LIGHT RAIL MODELLING WITH OPENTRACK

Examples and perspectives
IT13.rail – OpenTrack Userworkshop
Zürich, 18. January 2013

Johannes Meister
Fosca Romani
Light rail modelling with OpenTrack

Contents

> Short presentation of TTK

> Why LRT Modeling with OpenTrack?
  > Different project scope/objectives

> Examples
  > Nottingham
  > Montpellier
  > Karlsruhe

> OpenTrack requirements in LRT simulation field
  > Input
  > Simulation functionalities
  > Output/Statistics
Light rail modelling with OpenTrack

TTK / Karlsruhe

TransportTechnologie-Consult Karlsruhe GmbH
> Founded in 1996
> 32 staff from Germany, France, Italy
> Headquarters in Karlsruhe – Germany
> Branch office in Lyon – France

Subsidiary
> 51% PTV AG – Software and Consulting for Transport (VISUM, VISSIM)
> 44% AVG Albtal-Verkehrs-Gesellschaft mbH – Tramtrain Operator Karlsruhe

Focus on
> Light Rail, Tramway and Tramtrain
> Operations and Design
Light rail modelling with OpenTrack

Why LRT Modeling with OpenTrack?

OpenTrack ...

> ... was developed at the ETH Zürich, initially for heavy rail systems
> ... was adapted for light rail simulations with TTK’s support (since 2007)
> ... allows the implementation of realistic operational behaviour
> ... allows with some restrictions the implementation of road traffic effects
> ... is a dynamic model which can also replicate perturbations

Open Track is being used ...

> ... to optimise operational activities on the LRT network
> ... to compare different operational concepts for existing and new lines/networks
> ... to determine the impacts of different infrastructure solutions

> Visualisation of the operational activities allows the simple assessment of existing problems and solutions
> Depending on existing requirements, OpenTrack models can be implemented with relatively little effort or be very detailed
> Tasks can be carried out incrementally and iteratively
Light rail modelling with OpenTrack

Why LRT Modeling with OpenTrack?

Simulation Capabilities for Tramway/LRT

<table>
<thead>
<tr>
<th></th>
<th>Rail</th>
<th>LRT</th>
<th>Tramway</th>
<th>Bus</th>
<th>PrT</th>
<th>Pedestrian</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpenTrack</td>
<td>☣</td>
<td>☣</td>
<td>☣</td>
<td>☣</td>
<td>☣</td>
<td>☣</td>
</tr>
</tbody>
</table>

Delay
Light rail modelling with OpenTrack

OpenTrack:
Between microsimulation and static timetabling

> Microsimulation of intersections using VISSIM
  > Simulation of all transport modes (including pedestrians)
  > Detailed implementation of traffic signal controllers
  > software developed mainly for road simulation

> Dynamic simulation using OpenTrack
  > Assessment of service efficiency
  > Focus on “the operators perspective“
  > Determination of robust working timetables
  > Modelling of complex PT networks possible
  > Modelling of realistic LRT traffic behaviour
  > In many cases detailed road traffic simulation only required for individual intersections
  > Input of VISSIM results possible

> Static timetabling (using e. g. FBS)
  > Run time estimation
  > LRV rostering
# Light rail modelling with OpenTrack

## TTK main references for tram and LRT projects with OpenTrack

<table>
<thead>
<tr>
<th>Existing Lines/Networks</th>
<th>New Lines/Networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ludwigshafen (D)</td>
<td>Utrecht (NL)</td>
</tr>
<tr>
<td>VBL (Local Operator)</td>
<td>Regio Utrecht</td>
</tr>
<tr>
<td>Operational optimisation</td>
<td>Sneltram extension</td>
</tr>
<tr>
<td>Heidelberg (D)</td>
<td>Heilbronn (D)</td>
</tr>
<tr>
<td>City of Heidelberg</td>
<td>City of Heilbronn</td>
</tr>
<tr>
<td>Network Optimisation</td>
<td>Comparison of alignments</td>
</tr>
<tr>
<td>Croydon (GB)</td>
<td>Ulm Tram (D)</td>
</tr>
<tr>
<td>London Tramlink (Local</td>
<td>SWU (Local operator)</td>
</tr>
<tr>
<td>operator) Network</td>
<td>Network extension</td>
</tr>
<tr>
<td>operations</td>
<td></td>
</tr>
<tr>
<td>Karlsruhe (GER)</td>
<td>Montpellier (F)</td>
</tr>
<tr>
<td>City of Karlsruhe</td>
<td>Montpellier Agglomeration</td>
</tr>
<tr>
<td>Network robustness</td>
<td>Network Development</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>New Lines/Networks</td>
<td></td>
</tr>
<tr>
<td>Bordeaux (FR)</td>
<td>Avignon Tram (F)</td>
</tr>
<tr>
<td>CUB (Local authority)</td>
<td>Grand Avignon (Local authority)</td>
</tr>
<tr>
<td>Tramtrain extension/connectio</td>
<td>Network development</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Nottingham (GB)</td>
<td>Edmonton (CAN)</td>
</tr>
<tr>
<td>NET (Local authority)</td>
<td>City of Edmonton</td>
</tr>
<tr>
<td>Network extension (Call for tender)</td>
<td>New LRT Line and Depot</td>
</tr>
</tbody>
</table>

© TTK GmbH 2013
Light rail modelling with OpenTrack

Nottingham – Network extension (Call for tender)

Context
> Network extension (from 1 to 2 Lines)
> Call for tender
  > Standard operations
  > Incidents

OpenTrack tasks
> Assessment of
  > Run times
  > Rolling stock and rotations
> Perturbations
  > Different scenarios
  > Impact (recovering time) and mitigations measures

Highlight
> Findings from OpenTrack used as elements in the call for tender
> Interaction with Highway Authority (VISSIM Simulation)
Montpellier – Network development

Context

> Network development (from 2 up to 8 Lines)

OpenTrack tasks

> Assessment of
  > Run times and rolling stock
  > Operational robustness
  > Evaluation of “network” effects

> Comparison different network scenarios

> Perturbations
  > Impact and mitigations measures

Highlight

> Many lines highly interconnected
> High frequency on the common sections (each Line 5 min headway)
> Many complex nodal points
> Single and double stops
Light rail modelling with OpenTrack

Karlsruhe – Network robustness

Context
>
> Simulation of tramway and tram train deviations due to major infrastructure works

OpenTrack tasks
>
> Assessment of
> > Additional run times
> > Operational robustness
> > Interaction with private traffic at main road junctions

> Perturbations
> > Road traffic (from VISSIM) as incidents

Highlight
>
> integrated use of OpenTrack and VISSIM (PTV)
> Iterative simulations
> Support short term decisions
Light rail modelling with OpenTrack

Required improvements in LRT simulation field

To allow the simulation of specific LRT operational conditions with OpenTrack there are ...

> Missing additional functionalities

> Existing constrictions to eliminate

> Refinements needed to facilitate the simulation

> Need of attractive output to win over institutional clients

Simulation performance

> Crash of OpenTrack in case of simulation of complex networks (up to 6 Lines) with simultaneous on-line compilation of Train Graphs

> Higher simulation speed would allow increased efficiency
Light rail modelling with OpenTrack

Required improvements in LRT simulation field

**Input** (not LRT specific)

- User friendly import of alignment information (from Excel tables/lists/…)
- User friendly modifications of courses and course connections
- Import of backgrounds in jpg format
- Semi-automatic definition of double track sections with optimized design

**Simulation functionalities**

- Priority rules at complex LRT nodal points between LRT lines
- Possibility of minimum time interval between two following trains at signals
- Stop on demand at stations
- Possibility to define different stop position at stations (depending on the line)
- Signal Stop Incident should function with discrete operation too
Light rail modelling with OpenTrack

OpenTrack required improvements in LRT simulation field

**Output/Statistics**

- Attractive visualisation for institutional client
- Quantitative evaluations
  - run times
  - stop times
  - key values of variability
  - key values of reliability
- Timetable export in a table format
- Train Graphs of circular lines
- Train Graphs of lines using more than one common section

Train diagram cannot be used to show multiple use of part of the tracks
Many thanks for your attention

Johannes Meister, TTK – johannes.meister@ttk.de
Fosca Romani, TTK – fosca.romani@ttk.de