Midyear Report 2013

TRANSPORTATION RESEARCH BOARD
JOINT TRAFFIC SIMULATION
SUBCOMMITTEE

AHB45 (1)
SimSub

Chairman's Message

SimSub Chair
Dr. George List
NC State University

Greetings from SimSub. Thanks to the efforts of David Hale, our new newsletter editor, for perhaps the first time, we have a midyear edition. As you can see by reviewing the ensuing pages, David has done a terrific job of assembling timely information about topics of interest to all of us.

Consistent with prior years, we will also be holding a midyear SimSub meeting next week on Thursday, August 1st in conjunction with the midyear meeting of the Highway Capacity Meeting. The meeting will occur in conjunction with the Simulation Subcommittee from 2:45-4:15.

As you may already know, the spotlight theme for the 2014 TRB Annual Meeting is "Celebrating our Legacy, Anticipating Our Future". This theme reflects the move of the Annual Meeting from the Connecticut Avenue hotels, where it has been for nearly 60 years, to the Washington. DC Convention Center in 2015. Our plan is to have the Sunday afternoon workshop be consistent with this theme. While we have not issued a formal "call for papers" you are welcome to send suggestions to me about speakers who could be invited, topics on which to focus, etc. It's OK to volunteer yourself. We will discuss ideas about the workshop at the midyear meeting on Thursday and finalize the speaker and topic list in the next few weeks.

Also note that the ITE Simulation and Capacity Analysis User Group (SimCap) has scheduled morning meetings for August 6th (Traffic Studies of the Future Roundtable), and August 7th (National SimCap Meeting with conference call), at the 2013 ITE Annual Meeting in Boston.

Again, our thanks to David for creating this midyear newsletter. We look forward to seeing you at the midyear meeting or at the annual meeting in January.

Sponsor Committees

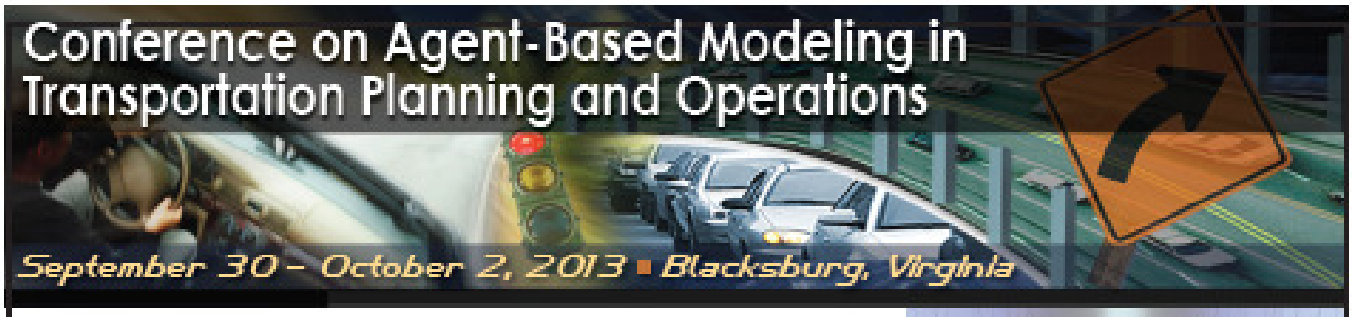
AHB45:	Traffic Flow Theory
AHB40:	Highway Capacity and Quality of Service
AHB20:	Freeway Operations
AHB25:	Traffic Signal Systems
ADB30:	Transportation Network Modeling
AHB55:	Work Zone Traffic Control
ADC20:	Transportation and Air Quality

Contents

SimSub Web Site

Alex Stevanovic, Webmaster http://sites.google.com/site/trbcommitteeahb45

Upcoming Simulation Events



The Conference on Agent-Based Modeling in Transportation Planning and Operations provides an international forum on the latest technical developments and research in the field of transportation planning and operations using agent-based approach. Researchers, academicians, practitioners, and industry and government agencies are invited to this conference to discuss their research and applications pertaining to agent-based modeling in transportation planning and operations. The conference is supported by the Mid-Atlantic University Transportation Center Program and by Virginia Tech.

Conference Objectives

The conference will provide the following objectives:

- Present the current state of the art/science in agent-based modeling in transportation.
- Provide the lessons learned from the current research efforts in this field.
- Define where the future lies in this type of modeling effort and what steps and research agenda need to be taken to ensure its success

Conference Topics

Topics of interest in agent-based modeling include but are not limited to:

- Developing the daily activities of travelers
- Spatial markets simulations (housing, demographics, firm-graphics)
- Routing of travelers in a dynamic traffic simulation
- Large scale microscopic traffic simulations
- Impact of hybrid and plug-in-electric vehicles on mode choice and transportation system performance.
- Integrated Transportation Planning and Operations Applications
- Traveler willingness to pay for toll roads/HOT lanes
- Evacuation planning and emergency management
- Acceleration and braking behaviors of individual drivers
- Car following and lane changing behaviors in traffic models
- Aggressive vs. defensive drivers in the context of eco-driving
- Driver behavior in the environment of co-operative vehicle-highway systems
- Modeling heterogeneous vehicle to vehicle networks including driverless fleets
- Applications in freight transportation modeling

Qualified papers will be published in a special issue of *Transportation Journal: Part C*

Questions

Technical questions regarding abstracts should be directed to:
Dr. Antoine Hobeika
Conference Chair
Email: Hobeika@vt.edu
Phone: 540-231-7407

Submission process and registration questions should be directed to:
Holly Williams
Continuing and Professional Education
Email: hmccall@vt.edu
Phone: 540-231-2186

Important Dates

Abstract Submission Deadline:
May 31, 2013

Notification of Abstract Acceptance:
July 15, 2013

Final Revised Submission Deadline:
September 1, 2013

Hotel Reservation Deadline:
September 2, 2013

Registration Deadline:
September 20, 2013

Conference Begins:
September 30, 2013 at 5:30 p.m.

VirginiaTech
Invent the Future

www.cpe.vt.edu/abmconf

Upcoming Simulation Events

Abstracts

Submission Guidelines

The submitted abstracts should be between 1,000 words and 2,500 words in length. Authors should submit their contributions electronically in PDF format at: www.manager.cpe.vt.edu/conferenceDisplay.py?confId=5

Proceedings and Publications

All abstracts accepted for the conference will be included in the conference proceedings that will be compiled on a flash drive and be given to all participants at the time of registration.

Authors of selective outstanding abstracts will be asked to submit full papers to be considered for publication in the special issue of Transportation Research: Part C dedicated for this conference. In preparing their final manuscript, invited authors should follow the paper submittal guidelines for the Transportation Research: Part C.

The chief editor of this special issue of Transportation Research-C is Lei Zhang from University of Maryland. The co-editors are: Hesham Rakha from Virginia Tech, Monty Abbas from Virginia Tech, and Eric Miller from University of Toronto.

Committees

Conference Chairmen

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Dept. of CEE, Virginia Tech

Hesham Rakha
Dept. of CEE/VTTI, Virginia Tech

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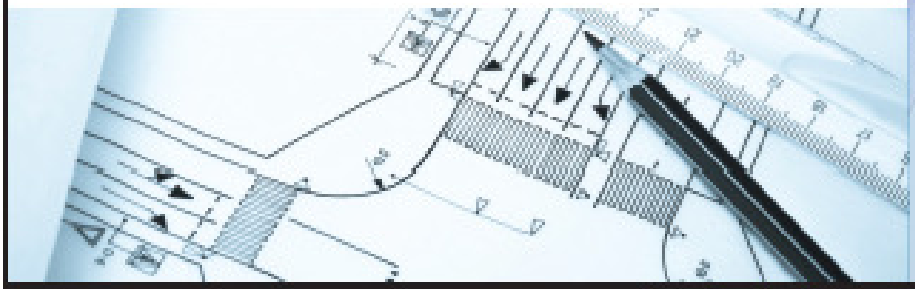


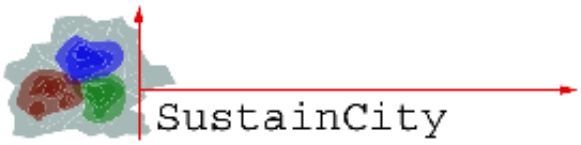
VirginiaTech
Invent the Future

www.cpe.vt.edu/abmconf

Upcoming Simulation Events

Web Site: http://www.rss2013.org/

Recent Simulation Events



Zurich, 08 March 2013
Revision: 9

SustainCity Conference on
Integrated Land-Use and Transport Simulation

Public open lectures
Wednesday 17 April 2013

Location	ETH Zurich (Zentrum) Building CAB, Room CAB G 11 Universitätstrasse 6, 8006 Zürich
Time	Wednesday 17 April 2013, 17:00-19:00
Registration	Please register until 7 April 2013 under www.sustaincity.eu.

Time	Content (Speaker)
17:00	**Welcome + introductions** K.W. Axhausen, ETHZ, Administrative Coordinator A. de Palma, ENSC, Scientific Coordinator
17:15	**Integrated Land-Use and Transport Simulation in Politics** Dr. Maria Lezzi
18:00	**Interdependences between Land-Use and Transport** Prof. Dr. Paul Waddell
18:45	**EU policy relevance of SustainCity project** D. Rossetti, European Commission
19:00	**Apéro**

Organization: **Prof. K.W. Axhausen**, ETHZ (axhausen@ivt.baug.ethz.ch)
Prof. A. de Palma, ENSC (andre.depalma@ens-cachan.fr)
Dr. B.R. Bodenmann, ETHZ (bodenmann@ivt.baug.ethz.ch)
Information: **www.sustaincity.eu**

DATA SIM Summer School (15-18 July 2013)

www.datasim-fp7.eu

DATA SIM Summer School 2013

The Transportation Research Institute (IMOB) of Hasselt University organizes the first DATA SIM Summer School on 'Mobility modeling and big data sources'. This Summer School will take place at **Hasselt University, Campus Diepenbeek** (Agoralaan Building D, 3590 Diepenbeek, Belgium) from **Monday July 15th to Thursday July 18th.**

Topics

This Summer School will feature a series of lecturers by renowned researchers in the following topics:

Mobility modeling: basic principles and tools.

1. Behavior modeling, activity based models (activity selection, planning, daily schedule generation)
2. Multi-modal trips
3. Modeling cooperation, cooperative scheduling (e.g. carpooling)
4. Ontologies
5. Traffic and transportation related models, travel demand prediction models
6. Simulations in practice: what conclusions can be drawn?

Special focus: Agent based modeling and simulation for mobility, travel behavior, mobility market, electro-mobility (including smart grid, etc.).

1. Delimiting the domain of applicability: where can agent based modeling be useful?
2. Models for cooperation, mutual influence, negotiation
3. Computability issues, scalability
4. Ontologies
5. How to interpret results? What can be expected?

Big data as source for modeling.

1. Big data repositories
2. Annotation, semantic enrichment of big data
3. Data mining and process mining to extract information from big data
4. Crowd sourcing and publicly available data: pitfalss and challenges
5. Using data from different sources: how to align?

	**Integrating big data and modeling.** 1. Using big data to feed models or to validate model execution results 2. How to integrate semantically poor big data with small sets of semantically rich data as input for microsimulation or agent based modeling
	**Applications** 1. Electric vehicles (including smart grid concepts) 2. Carpooling (cooperation on trip traveling) 3. Multi-modality and car-sharing (cooperation on resource usage) 4. Markets based on big data related to traffic • Business models for EV, multi-modal trips, car-sharing, carpooling • Online support systems (ride sharing advisors) • Traffic load prediction systems 5. Effect of EV characteristics (range anxiety, charging time, limited range) on household travel behavior
	**Hot research topics in transportation behavior, traffic safety and logistics.**

Target audience

The Summer School is suited for senior-researchers, early-stage researchers, practitioners and (PhD) students from the domain of transportation sciences, data mining, agent/activity based modeling and related topics.

Participants will have the opportunity to get feedback on their work during the graduate symposium sessions. Participants interested in presenting their work should submit a 1 page (A4) abstract motivating the main research challenge they are addressing and stating the approach being taken. A selection of proposals will be chosen for presentation.

Participation Certificates

Participation Certificates will be issued to all participants of the Summer School.

Contact

For more information please contact Luk Knapen (luk.knapen@uhasselt.be) or consult the DATA SIM Summer School webpages (www.datasim-fp7.eu).

Recent Simulation Events

Roundabout Operations Software Showcase

Sponsored by the ITE Roundabout Committee
Monday, March 4, 11:00 a.m.-12:30 p.m.
Room: Harbor Island Ballroom III

ITE 2013 Technical Conference and Exhibit
San Diego, CA, March 4th, 2013

Learning Objective:

Showcase and discuss software packages that can assist planners and designers in roundabout operations and design.

Presider:

Hillary N. Isebrands, Safety Engineer, U.S. DOT-FHWA, Lakewood, CO, USA

Speakers:

Modeling Roundabouts with PTV Vissim and Vistro
Karen Giese, Vice President Product Management, PTV America, Portland, OR, USA

SIDRA INTERSECTION Roundabout Demo
Howard McCulloch, Roundabout Design Specialist, NE Roundabouts, Averill Park, NY, USA

TORUS Roundabout Demo
Steven Chan, Senior Product Engineer, Transoft Solutions Inc., Richmond, BC, Canada

Synchro and SimTraffic Roundabout Demo
Michael T. Trueblood, Senior Traffic Engineer, Trafficware, Sugar Land, TX, USA

RODEL Roundabout Demo
Mark T. Johnson, Principal Transportation Engineer, MTJ Engineering LLC, Madison, WI, USA

Karen Giese presents roundabout simulation in VISSIM

Left-to-right:
Steven Chan (demonstrating TORUS)
Hillary Isebrands
Karen Giese
Howard McCulloch
Michael Trueblood
Mark Johnson

Recent Simulation Events

TRAFFIC ENGINEERING COUNCIL
NATIONAL SIMULATION AND CAPACITY ANALYSIS USER GROUP (SIMCAP) MEETING

MEETING AGENDA – ITE 2013 TECHNICAL CONFERENCE AND EXHIBIT
SAN DIEGO, CA
MONDAY, MARCH 4, 2013
2:45 PM – 4:15 PM (PACIFIC)
5:45 PM – 7:15 PM (EASTERN)

SHERATON SAN DIEGO HOTEL AND MARINA
MEETING ROOM: EXECUTIVE CENTER 4

1. Welcome and Introductions (Dave Petrucci)
2. Remarks and ITE Traffic Engineering Council Update (Troy Peoples)
3. ITE Update (Zaki Mustafa)
4. Regional Updates
    a. San Diego Section Transportation and Mobility Task Force (Erik Ruehr)
    b. Mid-Atlantic Section (Orla Pease)
    c. Washington D.C. Section (Alek Pochowski)
    d. Houston Section (Raj Basavaraju)
    e. North Carolina Section (Bastian Schroeder)
    f. MET Section (Gordon Meth)
    g. Florida District (Dave Hale)
    h. Washington State Simulation Roundtable (Matt Beaulieu)
    i. Oregon Traffic Simulation Roundtable (Miranda Wells and Tegan Enloe)
5. ITE E-Community Site (Dave Petrucci)
6. Next Meeting / Conference Call (Boston, MA August 4-7, 2013)
7. Open Discussion
8. Adjourn

Recent Simulation Events

Next Meeting: September 30th, 2013

Oregon ITE Simulation Roundtable

by Miranda Wells
HDR Engineering, Inc.
Co-Founder and Co-Chair of the Oregon ITE Simulation Roundtable

The Oregon ITE Simulation Roundtable Subcommittee is entering its second year since being established by Miranda Wells (HDR) and Tegan Enloe (DKS). Since its creation, the group has held five brown bag lunches and one half day workshop which typically have between 30 and 60 people in attendance.

This group of presenters was great because it gave the perspective of using simulation for adaptive analysis from a consultant view point, a research viewpoint, as well as a vendor view point. For copies of the presentation material from this meeting as well as past meeting presentations please check out the Oregon ITE Simulation Roundtable website at:

http://www.orsimulation.com/

At this website you can also see the next scheduled upcoming meeting. The most recent meeting planned is the Joint Oregon and Washington ITE Simulation Roundtable Half-Day Workshop. This meeting is planned for September 30th, 2013

The most recent brown bag lunch meeting was a joint meeting with the Oregon ITE ITS Subcommittee. The topic was "Analyzing Adaptive Signal Systems in Micro-Simulation." This meeting looked at ways to model adaptive systems in micro-simulation, the level of effort involved, and how effective the results are in replicating field conditions.

There were three presenters who discussed three different adaptive systems:

Miranda Wells, HDR (ScatSim)
Aleks Stevanovic, FAU (InSync)
Marshall Cheek, Trafficware (SynchroGreen)

and will be held in Portland, Oregon. If you are interested in joining the workshop please RSVP by email:

oritesimulationroundtable@gmail.com

The joint workshop will be followed by a joint happy hour with the PTV Group at the Benson Hotel.

Recent Simulation Events

Managed Lanes Webinar and Computer Lab Workshop

Presented by
Dr. Dimitra Michalaka

Course Content:

- Pricing Strategies
- Lane Choice Models
- Toll Structures
- Simulation of Managed Lanes using CORSIM

The Managed Lane Operations and Simulation using CORSIM Webinar and Computer Lab Workshop was held on April 29 & 30, 2013 at the University of Florida, Gainesville, and was presented by Dr. Dimitra Michalaka.

This two-part event consisted of a 1.5 hour webinar on April 29th; followed by 4-hour, hands-on computer lab workshops on April 30th.

In a typical setting, lanes on a given freeway are designated either as regular or managed toll lanes. The former has no toll while the latter can only be accessed by paying a toll. If high-occupancy vehicles (HOVs) do not need to pay, the facility is widely known as a high-occupancy/toll (HOT) facility. Some of the HOT lane facilities currently implemented in the U.S. are single-segment (e.g., SR-91 in California and 95 Express in Florida), while others are multi-segment (e.g., I-15 in Utah, I-10 in Texas, and I-394 in Minnesota). A single-segment HOT facility has essentially one entrance, one exit, and one tolling point. In contrast, a multi-segment HOT facility has multiple ingress and egress points that are located distantly from each other, and multiple tolling points. This webinar focuses on the operations of single and multi-segment managed lanes. It covers several components of managed lane operations such as pricing strategies, lane choice models, and toll structures. It also demonstrates how to use CORSIM to simulate managed lanes with one or multiple segments.

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UNIVERSITY of FLORIDA

T2 CTT
Florida Transportation Technology Transfer Center

Recent Simulation Events

Benchmarking of OD Estimation Algorithms

by Dr. Constantinos Antoniou

The EU COST Action TU0903 - MULTITUDE (Methods and tools for supporting the Use, caLibration and validaTIon of Traffic simUlations moDEls, www.multitude-project.eu), has now entered its last year and is set to culminate with a range of outreach activities and documents, in addition to finalising technical work on a number of issues.

One of these activities is performing a benchmarking exercise of origin-destination (OD) estimation and prediction algorithms, in a way that is fair to the various approaches and provides a level playing field for unbiased evaluation. The objective is not to conclude that one approach is better than another, but instead to illustrate the advantages and disadvantages of the various approaches, highlighting the conditions under which each might become more relevant. Several experienced OD estimation researchers are involved in this task, including several TFT and SimSub members, bringing expertise from diverse fields of OD estimation. The list of participants includes (in alphabetical order): Costas Antoniou (NTUA), Jaume Barcelo (UPC), Jordi Casas (TSS), Ernesto Cipriani (UniRoma3), Biagio Ciuffo (EU JRC), Tamara Djukic (TU Delft), Gunnar Flötteröd (KTH), Vittorio Marzano (UniNa), and Tomer Toledo (Technion).

A common evaluation and benchmarking framework has been developed, so that a number of algorithms can be implemented and tested under the same conditions. The framework is implemented in Matlab and python and uses the AIMSUN traffic simulator for the function evaluation/assignment. The mesoscopic simulator level of AIMSUN has been considered suitable for this task (considering computational requirements) and therefore this is the one that is being used in this task. However, the framework is flexible. Besides providing a common platform, the developed framework requires each participant to simply implement their algorithm (in Matlab), while taking advantage of the remaining infrastructure for the tedious tasks of interfacing with the simulator, performing (and averaging the output of) the replications and computing the goodness-of-fit statistics.

An experimental design has been performed along multiple dimensions, including:

- OD estimation and prediction algorithms;
- Networks;
- Data sources;
- Demand levels; and
- Levels of sensor coverage, depending on location of sensors, type of surveillance information, as well as quality of surveillance information.

The considered algorithms include (i) Kalman filter variants (in which case the problem is formulated as a state-space model), such as the Extended Kalman Filter (EKF), the Limiting EKF and quasi-dynamic Kalman Filter and (ii) direct optimization algorithms (in which case the problem is formulated as a standard optimization problem), such as SPSA, GLS, and LSQR.

Three networks are being used in this effort: (i) a test network, used primarily for debugging and verification purposes, (ii) a network from Vittoria, Basque country, Spain (57 centroids, 600km road network, 2800 intersections, 389 detectors) and (iii) a network from Barcelona, Catalonia, Spain (130 centroids, 1570 nodes, 2800 links).

Different types of data are considered by different groups. Besides the conventional loop detectors, counts from Bluetooth detectors and travel time information between detectors (e.g. Bluetooth sensors) are also considered.

Preliminary results of this task have been presented in a hands-on workshop in a recent MULTITUDE meeting in Delft, The Netherlands, on February 2013. Based on the results of this workshop, further refinements to the common platform and individual codes have been made and revised results will be presented at the MULTITUDE Management Committee meeting in Chania, Greece, in the end of May 2013. We expect that the results will be able to be published soon, hopefully in TRB2014!

multitude

Methods and tools for supporting the Use caLibration and validaTIon of Traffic simUlation moDEls

COST

Quasi-OTEE versus kriging-based approaches for the sensitivity analysis of computationally expensive traffic simulation models

Submitted by Biagio Ciuffo[1], Qiao Ge[2], Monica Menendez[2] (1. European Commission Joint Research Centre. 21027 Ispra, IT; 2. ETH Zurich, Institute for Transport Planning and Systems. 8093 Zurich, CH)

Introduction

Traffic simulations have become indispensable tools for academicians and practitioners worldwide. A significant amount of research has gone into improving the quality of the simulators. Nonetheless, model calibration continues to be a key factor in ensuring the accuracy of the outputs. One area of model calibration in which meaningful contributions are still needed is the sensitivity analysis (SA) of the input parameters. The SA explores the relationship between the simulation output and the input parameters. Although calibration is typically carried out for only a limited number of parameters, there is usually no formal procedure for selecting them. The wrong selection may lead to multiple issues, including model imprecisions, and unrealistic values for the calibrated parameters. A proper SA, therefore, can be very valuable for the calibration process and ultimately the final simulation results.

Research goal

This paper aims at comparing two recently developed SA methods, in order to better understand their advantages and disadvantages especially when applied to traffic simulators. The first model, called quasi-OTEE, was introduced in (*1*). It is a general screening approach based on the Elementary Effects (EE) method (*2*) but with much higher efficiency. It screens the influential parameters through computing the corresponding EE and qualitatively comparing the Sensitivity Indexes. The case study provided in (*1*) demonstrated that this tool can properly identify the most influential parameters from a computationally expensive model, for which other quantitative SA techniques are not feasible. The second method adopts Sobol indices (*3*) calculated on a kriging approximation of the simulation model. Effectiveness of this method has been proven in (*4*) where the authors show that Sobol indices calculated on the kriging emulator (based on 128 and 512 model evaluations) achieve approximately the same value than those calculated, following the procedure described in (*3*), on almost 40.000 model evaluations.

Preliminary results

A benchmarking exercise was carried out on five "toy" networks (the same as in (*4*)), using the mesoscopic version of the AIMSUN model. Seven model parameters were considered in the analysis, and, in both methods, 512 model evaluations were used. The SA was then carried out on four different model outputs calculated locally and globally. Preliminary results show that both methods were able to identify, to a good degree, the non-influential parameters. Furthermore, the kriging-based method was also able to provide a reliable estimation of first order and total order sensitivity indices, thus allowing a more powerful insight into the input-output relation of the model. The reliability of a kriging meta-model, however, suffers for the high dimensionality of the model itself. The experience carried out therefore suggests the following rule-of-thumb for the SA of computationally expensive traffic simulation models: the quasi-OTEE method can be used first to exclude non-influential parameters. Then, a kriging-based SA can be applied on the reduced set of parameters to refine the analysis and to identify with higher precision the effects produced by each

input on the outputs. In this way, just a few hundreds simulations can produce results as accurate and reliable as any other more computationally expensive sensitivity analysis tool.

Acknowledgements

Research contained within this paper benefited from participation in EU COST Action TU0903 – Methods and tools for supporting the Use caLibration and validaTIon of Traffic simUlation moDEls.

References

1. Ge, Q., and M. Menendez. An improved approach for the sensitivity analysis of computationally expensive microscopic traffic models: a case study of the Zurich network in VISSIM. *Proceedings of the 92th TRB Annual Meeting*, Washington DC, 2013.
2. Morris, M. D. Factorial sampling plans for preliminary computational experiments. *Technometrics*, Vol. 33, No. 2, 1991, pp. 161 - 174.
3. Saltelli, A.; Ratto, M.; Anres, T.; Campolongo, F.; Cariboni, J.; Gatelli, D.; Saisana, M.; Tarantola. S.; *Global Sensitivity Analysis – The Primer*; John Wiley and Sons Ltd: Cheichester, England, 2008.
4. Ciuffo, B., Casas, J., Montanino, M., Perarnau, J., Punzo, V. From Theory to Practice: Gaussian Process Meta-Models for Sensitivity Analysis of Traffic Simulation Models: Case Study of Aimsun Mesoscopic Model. *Proceedings of the 92th TRB Annual Meeting*, Washington DC, 2013.

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

JAMES WORTH BAGLEY COLLEGE OF ENGINEERING
MISSISSIPPI STATE UNIVERSITY

CIVIL & ENVIRONMENTAL ENGINEERING

Traffic Simulation in Research Projects

by Dr. Li Zhang, Zhitong Huang, and Yi Wen
Mississippi State University

Traffic simulation has been extensively used for simulating traffic systems in transportation research projects at the Department of Civil and Environmental Engineering, Mississippi State University. In the project "Coordination of Connected Vehicle and Transit Signal Priority on Transit Evacuations", we developed the complete Gulf Coast traffic network in TSIS-CORSIM. Traffic signals, freeways, highways, traffic signs, and traffic flow were simulated. The simulation was implemented in an emergency evacuation scenario to help us evaluate the proposed Transit Signal Priority (TSP) system. In addition, a Run Time Extension (RTE) was developed for the simulation to help us on the evaluation. For example, RTE enabled us to implement Transit Signal Priority (TSP) operations at specific signalized intersections. Moreover, Connected Vehicle, which is a technology under development for wireless communication among vehicles and infrastructures, was simulated and integrated with TSP to improve transit evacuation efficiency. We could also simulate different scenarios for different levels of evacuations. The proposed TSP strategies were demonstrated effective by the simulation.

In the project "I-55 Integrated Diversion Traffic Management Benefit Study", simulation was used to create a scenario in which the freeway was very congested and freeway traffic was diverted to arterials to bypass the congested segment. RTE was also developed for the simulation. We implemented our models and algorithms in the simulation to optimize the diverted traffic volume and traffic signals on the arterials. We performed before/after simulations to evaluate the diversion system performance. It provided us valuable results which were helpful on the analysis of diversion traffic pattern, diversion route selection, DMS implementation, and traffic signals on the arterial roads when there is serious congestion on the freeway.

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Recent Research Results

Directed Brute Force Calibration (patent pending)

by Dr. David Hale
University of Florida

Use of traffic simulation has increased significantly, and has allowed important transportation decisions to be made with better confidence. During this time, traffic engineers have typically been encouraged to embrace the process of calibration, in which steps are taken to reconcile simulated and field-observed traffic performance.

Federal Highway Administration (FHWA) guidelines for applying microsimulation modeling software (1) state "the importance of calibration cannot be overemphasized"; and then refer to a study (2) by Bloomberg et al., which makes the following statement: "Recent tests of six different software programs found that calibration differences of 13 percent in the predicted freeway speeds for existing conditions increased to differences of 69 percent in the forecasted freeway speeds for future conditions."

According to international surveys (3), top experts, and conventional wisdom, existing (non-automated) methods of calibration have been difficult and/or inadequate. Consulting engineers and DOT personnel have expressed strong interest in making calibration faster, cheaper, easier, and requiring less engineering expertise. Some users of simulation have been unwilling to perform any amount of calibration; frequently citing labor-intensive data collection procedures, or a lack of coherent procedures and guidelines. Some simulation users have tried to apply procedures and guidelines that exist in the literature (1, 4, 5, 6); but have found that these guidelines are difficult to apply, or that these guidelines are a poor fit for their specific type of simulation analysis. Finally, some simulation users believe that they have somewhat mastered the process of calibration; but that the amount of engineering expertise required to achieve this mastery could be measured in decades, or that successful execution of calibration for a project could require weeks of hard work.

There has been a significant amount of research in the area of automated calibration techniques, for traffic simulation. However, many of these research projects and papers have not provided the level of flexibility and practicality that are typically required by real-world engineers. In the research papers by Lee and Ozbay (7) and Lee et al. (8), the authors present substantial literature reviews for both manual and automated calibration techniques. Their literature reviews contain references to dozens of related papers. The authors then emphasize that, despite the extensive efforts, existing calibration procedures continue to require excessive time and expertise.

With this in mind, the self-calibration features within TSIS-CORSIM were designed with an eye on maximizing practicality, flexibility, and ease-of-use. The implemented methodology allows engineers to quickly and easily select a set of input and output parameters for calibration. This methodology also allows engineers to prioritize specific input and output parameters, and specify their tolerable computer run time, prior to initiating the self-calibration process. The "directed brute force" search process is believed to be a key element in making this methodology flexible and practical, for real-world use.

FHWA is in the process of updating Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software (1), which was previously published in 2004. To support this effort, engineers from Noblis, Inc. are helping FHWA to produce a literature review (9) of existing calibration guidelines. This literature list demonstrates a widespread interest in simulation guidelines. It is hoped that the directed brute force calibration process described in this article may someday be recognized by many of these guideline documents.

Largely due to CPU speed limitations, automated calibration is unlikely to fully replace engineering judgment, engineering expertise, or manual (non-automated) calibration. The automated tools also cannot defend against fundamental (volume, timing, laneage) input data errors, simulation software bugs/limitations, or inconsistent performance measure definitions. Despite this, these software tools can hopefully "bridge the gap", in terms of significantly reducing the amount of time and expertise required for complex engineering projects.

[1] Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, June 2004, Publication No. FHWA-HRT-04-040

[2] Bloomberg, L., M. Swenson, and B. Haldors, *Comparison of Simulation Models and the Highway Capacity Manual*, Preprint, Annual Meeting, TRB, Washington, DC, 2003.

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Online traffic simulation software for heterogeneous road networks – current state and future trends

Submitted by Andreas Pell, Andreas Meingast, and Oliver Schauer (University of Applied Sciences Upper Austria – Logistikum, Steyr AUT)

Introduction

This article presents the results of an evaluation process of traffic simulation systems, which were presented at this year's European Conference on Intelligent Transportation Systems in Dublin. The evaluation was part of the on-going project "Intelligent Transport Systems Austria West" commissioned by the Office of the Provincial Government of Upper Austria and sponsored by the Austrian Climate and Energy Fund, which aims to implement and introduce a simulation software tool for providing real-time traffic estimation and short-term traffic predictions for the roads of Upper Austria. This road network includes urban streets in cities and towns as well as rural roads. In addition heterogeneous traffic has to be taken into account.

Road-side detectors are expensive and can only measure traffic volume at single points. To describe the current traffic situation of a heterogeneous road network an online sensor-integrated software tool has to be implemented to simulate and estimate the current traffic conditions in sections without real-time sensor information by abstraction of real world conditions by developing computer models [1].

A literature review revealed that in the last few years 24 reports were published but no comprehensive comparison of traffic-simulation tools like the "SMARTEST" project coordinated by the University of Leeds and funded by the European Commission [1][2][3][4]. Technical documents have been evaluated and an online survey with developers and product managers has been conducted. In addition predictions of future trends in traffic simulation software (TSS) have been collected on basis of expert interviews.

Comparison study

As part of this study, a survey was conducted to ascertain the current state of TSS. The questionnaire was based on SMARTEST [4]. As new fields of application have developed over the last few years, a lot of additional functionalities of other publications were added. The aim was to provide an overview of as many products as possible. The outcome of the study is an overview of 17 products. The information was gathered either by the questionnaire or from literature. Comparing the up-to-date results with earlier studies it seems that some simulation systems have been developed faster than others. It also reveals a further development of some products to adapt them to new fields of application. Due to the fact that traditional simulation programs have not been developed for being used in this area this step seems to be necessary [5].

Expert interviews

In addition to the comparison, future trends were collected by expert interviews. Analyzing the interviews show, that using TSS for ATMS & real-time simulation causes special requirements on TSS. The use of real-time traffic simulation is relatively new and from a market perspective still underestimated. Today, there are very limited real-world applications of real-time systems. Most of these applications are academic research case studies. There are many vendors, but only a few of them deliver suitable products that fit for those real-time applications. To operate real-time TSS good behavioral models, driver response and prediction algorithms are needed. The trend of using TSS for ATMS has created increased interest in mesoscopic solutions, their ability to scale wide areas without too much loss of fidelity in representing traffic dynamics. Yet, vendors of TSS do

not offer all of these functionalities in one single product. By providing interfaces in TSS vendors ensure, that missing functionalities can be implemented. However, for customizing TSS, a lot of research, coding and calibration must be done. Therefore, it needs more than a tool from a user's perspective. Real-time traffic simulation needs a bundle of software tools, knowledge and sometimes know-how. Another challenge will be to process great volumes of data provided by vehicles, mobile phones or road side sensors. They all have to be integrated in TSS to provide real-time traffic estimation, prediction and predictive route guidance. Predictions are required in order to anticipate congestion and drivers' response to any guidance that is disseminated to them. Some real-time systems without sophisticated prediction models exist in practice. Real-time predictive methodologies are still in the research/ academic domain.

TSS in rural areas have to deal with different challenges. Comparing rural areas with urban and inter-urban areas it arises, that rural areas have to deal with motorized and non-motorized traffic. Due to the fact that pedestrians, bicycles, cars, trucks, busses, etc. interact on these roads, parameters require a calibration. Freight traffic also needs to be properly calibrated to be able to take into account the effects of trucks on traffic congestion. To model heterogeneous traffic it is possible to change parameters in microscopic simulation systems and develop mesoscopic models. TSS need to adapt their methods of assignment on the different road categories rural, interurban and urban. In some cases legacy asset management and network information systems have to be replaced with more comprehensive database solutions. Additionally, poor data quality, a small amount of real-time data and communication costs in remote rural areas are common challenges – not only for operators, but also for vendors.

Conclusions

A state-of-the art review report has been drawn up. The results of the evaluation show, those existing simulation systems can estimate current traffic situation and predict traffic conditions. Most of the simulation tools are designed for "urban", "interurban" or "combined" road networks and can deal with real-time data. No system delivers all functionalities; no system seems to have a focus on a single field of application. Some of these systems use hybrid models (micro+meso, micro+macro, micro+meso+macro); some of them have limitations in links, etc. A detailed network model is necessary. A GIS data based network model would improve data consistency and efficiency, which is often not recognized by software vendors.

There is a lack of online traffic simulation software applications specially designed for heterogeneous road transportation networks in peripheral regions. Regarding the rising performance of traffic simulation systems, future research could be done to further develop this functionality in simulation systems to can use them better for providing real-time traffic information and short-term traffic predictions in mixed wide areas (rural, urban, inter-urban) by the use of vehicle probe data without focusing only on highways, highly-ranked arterial roads and conurbations. Customization provides more room to develop future applications but also overstrains some users.

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SimSub Activities

Animations of Traffic Flow Phenomena

by Dr. Aleks Stevanovic

I've created a page on our website that lists some of the websites that contain simulations/animations of traffic flow phenomena. The list is not inclusive and it contains links which were either given to us or were known from personal experiences. If you know any other similar links which you think deserve to be included please let us know (trbcommitteeahb45@gmail.com). Animations of traffic conditions (e.g. shock waves, ramp metering, signalized operations) are great visual tools to popularize the traffic engineering discipline and great resources for our students in traffic engineering/ traffic flow theory courses. If you have any ideas how to improve this page please send your comments to the email address given above.

Carlos Daganzo's Animations of Traffic Phenomena
http://www.ce.berkeley.edu/~daganzo/index.htm

Ben Coifman's (OSU) Shock Wave Animations
http://www2.ece.ohio-state.edu/~coifman/shock/

This page illustrates wave propagation on freeways. In the extreme, such waves take on the form of stop and go traffic. All of the data shown here come from real traffic, having been reduced by hand from video.

Jorge Laval's (GA Tech) Online Simulations
http://trafficlab.ce.gatech.edu/

Here you will find information and resources on vehicular traffic simulation models. Most of the models included in this website are based on the kinematic wave model (also known as the LWR model), which is the simplest model able to capture basic traffic dynamics features such as the propagation of congestion in the form of "waves".

Martin Treiber's Traffic Animations

1. MovSim
Homepage of the Multi-model open-source vehicular traffic simulator (MovSim): www.movsim.org

Besides working with/contributing to the open-source simulator, you can play two online games:

Ramp-Metering Game: Control interactively a signalized freeway access and try to beat the high-score, i.e., the minimum simulation time to manage all the prescribed traffic demand. If your control abilities are low, you will create massive jams, or even a gridlock, on the secondary road.

Routing Game: Reroute interactively some of the prescribed freeway traffic demand over a deviation to avoid/ delay traffic breakdown. However, you can do too much of a good thing and create massive jams on the deviation. Again, the goal is to beat the high-score, i.e., the minimum time to manage all the traffic demand. The routing game will be available as an Android App, soon.

By the nature of the traffic management simulated in the games, action and effect are significantly delayed. This makes it tricky (and interesting) to obtain good scores. Both games have been tested on our annual science fair for pupils and the general public ("Lange Nacht der Wissenschaften") and can be made available for similar events.

2. Traffic-Simulation (DE)
www.traffic-simulation.de

In this interactive Java applet, you can create your own traffic jam in different situations, provoked by bottlenecks, traffic demand peaks, external perturbations, or by changing the driver's behavior. All the above elements can be controlled interactively.

3. Traffic-States
www.traffic-states.com

This is a searchable graphical data base for spatial-temporal traffic jam patterns.

SimSub Web Site

Alex Stevanovic, Webmaster **http://sites.google.com/site/trbcommitteeahb45**

SimSub Activities

SimSub Meeting at the Mid-Year Highway Capacity Committee Meeting

The Highway Capacity and Quality of Service Committee (HCQS) held its mid-year meeting between July 31st and August 3rd, 2013, at the Polytechnic Institute of New York City. On August 1st, a SimSub meeting was held in conjunction with the HCQS Traffic Simulation Applications Subcommittee meeting. The meeting was moderated by George List (NC State University) and Loren Bloomberg (CH2M Hill).

Lily Elefteriadou conducts the HCQS full committee meeting on August 3rd

During this meeting, members discussed future research and activities to consider. Popular research ideas included integration of HCM methods with macroscopic simulation, and developing procedures for comparing HCM outputs to simulation outputs. Activity ideas included documenting the relationship between three analysis paradigms (capacity analysis, simulation, "Big Data"), and maintenance of simulation-based guideline manuals.

About halfway through the meeting, David Hale (University of Florida) repeated some of the other simulation-based topics mentioned during Wednesday's HCQS Research Workshop. These topics included HCM guidance on calibrating simulation (especially geometric factors), defining performance measures for simulation, prescribing when simulation should supplement field data, using new data to facilitate simulation algorithm development, guidance on field data measurement for simulation, and using simulation for reliability analysis. Karen Giese (PTV Group) mentioned the effectiveness of macroscopic simulation for reliability analysis.

Towards the end of the meeting, Jim McCarthy (FHWA) reported on the progress of Traffic Analysis Tools Volume III, which is undergoing a major revision. Finally, members discussed the Sunday Workshop at TRB 2014, at which expert speakers are expected to discuss the past, present, and future of simulation.

Product Updates

TransModeler Traffic Simulation Software

Caliper released TransModeler 3.0 in mid-December 2012. Version 3 includes complex transportation features including trip- and zone-based dynamic pricing for managed lanes, two-way left turn lanes, overtaking on two-lane rural highways, reversible and contra-flow lanes, bicycle simulation, and a GIS-enabled API.

TransModeler 3 uses a native 64-bit implementation. The 64-bit architecture supports the use of more machine memory. Both driver route choice and vehicle simulation are multithreaded, which can significantly reduce running time. These shorter running times make computationally-intensive processes like simulation-based dynamic traffic assignment feasible for wide-area networks on a reasonable time scale.

The road editor was redesigned to make model development simpler and less time-consuming. The road editor now has devoted functionality for editing and managing two-way left turn lanes (TWLTL), reversible lanes, roundabouts, and passing zones on two-lane highways. The road editor enables changing a road from one-way to two-way and back again each with a single mouse click. Streets can automatically intersect when they cross. Roundabouts can be created quickly with two mouse clicks. Additionally, TransModeler 3 is able to import digital elevation data and use those data to calculate grades. During simulation, TransModeler 3 automatically calculates the effects of grade and horizontal curvature on vehicle speeds.

TransModeler 3 also includes updates to simplify the management of signal timings. Timing plans for multiple time periods for all controllers are stored in the same file. Different timing plans can be linked to a base timing plan so as to simplify timing plan updates. Multi-node signal controllers can be created by clicking each intersection that should be operated by the controller.

TransModeler 3.0 offers more and better reports than previous versions. New reports include Highway Capacity Manual (HCM) 2010 simulation-based levels-of-service for freeways (including merge, diverge, and weaving segments), urban streets, multilane highways, 2-lane highways (including Classes I, II, and III), signalized intersections (both pretimed and actuated), all-way and two-way stop-controlled intersections, and roundabouts. Additionally, the Intersection Control Editor can be used to calculate intersection and roundabout levels-of-service according to the HCM 2010's analytic methods.

Caliper

Version 3.0 is the first TransModeler to simulate bicycles that are permitted to pass or travel alongside one another within a lane or in a dedicated bicycle lane. Motorists will move laterally in order to pass a bicycle.

TransModeler 3.0 has already been deployed on many wide-area traffic modeling projects around the United States. TransModeler 3.0 is being used by the Maricopa Association of Governments to simulate 500 square miles of Central Phoenix, toll road operator Transurban to analyze and plan operations on the 495 Express Lanes in Northern Virginia, and the California Department of Transportation (Caltrans) to model the whole of Lake County, CA. The North Carolina Department of Transportation has just commissioned county-wide studies of the Asheville and Kinston areas in order assess freeway and interchange improvement build proposals. INRIX speed data were integrated into the Central Phoenix calibration and will be used in the North Carolina Department of Transportation's projects as well.

Version 3.0 has thoroughly updated documentation and tutorials. The documentation is provided electronically as part of the software, and printed manuals are also available.

Product Updates

TSIS-CORSIM version 6.3 was released in August 2012, and has been mailed to all registered offices with a current support subscription. TSIS 6.3 contains several improvements including the Streets Editor, Freeways Editor, HOT lanes, advanced toll plazas, interactive lane alignment in TSIS Next, adaptive cruise control, and bug fixes.

Streets Editor and Freeways Editor. Based on the Urban Streets and Freeway Facilities modules from HCS, these new editors use basic volume and timing data from the user to automatically construct complex simulation networks within seconds.

High Occupancy Toll (HOT) Lanes. The new version of CORSIM supports different HOT lane pricing algorithms, monetary value of time for each vehicle type, HOT pricing output data, and specification of vehicle types permitted to use HOT lanes in each time period. In addition, the user can specify a percentage of transponders for each vehicle type, and numerous calibration parameters to customize vehicle behaviors near HOT lanes.

Advanced Toll Plazas. CORSIM now supports different types of toll payment in each lane, vehicle type restrictions in each lane, and the percentage of vehicles using each payment type. In addition, the toll plazas now allow all settings to vary between time periods, and numerous calibration parameters to customize vehicle behaviors near toll plazas. TRAFVU 6.3 has been modified to indicate advanced toll plazas, and provides color coding to indicate payment types for each vehicle.

Interactive Lane Alignment in TSIS Next. TSIS Next users can now drag-and-drop entire roadway sections to achieve better upstream/downstream lane alignment. Endpoints are used to control intersection and node alignments, and the midpoints are still available to affect curvature. Alternatively, a pop-up dialog is available to manually enter the X/Y feature point values.

Adaptive Cruise Control (ACC). CORSIM now allows the user to specify the percentage of advanced technology vehicles in the traffic stream, plus car-following time headways for each ACC driver type.

New Input Screens in TSIS Next. TSIS Next has been updated for version 6.3; with added support for ACC, HOT lanes, and advanced toll plazas.

Minor Improvements and Bug Fixes. Increased the number of lanes allowed at interface nodes**;** fixed the control delay calculation on NETSIM entry links; fixed a problem with freeways that split into two branches and then rejoin downstream; improved some of the input error checking logic; updated the CSV output format to handle 9-lane approaches; corrected a bug in spillback checking that occurred when the right receiving link and the right-diagonal receiving link were the same link; fixed the calculation of travel times and average speeds on interface links.

Upcoming Developments. Upcoming features of CORSIM may include new vehicle trajectory analysis tools, automated "self-calibration", next-generation emissions models, and improvements to the software architecture.

Product Updates

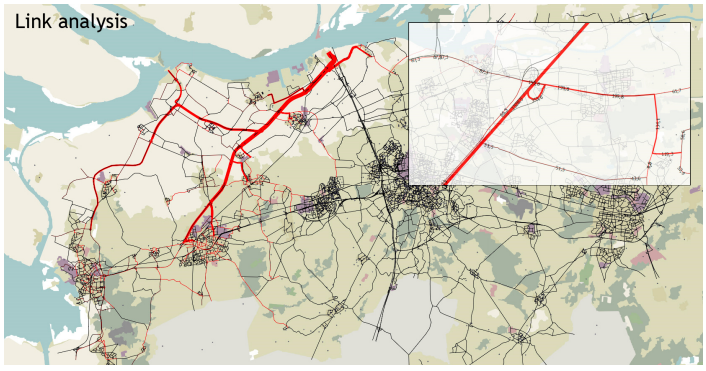
TSS TRANSPORT SIMULATION SYSTEMS

Aimsun

TSS-Transport Simulation Systems views its latest software release, Aimsun 8 Expert, as a development in the emerging sector of integrated transport modeling rather than an addition to the established travel demand modeling software sector.

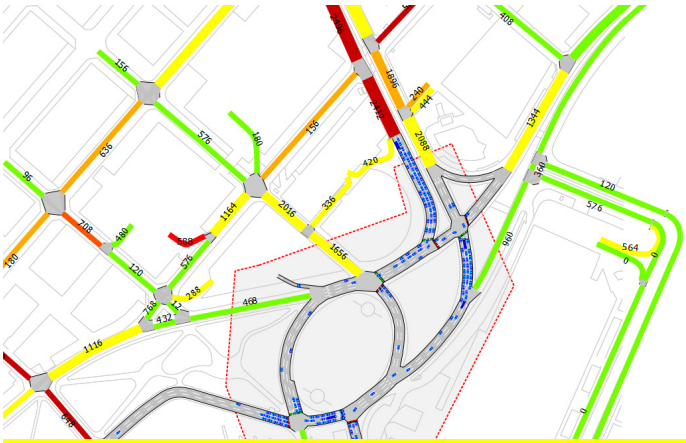
According to TSS commercial director Alex Gerodimos, the company is aware that the travel demand modeling market is well served by existing software; but Aimsun 8's originality lies in its integrated approach, meaning its set of features can support simulation projects from beginning to end.

"It might seem odd that we would want to enter a saturated market, but our aim is not to add just another package to a long list. Aimsun Expert adds support for the four-step transportation planning process to a software application already capable of dynamic traffic assignment coupled with mesoscopic, mircoscopic and hybrid simulation - all in the same environment. Our primary audience is users who see integration as a key requirement; perhaps those who have been using simulation all along and have been longing for access to travel demand modeling features in the course of a project," he said.



Gerodimos said that consultants carrying out simulation studies were often artificially constrained in their ability to make adjustments to their demand because of the need to establish arduous links with other software packages, often used by different groups. "We now provide the option of doing this type of analysis inside the software they are already using," he said.

Aimsun 8's approach is the opposite of an exclusive approach, he says. "Ours is not a walled garden, where clients have to use our software every step of the way. While we believe that Aimsun 8 Expert is currently the most complete package on offer, we also expect that users might want to use a subset of what we offer alongside another's package. We will continue to support interfaces with other software applications, including those of our competitors."



Aimsun hybrid simulator:
a pocket of microscopic detail in a mesoscopic model

Gerodimos says the new software benefits engineers in the field. First, he says cost efficiencies encourage them to build larger models and maintain them, rather than build smaller ones they cannot keep. "The work then becomes cumulative and you don't have to start from scratch," he said. Second, the engineers do not face the temptation to make blanket assumptions to avoid transferring data between packages.

"They can just change the inputs, then run the model again and continue looping between the two until they are satisfied that the interplay between supply and demand has been captured adequately." Gerodimos cautions that there is no magic button that will replace thoughtful analysis in this process.

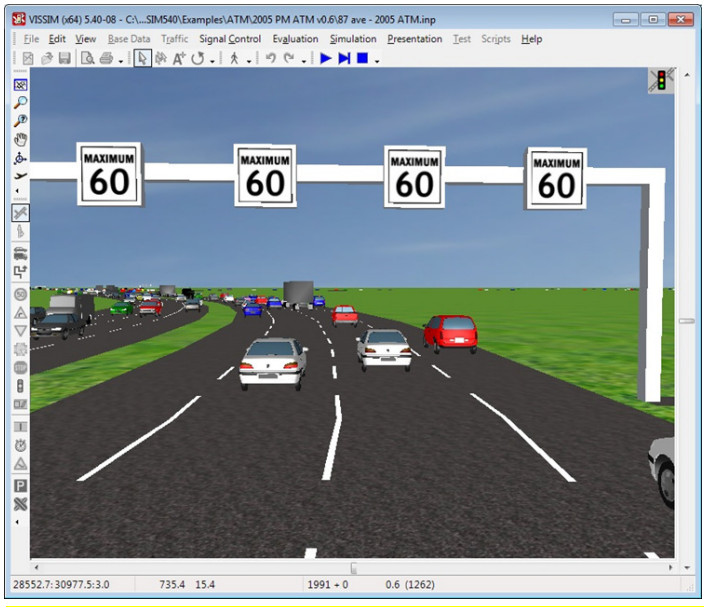
"However, we are removing a technological burden that should not be there in the first place, and that is no small thing."

ATM Lab

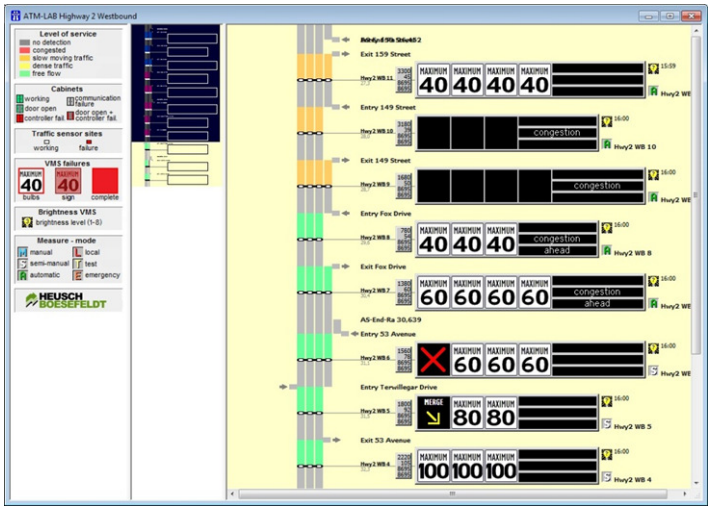
The concept of testing new traffic management and control strategies and algorithms in a traffic modeling environment is often referred to as a laboratory or testbed. Following this testbed concept, Traffic Technology Solutions in conjunction with its partner and shareholder Heusch/Boesefeldt has developed the ATM Lab by integrating the ATM control and management software GeoDyn – Control with the microscopic traffic simulation tool Vissim. The ATM Lab allows the user to test various traffic and incident scenarios in microsimulation, observe their impact on the whole network through Vissim, and determine the most promising ATM activation strategies. The ATM Lab far exceeds the capabilities of traditional traffic simulation modelling, providing a virtual reality for operators to interact with their traffic management systems more realistically with quicker response feedback.

GeoDyn – Control. GeoDyn – Control is the flagship product of our partner and shareholder Heusch/Boesefeldt. Incorporating operational experience of approximately 70 operational systems in Europe and more than 30 years of traffic control experience, it is a mature and reliable off-the-shelf management and control software for Active Traffic Management (ATM) freeway control supporting the following ATM strategies:

- Speed harmonization
- Congestion warning
- Fog warning
- Wetness warning
- Ice warning
- Temporary passing ban for trucks
- Vehicle headway warning
- Wrong way driver warning
- Cross wind warning
- Hard shoulder running
- Ramp metering



Vissim's powerful 3D graphics provide the ATM Lab user with realistic feedback of his/her management decisions.



The ATM Lab's actual traffic management center user interface provides for an authentic user experience of actively managing traffic by deploying various ATM strategies.

PTV Vissim

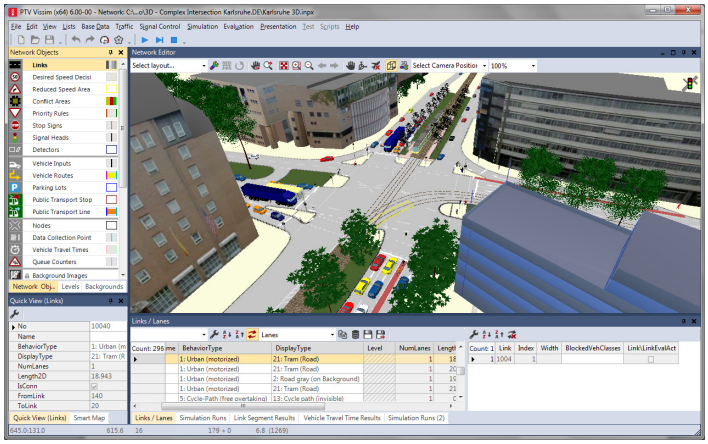
PTV GROUP
the mind of movement

PTV Vissim 6 has just been launched and is the result of extensive user feedback and intense software development. PTV Vissim 6 brings to our users a brand new, modern interface along with expanded functionality.

Vissim is still the ideal tool for state-of-the art transportation planning and operations analysis and now has new features to further streamline in your workflow.

Flexible Window Interface

When Vissim users open Vissim 6, they'll see an interface with a flexible window concept. This allows users to open and edit multiple networks, access data listings, and arrange windows within the main interface window or extract and arrange them across multiple monitors. Vissim users can truly customize the workspace to suit their personal preferences and project needs.



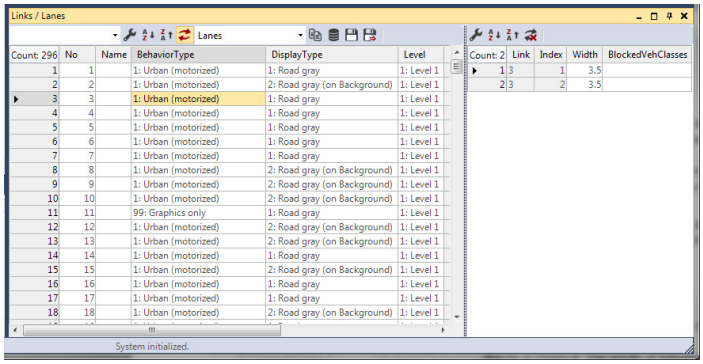
More Efficient Network Coding

Vissim 6 brings new efficiency to the network coding process. The Vissim object bar has been expanded to easily access graphical parameters, context menus have been added for key coding functionality, and management tools allow users to manage background images and network levels.

PTV VISSIM
the mind of movement

Data Access

All network objects and data attributes are directly accessible in the Vissim 6 interface through the new Lists. Here, users can sort, copy/paste, and multi-edit, significantly improving efficiency in data entry and network building. Complex data structures are also supported through access to related objects and indirect data editing.



In addition, COM access has been extended to include all data objects and new COM functions for advanced modeling applications.

Output and Reporting

Vissim 6 provides users with new functionality to analyze output directly in the interface. Output can be summarized across multiple runs and results of individual runs and time intervals are provided along with average values and other statistics. This output is managed & displayed through lists while labels for network objects can be displayed with color schemes for the thematic display of network outputs.

PTV Group is excited to bring Vissim 6 to our users and believe it is a significant step into the future of simulation software.