Railway Alignment Optimization for Specified Travel Timesaving

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Motivation

- *Project raised by a transportation infrastructure co.*

- *To upgrade an existing railway line for saving certain amount of travel time*

  - *travel timesaving → establish a new station for a developing town along the railway route*

  - *Cut down budget*

- *Necessary improvement to a railway line to achieve specified travel time reduction*

  - ***Timesaving → Location + Intervention + Cost***
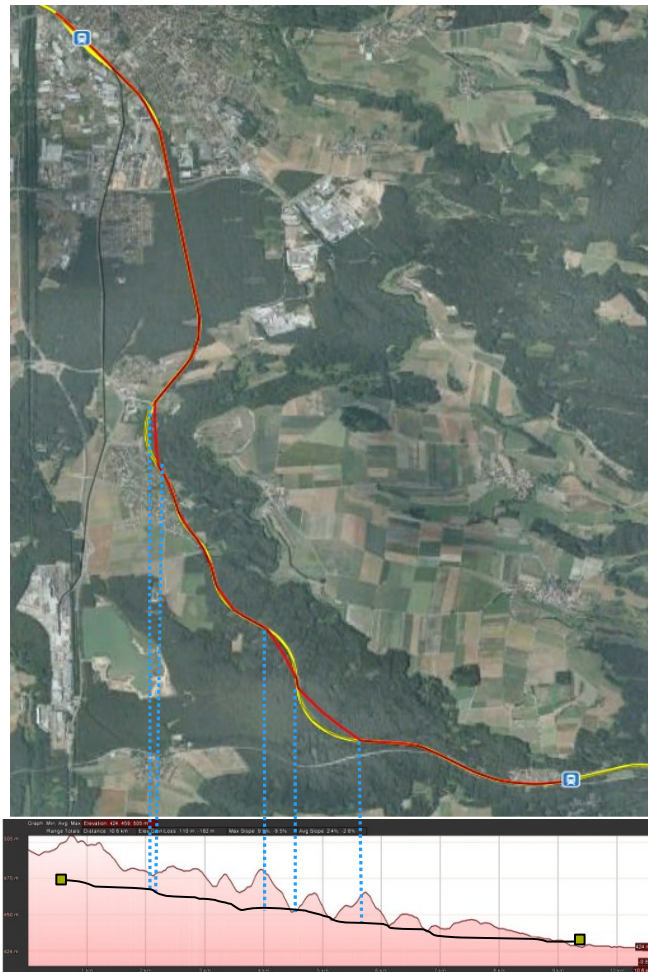
Case: Neumarkt(Oberpf) - Deining(Oberpf)

- Route length: 10.3km

- Travel time: 7mins / RegionalExpress train

- Optimization goal: 2 mins → longer stop at Deining

* Maps and data from http://www.bayern-fahrplan.de

Optimization result

- Intervention
  - straightening curves
  - simplification: normal speed
- Location
  - 18 sharp curves
  - Each has certain contribution to travel time reduction
- Cost indicators
  - Total: 4.4 km/10.3 km
  - 3 sections involving large earthwork
  - 1 section crossing water way
  - 1 section locates in urban area
  - 4 intersections with highway

RAO for Specified Travel Timesaving

- Driven by requirement of specified travel timesaving

- To find a best feasible alignment of a railway

- With minimum construction cost and environmental impact

- Outcome → an automated optimization tool to assist railway line designing

Research questions

- What impact do the interventions to the railway infrastructure have on travel time?
  - i.e. how much time would be saved by replacing one sharp curve section with one gradual curve section?
  - Travel time is influenced not only by infrastructure
    - Operation, different types of the train
- How can the optimal solution be determined among numerous alternatives with multiple objectives?
  - Numerous alternatives
  - Multiple objectives

Speed-limiting section

- Track sections where trains has to travel with a limited speed for safety and comfort reason

- i.e. at curve sections, high speed traveling may cause derailment

- Identification method
  - Geometry analysis
    - Straight, Curve, transition curve
  - Model railway facilities
    - railway station,Tunnels, bridges

Workflow

- Identification of the speed-limiting sections

- Adjustment of the speed-limiting sections
    - Choose interventions for the track sections to enable desired traveling speed

- Generation of alternatives
    - An optimization alternative is a set of sections which in total achieve the required travel time reduction

- Evaluation of alternatives
    - evaluate the alternatives using criteria according to user preference and rank the alternatives

Thanks for your attention!

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