

VeGIS – Tool for the connectivity between traffic models and geographic information systems

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1 ABSTRACT

VeGIS develops concepts and technical solutions for the synchronization of data between traffic models and geographical information systems (GIS).

Test routines contribute to the quality improvement of traffic-related data concerning traffic information systems as well as to traffic development plans and subsequently developed technical plans. The project generates a basis for a continually expandable and better maintainable set of data relating to transport and mobility.

2 PROJECT DESCRIPTION

Due to a lack of resources, current transport development plans and corresponding transport models and the data contained therein are not maintained at the necessary degree but are, at best, updated only when demand arises. However, a continuous maintenance of similar but non-identical sets of data usually only occurs at regional departments responsible for Geo-information. This maintenance will be additionally reinforced with the development of a uniform traffic graph for Austria (GIP.at). Planning data accumulate within traffic development plans. Yet, despite the fact that they would be useful for calculations and traffic information they will not be part of the Austrian-wide traffic graph, where a special extent or conclusions are concerned.

Within VeGIS, concepts and technical solutions for the synchronization of data between traffic models and geographical information systems are developed. Based on the graph integration platform, GIP, and traffic development plans magnitudes from traffic models are identified that are relevant for users of GIP. Vice versa, GIP data are examined to establish to what extent their continuous maintenance would facilitate the creation and continuation of traffic development plans. The project is based on findings from previous projects – especially VIP Vienna Region, integrated road and path network Styria and GUARD – and takes into account ongoing activities with regard to quality assurance of traffic planning actions (Qualivermo).

A bi-directional data transfer, allowing a mutual illustration of two road networks with different net granularities, is designed on the basis of heuristics for “net matching”. Test routines are developed to assess consistent and routing-compatible transport networks, for one or more transport modes (pedestrians, cyclists, cars and trucks).

Depending on the problem, different graduations of the net granularities (accuracy of illustration and depth of the net) are required for a transport model. In the outer sector of an investigation area complex junctions, like roundabouts or level-free intersections are simplified in the illustration as individual nodes to reduce the data preparation and calculation time. By contrast, tight tolerances, e.g. necessary within the planning area with an exact modelling of the geometry of the lanes, are not present in GIP. For this purpose, the design of a multilevel net topology coordinated with the planning task and the geographical location is essential, whereas, at the same time a burden on the basic data of GIP should be avoided.

Furthermore, a method is designed facilitating the illustration of net efficiencies and planning scenarios as not yet realized measures within GIP, in order to provide typical GIP users with planning data too.

By integrating traffic model data in GIP, VeGIS contributes to the smooth utilization of data from traffic development plans, also for sectoral technical plans like e.g. clean air plans and environmental compatibility assessments. Linking further spatial data to the net graph (e.g. traffic cells) is an equally important requirement as the possibility to depict planning variants and scenarios in geographical information systems with variable read permission and accession depth.

The detailed work conducted within VeGIS comprises:

2.1 System Analysis

Within the system analysis the different systems-theoretical concepts of geographical information systems – especially the graph integration platform (GIP) – and usual traffic modelling software will be worked out.

The applications use different methods to represent graphs and their spatial characteristics and attributes. Graphs inside the GIP satisfy several important criterias such as net connectivity and routability. Therefore the GIP structures are particularly suitable for traffic models.

The former projects VIP Vienna Region and Integriertes Wegenetz Steiermark used the INTREST interface for data transfer. This solution allows only a data flow out of the GIP but not back. VeGIS develops a bi-directional data exchange interface which needs detailed definitions about the different options of data transfer. Special cases are e.g. changing attributes along the street segments like speed restrictions or the number of lanes requiring an automatical splitting of segments.

The system analysis figures out the approach to solve problems and to find decisions to develop the bi-directional interface. The output of this work will be a technical and graphic representation of an information model which shows and describes the relations of the system elements to each other and the technical opportunities for the bi-directional data transfer.

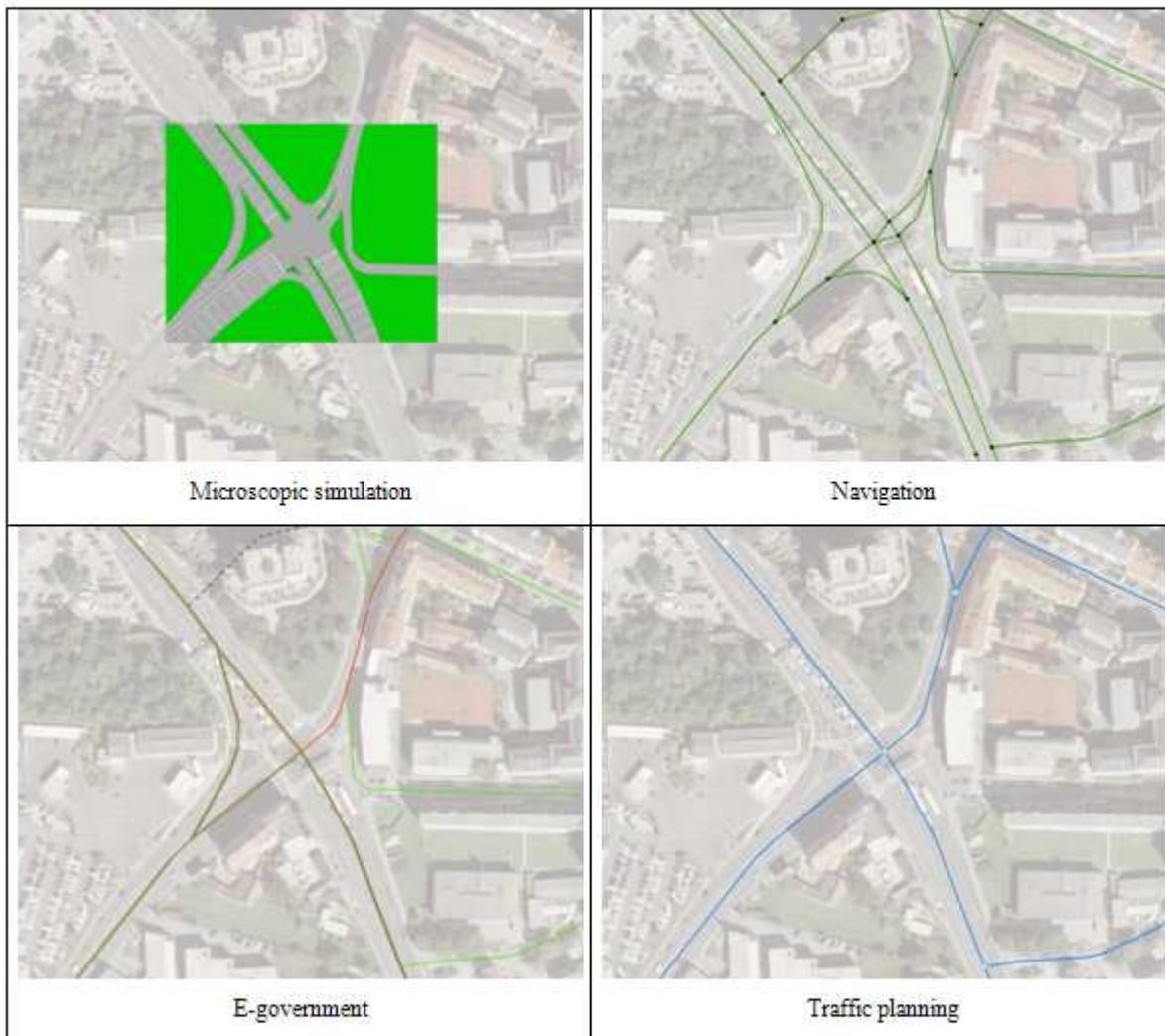


Fig. 1: Different granularities of a junction

2.2 System Conception

The system conception develops the transformation specifications for the new interface. The focus is on figuring out a sensible and technically feasible basis of decision-making by considering the framework requirements. The output will be a representation of all relevant work flows and processes from the user’s point of view. After enabling the data transfer from GIP to the traffic modelling software and back it is necessary to define and show the conditions, options and system limits for both transformations.

2.2.1 Definition of the Organisation Model

The organisation model makes clear

- which framework requirements are necessary for a successful bi-directional information transfer between GIS and traffic planning models
- which data flows are possible and sensible and
- which technical basics must be created for this exchange

2.2.2 Definition of the Application Procedures and the Transformation Model

One of the challenges in VeGIS is to transform network elements into different granularities. The first step is to define the transformation rules on a concept level. A practical example is to reduce a complex roundabout into a simple junction or to unify parallel links with different traffic modes (bicycle and pedestrian/ car and public transport) to one link which includes all these modes. A special focus is to maintain the original IDs for reference purposes also in case of merged or splitted links.

2.2.3 Definition of the Exchanging File Formats and Interfaces

Based on existing interface definitions (INSPIRE – transportation draft, INTREST) an addition is necessary to develop the VeGIS interface with the following requirements:

- Exchanging of partial network graphs
- Creating a bi-directional reference of graphs in different systems
- Creating references of elements with different granularities
- Updating information

2.3 System Development

The heart of VeGIS is to develop the system interfaces for a bi-directional data transfer. Based on the theoretical fundament of the system conception the existing data model will be extended by further functional mappings – higher and different granularities on junctions and links, new elements like traffic cells and its connections to the path network in geographic information systems. Development of routines for data exchange between GIS and traffic modelling software considers special requirements like user acceptance as well as the handling of big data volumes.

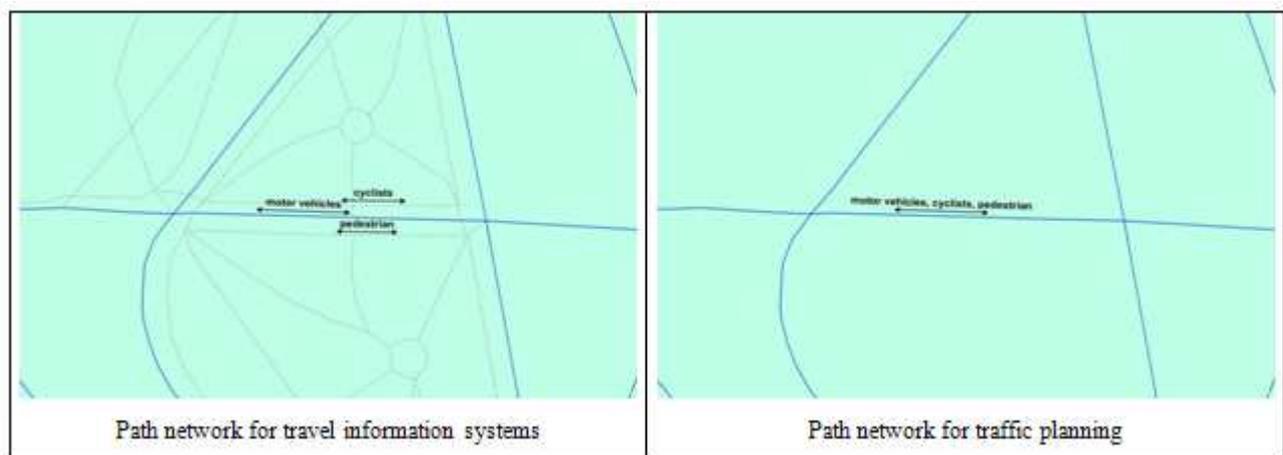


Fig. 2: Different granularities / reduced networks / transformation of traffic modes

2.4 Test Cases

For raising the user acceptance and figuring out the practicability test cases with different conditions will be defined.

2.4.1 Traffic Model Vienna

The municipality of Vienna, department for transport planning, maintains a detailed traffic model for the Vienna region. The model is detailed inside the City of Vienna and sketchy in the surrounding area (Lower Austria) There is also an existing harmonised Geodata infrastructure – GIP Vienna Region – for the region Vienna/ Lower Austria/ Pannonia.

In this test case map matching methods for a bi-directional data transfer on road sections with different granularities will be tested.

2.4.2 Integriertes Wegenetz Steiermark (Styria)

Several departments of the municipality of Styria and the city of Graz are working with the graph integration platform and maintain one intermodal road- and pathnetwork with all relevant modes – pedestrian, bicycle, cars, trucks, trains, tram, busses and some special modes.

In the project GUARD a monodirectional automatically data transfer from GIS into a traffic model was practised by integrating an entire network. Because of wrong transformations during this process some manual adaptations were necessary. This test case should show which manual steps can be eliminated by automation and which not.

2.4.3 Traffic Model Tirol (Tyrol)

The State of Tyrol neither has a maintained traffic model nor the system of Graph Integration Platform (GIP) in use. Currently the GIP will be implemented and an area-wide traffic model for Tyrol is planned. Therefore the road network graph in the existing Tyrolian GIS system (TIRIS) will be matched with further commercial data (TELEATLAS) to get a complete graph. This graph will be used to build the Tyrolian traffic model.

3 CONCLUSION

According to the GIP system VeGIS stimulates the development of a harmonised data pool for traffic model relevant structures and attributes. The GIP will be extended with regard to these special requirements. Continuously filled and updated by traffic models data can be maintained in a geographic information system (GIS). Otherwise a part of the integrating data is important for the GIS user. Redundant maintaining of information will be reduced effective. Data can flow back from GIS to traffic models everytime. By harmonising the data and implementation in GIP a never seen transparence in traffic models is developing and the common acceptance of traffic models is rising. Up to today traffic models often are “black boxes”. Advanced traffic models deliver better results which avoids wrong decisions in infrastructure investments and high costs.

4 REFERENCES

- BOHNET, M., GUTSCHE, J.-M., MENZE, A., STUL, D., WEINER, T.: GIS-Werkzeuge zur Aufbereitung von Strukturdaten für Verkehrsmodelle, In: ECTL Working Paper 34, Hamburg-Harburg, 2006
- SCHNÜLL, R.: Brauchen wir eine neue Art von Verkehrsentwicklungsplänen?. In: Straßenverkehrstechnik, Heft 8, Kirschbaum-Verlag Bonn, 2009.
- Projects:
- GUARD – GUARANTEED RIDE HOME: Technical solutions for quality improvement in public transport systems, travel information, interchanging guarantee for passengers, traffic model, I2V/ BMVIT, Graz, 2008-2010
- INTEGRIERTES WEGENETZ: Integrated, intermodal and routable path network for interoperable multi user processing, I2/ BMVIT, Graz, 2006-2008