Simulation of modified timetables for high speed trains Stockholm – Göteborg

Hans Sipilä
Royal Institute of Technology (KTH), Stockholm, Sweden
Introduction

• Western Main Line in Sweden
  - Stockholm – Göteborg (456 km)
  - Highly utilized double track line

• Heterogeneous average speeds
  - High speed (X2000), max 200 km/h
  - InterCity + Regional, max 120–200 km/h
  - Commuter, City regions, max 140–160 km/h
  - Freight trains, max 80–100 km/h
Line map
Problems

- Increased demand for passenger and freight train slots
- Demand for more scheduled passenger train stops
- Speed differences contribute to delay propagation
- High speed trains, in particular, are sensitive to disturbances
Method – Simulation with RailSys

- Infrastructure model
- Timetable
- Delay distributions
  - Trains disturbed at certain stations and sections
  - Registered data + manual measurements
  - Run time extensions – primary delay causes
  - Resolution in delay data 1 min,
    cause reports for delays ≥ 5 min
- Random perturbations created in RailSys
- Simulation of several days (cycles)
Some limitations

- Early train departures
- Freight train configurations
- Swedish interlocking not fully modeled
Simulation scenarios

- Timetable for year 2009 (weekday)
- Decreased supplements 4 min for X2000
- Increased supplements 4 min for X2000
- Increased buffer times between X2000 and other trains
Results, aggr. punctuality 5 min
Difference in train performance
Disturbance sources

- Level of primary delays
- Low supplements on sections
- Small buffer times between trains
- Overtaking situations
- Junctions
Some improvements with incr. buffer times
Delay distribution characteristics

![Graph showing delay distribution characteristics with data points for different time intervals.](image)
Some conclusions

- Increased buffer times
  - Reduction in changed train sequence events
  - Overtakings more reliable
  - Changes to other trains realistic?
  - Drawback: less trains?

- Changed timetable supplements
  - Difficult to apply due to high variances compared to average delays
Southern main line project

- Extended use of delay statistics: entry + line perturbations
- Primary line perturbations created by reducing absolute values from statistics
- Auto implementation in RailSys
- General method to get acceptable delay modelling in RailSys simulations? Instead of guessing.
Entry delay model problems

Passenger trains

Freight trains
X2000, different line delay levels
Night freight (mail trains black)