime\text{-}Slot_{i,j} - P_{90}(RunningTime\text{-}act_{i,j}))$

Figure 3 illustrates that independent of the traffic-flow classes, both Z- and F-trains perform worse compared to their actual running times. Compared to either the 84th or 90th percentile of their actual running times, however, performance improves.

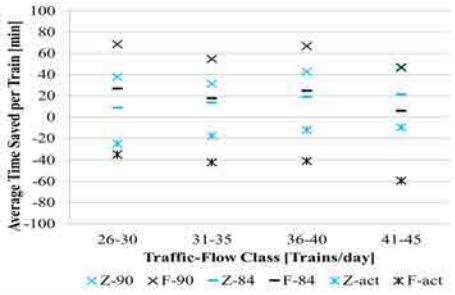

Figure 2: Results of comparison studies, Riverbank-Fresno

Summary

Today's operation on the BNSF San Joaquin Rail Corridor is designed for highest flexibility. Current running times are shorter if compared directly to the travel times of slot catalogue-based operation. Compared to expected running times, however, the designed slot catalogue outperforms existing operations, independent of traffic flow. It also increases predictability and capacity.

Client

Institute for Transport Planning and Systems, Swiss Federal Institute of Technology Zurich

Applied Methods

Statistics, running time calculations, train assignment

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