

Open Traffic: a toolbox for transport & traffic model research

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Main research objectives of my PhD study

- Creating a design for a transport and traffic model system that is suitable for innovative research and applications.
- To initiate this transport model research environment by creating an open source software project named Open Traffic Sim.
- Elaborate the design for the road infrastructure

Serge Hoogendoorn, Hans van Lint, Alexander Verbraeck

Majority of transport model applications aims to support policy making process of public authorities

- **Strategical** transport models for planning that provide insight in the long term impact of economic and demographic developments on the demand for transport and the use of both land and roads. And consequently examine the need for new infrastructure or explore the impact of various land use scenarios.
- Assignment models at a **tactical or operational** level to assess the impact of short term measures to mitigate traffic in congested situations, for instance by optimizing traffic lights or optimize the junction lay-out.

Open Traffic

• Playing field:

 Currently, focussing on assignment and simulation



∦ TUDelft

Wide variation in transportation and traffic models



Why start a new transport model programming environment?

Given the current supply of traffic models

- Supply of model packages: a great variety in commercial models offering a lot of methods, approaches and tastes
- User groups: consultants, public authorities, road management organizations, automotive, ICT/ITS industry, service providers and researchers
- Problem: current packages not always offer the desired workflow and flexibility for academic research



Current (academic) research practice

Code the Transport Model from scratch



- Tailored to the needs
- Learn by experience

😕... but

- Large development costs
- Only small part of the code is "new"
- No attention for software quality: re-use of the code is rare



Design process and fields of expertise



Software development ... long term

Object Oriented / Java / Open Source Software

Providing a modelling environment with basic tools and objects to build or design model applications

- Methods: e.g. paths algorithms, network design
- Components describing: vehicles, infrastructure ...
- Utilities: graphics editor, import/export data, statistics
- Modular
- Extendable



Using existing knowledge from Open Source Software such as OpenGeoTools, JTS, JGraphT



Design philosophy of Open Traffic

Start at the highest level of detail

A highly disaggregated approach to accommodate all other (more aggregated) approaches

For example:

- Activity based approach
- Micro simulation
- Agent based decision processes
- Human factors
- Geo-data: high level of detail



Core object groups of transport models





My PhD: focus on infrastructure objects



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Open Traffic: infrastructure

Requirements and design of objects

• Model environment should enable multiple scales/modes:

- From microscopic to macro/meta
- From detailed to global
- Applicable / extendable for multiple (and mixed) modes
- What are the requirements?
- How should we design and define model objects to represent a road network or pedestrian space?



Taxonomy of driving / movement

• Driving: Longitudinal / lateral movements (network)



• Pedestrian: space based (x,y)





Your driving experience

- Diriving behaviour :
 - Interaction with other traffic
 - The environment (perception)

Grontmij

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•Driving seems so easy (Lie, 2003)

Ambition: seamless switch between detailed and coarse representation of the infrastructure



Multi-scale and multi modal

Requirements

- Some applications require a lot of detailed information about geometry and objects
- Multi modal simulations require tuning of their various infrastructures (pedestrian, train, car) – transit locations





Align to GIS standards: cityGML?

Open Geospatial Consortium

- Several levels of detail
- Adhere to city topology



LOD 0 – Regional model



LOD 3 – Detailed architectural model



LOD 1 – City model



LOD 4 – Interior Model



LOD 2 – City model with explicit roof structure



Virtual 3D city models

- 3D GIS: coherence of semantics and geometry
- Modularisation (Buildings, Transportation, City Furniture, Bridges, Tunnels)



Fig. 62: Complex urban intersection (left: linear transportation network with surface descriptions and external references, right: generated scene) (source: Rheinmetall Defence Electronics).



GIS data requirements CityGML seems a perfect match is it?



Fig. 62: Complex urban intersection (left: linear transportation network with surface descriptions and external references, right: generated scene) (source: Rheinmetall Defence Electronics).



Model approach: often line and ribbon based. *CityGML*: Lines and surfaces. Direction of a road?



A junction: how to define it in CityGML? Relation between LOD's?







In LOD0 areal transportation objects like squares should be modelled in the same way as in GDF, the ISO standard for transportation networks, which is used in most car navigation systems. In GDF a square is typically represented as a ring surrounding the place and to which the incident roads connect.

Questions

- Is CityGML a proper choice? Alternatives?
- Switch between levels of detail: from detail to aggregation?
- CityGML editors (2D/3D)?
- There are few examples that focus on transportation. Where to find them?
- Road description: ribbons or surfaces?
- Design guide lines: for instance how to model a junction in CityGML?



Example of a CityGML junction



WAS: Kruispunt

WORDT: Rotonde

CityGML Transportation objects

Code list of the AuxiliaryTrafficArea attribute function				
http://www.sig3d.org/codelists/standard/transportation/2.0/AuxiliaryTrafficArea_function.xml				
1000	soft shoulder	1300	traffic island	
1010	hard shoulder	1400	bank	
1020	green area	1410	embankment, dike	
1030	middle lane	1420	railroad embankment	
1040	lay by	1430	noise protection	
1100	parking bay	1440	noise protection wall	
1200	ditch	1500	noise guard bar	
1210	drainage	1600	towpath	
1220	kerbstone	1700	others	
1230	flower tub			
	~	-	~	
Code list of the <i>TrafficArea</i> attribute <i>function</i>				
http://www	v.sig3d.org/codelists/standard/transportation/2	.0/Traffic/	Area_function.xml	
1	driving_lane	20	crosswalk	
2	footpath	21	barrier	
3	cyclepath	22	stairs	
4	combined foot-/cyclepath	23	escalator	
5	square	24	filtering lane	
6	car_park	25	airport_runway	
7	parking_lay_by	26	airport_taxiway	
8	rail	27	airport_apron	
9	rail_road_combined	28	airport_heliport	
10	drainage	29	airport_runway_marking	
11	road marking	30	green spaces	
12	road marking direction	31	recreation	
13	road marking lane	32	bus lay by	
14	road marking restricted	33	motorway	
15	road marking crosswalk	34	motorway entry	
16	road marking stop	35	motorway exit	
17	road marking other	36	motorway emergency lane	
18	overhead wire (trolley)	37	private area	

9999

unknown

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train platform

Code list of the TransportationComplex attributes fu			
http://www.sig3d.org/codelists/standard/transportation/			
http://www.sig3d.org/codelists/standard/transportation/			
1000	road		
1010	freeway/motorway		
1020	highway/national primary road		
1030	land road		
1040	district road		
1050	municipal road		
1060	main through-road		
1100	freeway interchange/ highway junction		
1110	junction		
1200	road		
1210	driveway		
1220	footpath/footway		
1230	hiking trail		
1240	bikeway/cycle-path		
1250	bridleway/bridlepath		
1260	main agricultural road		
1270	agricultural road		
1280	bikeway/footway		
1290	access road		
1300	dead-end road		
1400	lane		
1410	lane, one direction		
1420	lane, both direction		
1500	pedestrian zone		
1600	place		

Thank you for your attention

Questions?

Remarks!! Suggestions!!!

Want to know more or provide feedback? Mail to: guus.tamminga@sweco.nl

