Sponsor Committees:
AHB45: Traffic Flow Theory
AHB40: Highway Capacity and Quality of Service
AHB20: Freeway Operations
AHB25: Traffic Signal Systems

**TRB Joint Traffic Simulation Subcommittee**

**SimSub**

**AHB45(1)**

# Newsletter

## July 2007

**Contents**



Please visit our web site at:
http://www.tft.pdx.edu/simsub.htm

## Chairman's Message

This is the fourth and largest issue of our newsletter. Our task groups have been productive and we are in the process of adding new task groups. These new groups are evidence of interest and enthusiasm among our members.

We will get the opportunity for a mid-year meeting this year during the Highway Capacity Committee meeting in Charlotte, NC. Please see the agenda in the box at the right.

One of the main topics of the meeting will be a discussion of our relationship with the proposed NGSIM Community. As most of you know, the original FHWA NGSIM project will not be funded at its former level. To keep its mission intact, FHWA has decided to launch a volunteer community with some formal organizational rules and procedures. They will be discussing this subject at a 1 ½ day meeting immediately following the Capacity Committee meeting. Please see the announcement and agenda inside.

SimSub is also a volunteer community. In spite of our limited resources, we have been successful in maintaining our momentum, thanks to the dedication of our members. We need to be concerned about the duplication and overlaps that will happen if another parallel volunteer community enters the picture. We must identify common objectives and activities and establish relationships that will make the best use of our volunteer resources.

Thanks to all who have contributed to our productivity and to this newsletter.

**SimSub Meeting Agenda**
Charlotte NC, July 30, 2007
*5:00-5:30 PM- Immediately following the NCHRP 3-85 workshop (same room)*

Discussion of task group reports
- Annual Workshop
- Research Needs and Resources (Discussion of research prioritization
- Simulation Application Summaries (Discussion of draft survey)
- Awards

New Task Groups

NGSIM – SimSub Relationships

Old Business

New business

Adjourn

## Task Group Reports

Here are the reports submitted by each of the task groups:

### Annual Workshop Task Group

*Submitted by John Halkias and James Colyar, FHWA*

The Simulation Workshop Task Group is responsible for organizing the annual Simulation Workshop during the Annual TRB Meeting (typically held on Sunday afternoon). The 2007 Simulation Workshop focused on Simulation Modeling for Corridor Management, and approximately 150 people attended the session. Thanks to everyone that helped make the 2007 Workshop a success!

The topic for the 2008 Workshop will be **Simulation Modeling and Analysis for Traffic Evacuations**. Many public agencies and research institutions have been preparing traffic evacuation plans for a wide range of scenarios based on simulation modeling. However, there are many technical challenges for an analyst in conducting such an analysis. The purpose of this workshop will be to highlight best practices, lessons learned, innovative applications, and recent research regarding this topic. We would like to cover a variety of issues, such as: individual facility evacuations, large regional evacuations, contra-flow lane modeling, traveler information strategies, multi-modal evacuation strategies, driver behavior during evacuations, data collection for evacuation modeling, and calibration and validation of simulation models for evacuations.

We are currently soliciting presentation ideas for the 2008 Simulation Workshop. If you, or someone you know, are involved in simulation modeling and analysis of traffic evacuations and would like to participate in this workshop, please contact John Halkias (John.Halkias@fhwa.dot.gov) or James Colyar (James.Colyar@fhwa.dot.gov).

## Research Needs and Resources Task Group

*Submitted by Mohammed Hadi, Florida International University*

In the period since our last meeting, the SimSub Research Needs and Resources task group has produced an article entitled "Data Repository to Support Traffic Simulation Research and Development - Data Needs." This article identifies the needs for creating a data repository to support the research and development of traffic simulation. The article also includes a call to the members of the traffic simulation community to submit data to the group for possible inclusion in the SimSub simulation data repository. This article is published in this issue of the SimSub Newsletter. Please, review the article and the Call for Information at the end of it and provide your inputs to Mohammed Hadi at hadim@fiu.edu.

The SimSub Research Needs and Resources task group is also discussing the possibility of initiating a survey of simulation research activities in other parts of the world (outside the United States). At this stage, it is anticipated that the following questions will be asked as part of the survey:

1. Please, identify simulation research activities in your region that you think should be shared with the rest of the world.

2. Please, identify (give a web link or send a copy, if possible) of any simulation research document in your region that you think should be shared with the rest of the world

3. Please, identify any standards related to simulation modeling that you know of.

4. Please, identify the most challenging tasks that you face in using simulation. What are the things you want to simulate but the simulator cannot do?

This survey will be discussed further in our meeting in Charlotte. Please, send any comment about the international survey to the e-mail above.

## Simulation Application Summaries Task Group

*Submitted by Do Nam, T-Concepts Corp.*

This Task Group is responsible for compiling and publishing a summary of significant applications of microscopic traffic simulation models.

We have been quite active during the first half of 2007. The survey form has been finalized, incorporating many constructive comments and suggestions received at the January Annual Meeting. The survey form is available at the SimSub website http://www.tft.pdx.edu/simsub.htm.

We have identified potential survey recipients including relevant TRB committees and simulation program developers, and have asked the Committee Chairs to distribute the survey form among the members and friends. The list of identified survey recipients is as follows:

a) TRB Committee members and friends:

- AHB45: Traffic Flow Theory and Characteristics
- AHB45(1): SimSub
- AHB40: Highway Capacity and Quality of Services
- AHB40(1.2): Traffic Simulation and Application
- AHB20: Freeway Operations
- AHB20(2): Freeway Simulation
- AHB25: Traffic Signal Systems
- AHB25(3): Traffic Signal Systems Simulation

b) ITE

c) Program Developers: Paramics, VISSIM, AIMSUN, and Others.

As of July 2007, total of 10 surveys have been returned: 7 from US and 3 from abroad. We will continue to follow up with our distribution contacts to increase the sample sizes and the final results will be made available at the January 2008 Annual meeting.

## Liaison and Outreach Task Group

No report was received from this task group.

## Newsletter Task Group

*Submitted by Ken Courage, University of Florida*

This task group will post a newsletter to its web site in advance of each meeting to inform members and others of items of interest to the simulation community. This issue of the newsletter constitutes the task group report.

We welcome your comments on this issue, either at the meeting or by email.

## Awards Task Group

At the January 24, 2007, SimSub meeting, Dr. Thomas W. "Tom" Rioux made a presentation on the organization of the Awards Task Group.

The Chairman of the Awards Task Group shall be appointed by the Chairman of the Joint Subcommittee on Traffic Simulation and serves at the pleasure of the Chairman of the Joint Subcommittee on Traffic Simulation. Dr. Thomas W. "Tom" Rioux of Rioux Engineering in Austin, Texas, has been appointed as Chairman of the Awards Task Group.

Members of the Awards Task Group shall be appointed by the Chairman of the Awards Task Group and serves at the pleasure of the Chairman of the Awards Task Group. Mr. Dave Gibson of the FHWA Turner-Fairbanks Highway Research Center in McLean, Virginia, and Dr. Tomer Toledo of the Israel Institute of Technology in Haifa, Israel, have been appointed as Members of the Awards Task Group.

The Awards Task Group decided to create a Life-Time/Pioneer Achievement Award using the following guidelines:

1. Significant traffic simulation contribution 20 or more years ago,
2. Continued traffic simulation contributions,
3. Can be nominated by anyone,
4. Nomination letter and short resume are needed,
5. Nomination deadline October 1 of each year for presentation at next year's TRB Annual Meeting in Washington, D.C.,
6. Must be re-nominated to be considered again, and
7. Do not have to give an award each year.

Additionally, the Awards Task Group decided to create a Best Paper Award using the following guidelines:

1. One award per year for best TRB paper on traffic simulation algorithm and/or model development
2. One award per year for best TRB paper on traffic simulation model use and/or application
3. Each sponsoring committee for the Joint Subcommittee on Traffic Simulation can submit one paper for each Best Paper Award in each category, and
4. Do not have to give an award each year.

The Awards Task Group presented the first Traffic Simulation Pioneer Award to Edward B. Lieberman "For his pioneering and continued efforts in Traffic Simulation starting with DYNET in 1968, UTCS-1 in 1970, SCOT in 1972, NETSIM in 1973, and TRAFLO in 1977."

Ed Lieberman receives the Traffic Simulation Pioneer Award at the SimSub meeting last January.

## Proposed New Task Group on Calibration, Verification and Validation (CVV)

To properly use a simulation model, the role and effects of calibration, verification and validation (CVV) in simulation outcome should be clearly understood. Simulation can be an effective tool/technique in analyzing complex traffic situations when used properly. Understanding how a simulation program works and how it should be used would increase the utility and credibility of simulation models. This task group would look at the needs, concerns, steps to be taken, and issues involved in CVV for, at least, two users groups, including software users and model developers.

The two user groups have some overlapping interests/issues that will be identified and addressed.
Some of the proposed activities for the task group are:

1. Gather the information available in CVV in traffic simulation and compile the list of sources available for the users and developers
2. Discuss the issues in CVV and write a white paper.
3. Organize seminar, workshop, discussions on the CVV issues
4. Identify what are the future needs/challenges of CVV users/developers.
5. Propose remedies to meet the challenges

Others activities identified by the CVV task group or the simulation Task Force.

This task group was proposed by Ray Benekohal rbenekoh@uiuc.edu at the annual SimSub meeting in January. Ray will serve as its chair. Please contact him in you are interested in participating.

### Proposed New Task Group on Mesoscopic Simulation Modeling

This is another idea that emerged from the January SimSub meeting. A group of researchers involved in mesoscopic modeling have expressed their enthusiasm for a task group dedicated to mesoscopic modeling. Their feeling was that the existing SimSub orientation focuses heavily on microscopic modeling at the expense of other modeling levels. The goal of this task group would be to encourage more research in the mesoscopic modeling field. The specific mission will be:

- To attract all existing meso and micro/meso researchers and provide a magnet forum
- To review existing and past research and address future research needs.
- To work with the newly formed calibration, Verification and Validation and Task Group to address the validation and calibration issues of mesoscopic models.
- To interface with the DTA research community to address the applications of mesoscopic models

This task force was proposed by Yi-Chang Chiu from the University of Arizona *chiu@email.arizona.edu* , who will serve as its chair. Anyone interested in participating should contact Yi-Chang.

# Simulation-Related Activities of the Sponsor Committees

### Highway Capacity & Quality of Service Committee AHB40

The 2007 Mid-Year Meeting of the Committee on Highway Capacity and Quality of Service (AHB 40) will be held on Sunday, July 29 through Wednesday, August 1, 2007 in Charlotte, North Carolina at the Hilton Center City Hotel.

The Nest Generation Simulation (NGSIM) program will be having a stakeholders meeting immediately following the highway capacity meeting. Their meeting will start at 1PM August 1 and go through August 2. For more information on this second meeting please see the "NGSIM update" section of this newsletter.

The Committee is holding a workshop on Guidance for the Use of Alternative Traffic Analysis Tools in Highway Capacity Analyses on Monday, 3:30 to 5 PM. This workshop will discuss the progress of NCHRP Project 3-85 and the guidance on simulation to be included in the 2010 HCM.

The Simulation Applications Subcommittee will meet on Tuesday from 9:30 to 11:00 AM. The subcommittee objective: is "To develop HCM guidance on the application of traffic simulation tools." The agenda follows:

**Introductions**
- Attendee introductions
- Membership/roster circulation
- Review meeting objectives and finalize agenda

**Discussion Items**
- Review of 2007 TRB Meeting Discussions
- Coordination with NCHRP 3-85
- Summary of Monday workshop activities
- Review of working papers (current/future)
- Open discussion – coordination efforts
- Proposed Motion on MOEs (Ruehr)
    - Review of white paper
    - Discussion of proposed motions
    - Coordination with other subcommittees (Uninterrupted/Interrupted)
- Input on 2010 HCM Update and Fix-It List
- Coordination with SimSub
- 2008 TRB Activity Planning

**Input for Full Committee Meeting (Wednesday)**

A task force of the Traffic Simulation Applications Subcommittee, chaired by Erik Ruehr, will be recommending a set of five motions related to traffic simulation to the Highway Capacity and Quality of Service Committee at its Midyear Meeting. The motions are intended to provide for improved guidance in the Highway Capacity Manual regarding definitions and reporting of measures of effectiveness used by traffic simulation models and other traffic analysis tools. The text of the recommended motions is included below. A white paper explaining the background and justification for the motions is expected to be posted to the HCQS Committee website at http://www.ahb40.org prior to the Midyear Meeting.

MOTION 1: The Highway Capacity Manual should include guidance to developers of traffic simulation models and other traffic analysis tools to promote consistent and accurate reporting of measures of effectiveness for highway capacity analysis. This guidance should include a set of minimum requirements that all traffic analysis tools would be encouraged to achieve.

MOTION 2: In order to promote consistency among traffic simulation models and other traffic analysis tools, the Highway Capacity Manual should include a recommended list of common measures of effectiveness based on vehicle trajectories, definitions of those measures of effectiveness, and a recommendation that all traffic analysis tools include an option to provide those measures of effectiveness as outputs. For the purposes of this motion, vehicle trajectories shall be defined as documented in the report, Definition, Interpretation, and Calculation of Traffic Analysis Tools Measures of Effectiveness prepared by the Federal Highway Administration dated January 2007.

MOTION 3: The Highway Capacity Manual should include guidance that discourages the use of HCM level of service tables based on measures of effectiveness reported by other traffic analysis tools that are inconsistent with HCM definitions and calculations.

MOTION 4: The Highway Capacity Manual should include guidance that measures of effectiveness produced by traffic simulation models and other traffic analysis tools be considered to be incomplete, unless they also include clear documentation of the assumptions used to handle and report vehicle queues.

MOTION 5: The Highway Capacity Manual should include a discussion of the randomness inherent in the results of traffic simulation models and recommendations for dealing with this aspect of traffic simulation.

### Freeway Operations Committee AHB20

The mission of the Committee is to provide leadership and serve as the TRB focal point in promoting, implementing, operating and maintaining traffic management systems and strategies including Intelligent Transportation Systems, to enhance the efficiency, safety and environmental conditions on freeways and in freeway corridors.

The Committee's activities specifically include promoting research in traffic management and the application of promising results to operational systems; and fostering the cooperation, coordination, and information dissemination, between individuals and groups active in freeway traffic management and advanced technologies.

Their mid-year meeting took place from May 20-23 in Houston, Texas

### Traffic Signal Systems Committee AHB25

The Traffic Signal Systems Committee met in San Jose, California form July 22 – 24.
Here is an overview of their program:
**Sunday, July 22**
1:00 – 3:00 PM Traffic Signal Timing Manual Subcommittee
3:30 – 4:30 PM Simulation Subcommittee
4:30 – 5:30 PM Architecture Subcommittee
**Monday, July 23**
8:30 AM – 5:30 PM VII/CICIA Workshop
7:00 PM – 10 PM Signal Transition Logic Workshop
**Tuesday, July 24**
8:00 – 11:00 AM Business Meeting
11:00 AM – 2:30 PM VII/CICAS Tour

### Traffic Flow Theory Committee AHB45

The Traffic Flow Theory Committee will not hold a mid year meeting in 2007. The committee does, however, plan to meet in Woods Hole, Massachusetts from July 8-10, 2008 and to sponsor a symposium honoring Dr Bruce Greenshields and other founders of the science of traffic flow theory. The preliminary details are as follows:

**Themes of the Symposium**::

- Historical appreciation of traffic flow theory founders: Greenshields, Treiterer, etc.
- Influence on current practice – e.g., the HCM (US Highway Capacity Manual),HBS (German Highway Capacity Manual), TFT (Traffic Flow Theory) Monograph, etc. – from point of view of traffic flow theory and characteristics: status and critique, new materials, prospects for future editions
- Discussion of future developments: real time measurements of traffic performance, expected contributions of remote sensing, vehicle probe data, etc.

**Outline of the Program**

- Day 1: Historical developments, appreciations, tributes: how they influence current practice, international contributions
- Day 2: Presentations on Traffic Flow Theory Monograph and Highway Capacity Manual (selected topics) by invited and solicited presentations
- Day 3 (AM): Workshop – future directions

**Call for Contributions**
Contributions are solicited on the themes of the symposium. Please send proposed title and abstract, or interest in participation, by December 15, 2007 to:

- Nathan H. Gartner, University of Massachusetts Lowell, email: Nathan_Gartner@uml.edu
- Reinhart Kuehne, German Aerospace Center, email: Reinhart.Kuehne@dlr.de

Attendance will be limited to 75 people (invited participation).

## Research News and Results

This section contains updates and results for research projects that involve simulation. Anyone may submit an item that describes a project in progress, one that has been recently completed or one that is about to start. Items for this section should be brief summaries. If you have more to say about a project, you might want to consider submitting an application note or a technical article. Application notes generally will describe innovative uses of simulation. Technical articles should describe research findings, simulation success stories, etc.

### FHWA Update

FHWA is one of the major sponsors of research involving traffic analysis tools in general and simulation in particular. An NGSIM update is included in this issue. We hope to have more in future issues.

### NGSIM Update

The NGSIM program, sponsored by the FHWA, has had a significant impact on the traffic simulation community since its inception in 2003 by helping to improve the behavioral models in microsimulation software. In its four years of existence, the NGSIM team lead by Cambridge Systematics and including the Massachusetts Institute of Technology and the University of California at Berkeley, accomplished the following:

- Developed and validated core microsimulation **algorithms** including a) Freeway Lane Selection, b) Cooperative/Forced Freeway Merging, c) Arterial Lane Selection, d) Oversaturated Freeway Flow, and e) is currently incorporating acceleration into Cooperative/Forced Freeway Merging Algorithm (due in September 2007). These algorithms have been or will be validated in commercial microsimulation systems.
- Collected and processed detailed vehicle trajectory **datasets** along congested conditions on freeway and arterial facilities, including a) I-80 freeway in Emeryville, CA, b) U.S. 101 freeway in Universal City, CA, c) Lankershim Blvd. arterial in Universal City, CA, and d) Peachtree Street arterial in Atlanta, GA. These data (made freely available through the NGSIM program) have been analyzed by multiple researchers to develop new or improved behavioral models that capture vehicle interactions at a fundamental level. Further, the NGSIM trajectory data sets have been utilized by researchers world-wide in a variety of other research efforts outside the scope of the NGSIM program.
- Developed and released the Next Generation Vehicle Interaction and Detection Environment for Operations (NGSIM-VIDEO) **data processing software**, that helps extract vehicle trajectory data from videos captured from multiple cameras.
- Continued to support the NGSIM website, repository, stakeholder activities, and the overall program.

All NGSIM products are available at http://ngsim.fhwa.dot.gov

The NGSIM program has resulted in unprecedented collaboration between software developers, researchers, and software tool end-users. The end result is that four years after the inception of the NGSIM program, there is a critical mass of individuals composing an *NGSIM community* – a diverse and collaborative collection of academics, public sector staff, consultants and other analysts seeking to improve the underlying fidelity and accuracy of traffic simulation analysis.

Despite these successes, long-term preservation of the NGSIM intellectual capital (data sets, algorithms, tools and documentation) and the more efficient, collaborative market interactions engendered by the NGSIM program requires revisiting the nature of the FHWA role and the organization of the emergent NGSIM community. The current top-down, FHWA directed (and funded) model of the NGSIM community cannot be sustained indefinitely.

In the Spring of 2007 a discussion has started among NGSIM stakeholders on the development of a self-governing, self-sustaining NGSIM community that preserves core NGSIM assets (data, algorithms, tools, and documentation) and continues to facilitate cooperative action among the individuals in the community. This discussion will continue at the Summer meeting of NGSIM stakeholders in Charlotte, NC on August 1st and 2nd 2007. More information about the summer meeting is provided at the NGSIM website. The agenda follows:

**Wednesday, August 1, 1-5 PM**

- Introduction and NGSIM principles
- Proposed NGSIM Community structure and discussion
- Options for NGSIM Community structure and discussion
- NGSIM Community sizing/volunteer issues and discussion
- NGSIM Community roles, functions and action items for the next 12 months
- Wrap-up

**Thursday, August 2, 8:30 AM - 4:30 PM**

- Volunteer matching with NGSIM Community
- NGSIM Community by-laws and discussion
- Next steps
- Lunch
- University of Idaho research using NGSIM data
- NGSIM program status update
- Commercial validation of three new NGSIM algorithms
- A comparison between NGSIM and SimSub algorithm research priorities
- Wrap-up

Contact: John Halkias or James Colyar-

### NCHRP Update

**Project 3-85: Development of Guidelines for the Use of Alternative Traffic Analysis Tools in Highway Capacity Analyses**

*Objective:* Enhance the guidance in the Highway Capacity Manual for selection and use of traffic analysis tools.

The Interim Report has been posted on the project web site at http://trc.ce.ufl.edu/research/nchrp385/. The following topics are covered:

- Literature review
- Review of current practice
- Limitations of the HCM Procedures
- Review and comparison of alternative tools
- Proposed HCM Part V content.

A working paper on the proposed guidance for the use of alternative tools to be included the 2010 edition of the HCM will be considered by the HCQS Committee at their meeting in Charlotte

# Announcements and Call for Papers:

This section contains announcements of meetings and calls for papers on subjects that involve traffic simulation.

## 2nd International Symposium on Freeway & Tollway Operations and Highway Capacity Midyear Meeting

Honolulu, Hawaii, June 21-24, 2009

*Sponsored by the Freeway Operations Committee (AHB20) and the Committee on Highway Capacity and Quality of Service (AHB40)*

The Symposium will be held at the Hyatt Regency Waikiki Resort and Spa in beautiful Honolulu, Hawaii

SAMPLE TOPICS LIST

- International perspectives
- Country reports: state-of-the-art issues and applications
- State and City success stories
- Congestion tools: Political, Legal, Fiscal, Operational, Technological
- "One size does not fit all" - examples of failed solutions
- Freeway operations and pricing
- Highway capacity analysis
- Freeway analysis and simulation
- Variable speed limits
- Green travel initiatives
- Facility, corridor and area pricing
- Network signalization integration with fwy. ops. and traffic control centers
- Real time everything for all stakeholders and motorists
- Innovative sensors and other data collection and performance assessment tools and technologies
- Finance tools and politics
- HCM 2010

STUDENT PAPER COMPETITION

The competition for students requires a paper of up to 5,000 words with exhibits counting for 250 words each, and on a subject relevant to the Symposium. The top five entries win a $2,000 travel award to attend the 2nd ISFO. First, second and third papers win an additional $1,000, $500 and $250 cash award, respectively. Students should contact Dr. Panos Prevedouros for details (pdp@hawaii.edu). The symposium brochure is available at:
www.eng.hawaii.edu/~panos/2nd_ISFO_web1.pdf

## 2007 Microscopic Traffic Simulation Conference

*September 6-7, 2007: Millennium Hotel, Rotorua, New Zealand*

You are invited to attend the 2007 Microscopic Traffic Simulation Conference hosted by baseplus. Practitioners from Britain, Australia and New Zealand will be discussing calibration and modeling issues they have encountered and presenting peripheral areas of interest including guidelines and modeling research. We begin on Sept 6th with formation of the Microscopic Traffic Simulation User Group. On Sept 7, the conference will begin at 9.00 am and close in time for flights back to your home city. A dinner will be arranged on the night of the 6th with all conference delegates welcome.

We look forward to seeing you in Rotorua for what we anticipate to be a very useful conference.

## WORKSHOP ON TRAFFIC MODELING: TRAFFIC BEHAVIOR AND SIMULATION

University of Technology, Graz, Austria
September 24, 2007 – September 26, 2007

*Sponsored by the Federal Highway Administration, Office of Operations, Research, and Development, the TRB Committee on Traffic Flow Theory and the ,TRB Committee on Highway Capacity and Quality of Service*

This workshop will bring together the foremost experts, modelers, software developers and users to assess the future needs for traffic models, review the states of the art and practice and identify directions for further research and model development. The workshop will follow a series of bi-annual workshops previously being held in Sedona, AZ (2005), Sitges, Spain (2003) and Tuscon, AZ (2001). .

The three-day workshop will consist of several invited plenary talks remarking on the state of the art and practice. Two-to-three breakout sessions will explore themes related to traffic modeling and identify directions of further research and development. In particular, presentations and discussions on the following topics will be encouraged.

- Driver behavior modeling
- Driver strategic route-choice decision making
- Calibration and validation of model
- Modular architectures for simulation systems (micro-macro modeling)
- Simulation modeling in design and optimization
- Needs and requirements of users and other stakeholders

For further information, contact Dr. Martin Fellendorf (Chair), martin.fellendorf@tugraz.at or Dr. Pitu Mirchandani (Co-chair) : pitu@sie.arizona.edu

## The Huntsville Simulation Conference 2007

30 October 2007 - 1 November 2007 –
The Huntsville Marriott Hotel

*Sponsored by The Advanced Research Center (ARC) http://www.arc.army.mil/ and The Society for Modeling and Simulation International http://www.scs.org/ and The Alabama Modeling and Simulation Council (AMSC) http://www.amsc.to/*

The Huntsville Simulation Conference (HSC) is an annual conference located in Huntsville, Alabama with international participation. The final unclassified proceedings are available on CD and in print. The HSC seeks technical papers, briefings, tutorials, panel discussions, session organizers and session chairs in a wide range of topic areas. Contact the conference web site for more information
http://www.scs.org/confernc/hsc/hsc07/hsc07.htm
Note: The deadline for submitting abstracts has been extended until August 19.

### HOT & ML Simulation Modeling

**Call for Papers: for the 2008 annual TRB meeting**

The TRB Subcommittee on the Simulation of Freeway Operations (AHB20-2) invites you to submit papers for the TRB Annual Meeting in Washington, DC, in January 2008. Papers are invited on topics that concentrate on computer simulation issues of High Occupancy Toll (HOT) and other forms of Managed Lanes (ML).

- HOT lane operation modeling, e.g. barrier setting, toll plaza design, entry and exit areas, enforcement, and safety considerations
- Application of simulation in HOT lane demand forecasting and modeling such as advanced tools and methodologies.
- HOT lane pricing policy modeling (fixed price, pre-set variable pricing and dynamic pricing) and impact on HOT and general purpose lanes
- Advances in modeling HOV lanes
- Truck lanes and other ML simulation applications
- People throughput, pollution and consumption estimates from HOT, HOV and ML simulation applications, and lessons learned.
- Modeling unfamiliar motorists and "wrong movements"
- Use of ML lane capacity for emergencies

The August 1 deadline for submitting papers is very close. Authors who have submitted papers on one of the listed topics are requested to send the paper number and title to Panos Prevedouros, pdp@hawaii.edu, chair of the AHB20-2 Simulation Subcommittee, by August 3, 2007:

## Industry News

### TransModeler

NEWTON, MASSACHUSETTS; June 1, 2007 - Caliper Corporation announced the immediate availability of the latest version of TransModeler®, a revolutionary traffic simulation product for wide area traffic planning, traffic management, and emergency evacuation studies. TransModeler simulates the movements of vehicles at resolutions as fine as one tenth of a second fidelity and can do so over very wide areas or long transportation corridors. TransModeler is also a breakthrough geographic information system for traffic-related data including point to point dynamic travel times, congestion levels, and signal timings.

The new version supports analysis of dynamic as well as static pricing for toll roads and HOT lanes. It also models on-street parking, including parallel parking, for more accurate modeling of downtown and other urbanized areas. Version 1.5 also has a broadened tool set for planners, including analytic and simulation-based dynamic traffic assignment. Numerous other enhancements make project development and traffic simulation faster and more productive.

TransModeler is being used by state Departments of Transportation in California, Kentucky, and Indiana as well as by many metropolitan area planning organizations, traffic consultants, and research universities. For more information, please contact Daniel Morgan at 617-527-4700 or by email at daniel@caliper.com .

### SIAS

SIAS Limited has developed the microsimulation Transport Analysis Guidelines, MicroTAG, document. The objective of MicroTAG is to provide guidance on the application and interpretation of the use of microsimulation models.

Guidance on traffic models currently exists in documents such as the Design Manual for Roads and Bridges in the UK, but this guidance is fairly generalized and not specific to microsimulation. As a result of this there is some uncertainty as to how microsimulation methodologies should be applied, and how the outcomes can be interpreted.

One example of this is in convergence of equilibrium models to an optimal network wide minimum cost routing solution. This does not occur in microsimulation models and outputs lie on a distribution obtained from running the model a number of times. This allows the analyst to perform statistical analysis on performance measures and provide more information to reporting authorities such as the variability and the confidence in reported outputs.

MicroTAG is not intended as a replacement for the existing guidelines or current appraisal processes. It is a supplement to these existing guidelines and focuses on key aspects of the model inception, data collection, and particularly the interpretation and reporting of outputs, which are unique to microsimulation. For more information contact Pete Sykes, paramics@sias.com.

## Application Notes

This section contains brief descriptions of simulation applications that are more detailed than the research summaries, but do not constitute a full technical article.

(No application notes were submitted for this issue)

## Technical Articles

We received five excellent technical articles for this issue. Thanks to all of the authors who took the time to prepare them. Please send any comments on these articles to the authors.

## Integration of Mathematical and Physical Simulation to Calibrate Car-Following Behavior of Unimpaired and Impaired Drivers

Ivana Vladisavljevic, Peter T. Martin PhD, Aleksandar Stevanovic PhD, University of Utah Traffic Lab

**Introduction**

Formulations of car-following models range from the most simple to the most complex, which require extensive calibration of models' coefficients. Traffic engineers rely on sophisticated microscopic simulation models. Similarly, psychologists have been using physical driving simulators (see Figure 1) to investigate drivers' psychophysical responses when driving in traffic. In one group of such studies, psychologists have compared *unimpaired* with *impaired* (distraction by cell phone, alcohol, etc.) driving. Their results have shown that different types of distraction (if any) cause different driving behaviors. However, little research has been done to show whether results from psychological driver behavior research can be integrated in traffic engineering research using microsimulation.

FIGURE 1: Driving Simulator at the Department of Psychology at the University of Utah

When simulating traffic using the microsimulation models, in most cases, drivers are considered to have the same driving behavior. However, individual drivers make independent and randomly generated decisions, which are not always governed by the same rules. Thus, the goal of our research is to investigate ability to calibrate a traffic microsimulator's car-following model for various types of driving behavior. The goal is supported by two objectives: (1) calibrate microsimulation parameters to fit various types of driver behavior patterns, and (2) quantify the robustness of the calibrated microsimulation parameters. More specifically, the first objective reflects a need to mimic, in traffic microsimulation, behavior of *unimpaired* (regular) drivers and *impaired* drivers. As an example of impaired driving, we considered drivers who talk on a cell phone while driving, because this type of distraction has been recognized as a growing problem in recent years. The second objective is related to the robustness of the calibration which is measured by the relative difference between the same traffic metrics (speed and following distance) from the driver and traffic simulators.

***Driving Simulator Experiments -*** Research presented here was motivated by the study (Strayer and Drews, 2004) of the effect of cell phone use on drivers. In the experiments conducted in the driver simulator subjects "drove" for a total of 20 minutes accomplishing two tasks: driving without a cell phone (*unimpaired*), and driving while talking on a cell phone (*impaired*). Driving speed, distance between vehicles, and brake inputs were recorded for both tasks. Figure 2, derived from Strayer and Drews' study, presents a typical sequence of events between the two vehicles (the leading and the following vehicle) in the car-following process in both task conditions. Approximately a second after the leading vehicle starts to slow down (point A), the following vehicle begins to decelerate (point B). *Unimpaired* following drivers take about one second to decelerate (from B to C), while *impaired* following drivers take about 2 seconds to decelerate (from B to D). Further, *impaired* drivers take 17% more time to recover 50% of their speed lost after braking, when compared to *unimpaired* drivers (point F instead of point E). Also, *impaired* drivers' following distances are 12% greater than those of the *unimpaired*. This difference is the shaded area between the curves—it represents deterioration in the status of the traffic efficiency.

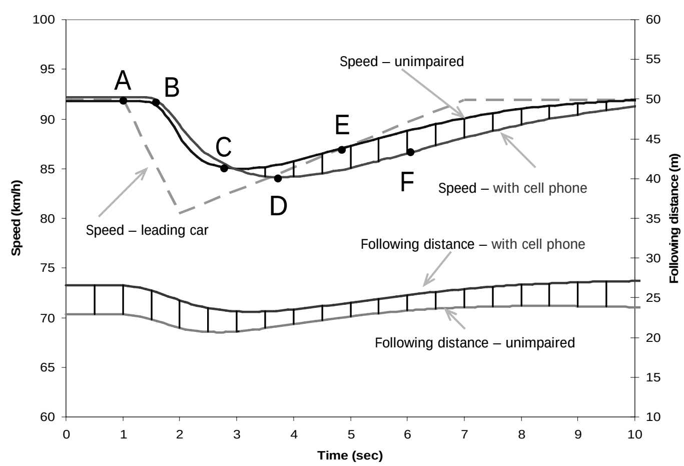


FIGURE 2: Car-following behavior from a physical driver simulator

***Emulating Experiments from the Driver Simulator in Microsimulation -*** The calibration of car-following parameters in our study is based on the speed and following distance from the Strayer and Drews' research experiments on the driver simulator. Thus, we used stochastic simulation software to emulate deterministic events from the driver simulator, which was the process of calibrating car-following parameters. Here, two sets of parameters were established: the first calibrates the control group of *unimpaired* drivers, and the second represents *impaired* drivers.

The car-following behavior from observations of subjects in driving simulators was translated into a form that can be represented in a traffic microsimulator. After examining available models and their advantages and disadvantages, the *psychophysical model* was chosen as the most appropriate for modeling an *impaired* driver. Two microscopic simulators apply a psychophysical car following model: PARAMICS and VISSIM. It was shown that VISSIM provides more realistic estimates of speed and following distance than PARAMICS. VISSIM uses the Wiedemann 99 car-following model for interurban highway traffic; this model offers ten parameters.

We addressed the interaction between two vehicles: the leading and following vehicle. The VISSIM network consists of two nodes and one link representing one lane of freeway with two vehicles. The participants in the driver simulator experiments followed the leading car which drove at a constant speed. Hence, the difference between the lower and upper limit of speed distribution in the traffic simulation model was minimized to ensure a realistic replication of speed from the driver simulator observation to the traffic microsimulator. Further on, the leading car in the driver simulator experiments braked at random points to measure driver reaction time. The *Desired Speed Decision* in VISSIM represents a brake point. This *Desired Speed Decision* was set to influence the speed of the leading vehicle, not the following vehicle, thus replicating the driving simulator experiments. In this way the reaction of the following vehicle in the traffic simulation depended solely on the speed of the leading vehicle.

The entire action of the leading vehicle breaking and accelerating to a "pre-braking" speed takes approximately ten seconds. The entire 10-second period was divided into intervals of 0.1 second, which totaled 101 intervals. For every 0.1-second interval, values for speed and following distance were recorded from both driver simulator experiments and VISSIM output files. Both speed and following distance values from these 101 intervals were used to calibrate microsimulation car following parameters in VISSIM.

***Optimization of Parameters to Fit Results from Driver Simulator* -** The calibration of parameters in the simulation model is an optimization problem. The goal of calibration is to minimize the difference between traffic metrics from the real-world (in this case represented by a driving simulator) and the traffic microsimulator. Furthermore, the car-following theories described by mathematical equations take into consideration the position, speed and acceleration of two consecutive vehicles.

Thus, the objective function should minimize the sum of the relative errors for any of these metrics or their combination. Since only speeds and following distances were available from the driver simulation experiments, only these two measures were used as objective functions in our experiments.

$$F = \sum_{i=1}^{n} \frac{|v_{ds} - v_{sim}|}{v_{ds}} + \sum_{i=1}^{n} \frac{|d_{ds} - d_{sim}|}{d_{ds}}$$

We tested whether the speeds and following distances from the driver simulator experiments statistically differ from the speeds and following distances from the microsimulation for two driver types (*unimpaired* and *impaired*).

To perform the optimizations we replaced a heuristic approach, traditionally used in car-following parameter calibration, with the Genetic Algorithm (GA) approach which has been recognized as a more systematic and rigorous method.

**Calibration Results for VISSIM Car-Following Parameters**

The calibration results are shown in Figures 3 and 4. These figures present a set of three curves (from driver simulator experiments, from VISSIM using default car-following parameters, and from VISSIM using GA-optimized parameters) for each of the two measures (speed and following distance). In addition, these figures show 95% (2σ) confidence intervals for the curves generated by VISSIM with GA-optimized parameters (based on 100 randomly seeded simulations).

The Mann-Whitney-Wilcoxon (MWW) test was used to test reliability of calibration. This non-parametric test, which determines whether two populations are identical, proved sensitive enough to distinct small differences that may exist between results from various experiments. The calculated values for the MWW test, shown in Table 1, were tested for 99% confidence interval, with the critical value of 2.58. If the values of the MWW test, for both speed and following distance, were in the range from -2.58 to 2.58, we concluded that the results generated by VISSIM were not statistically different from their counterparts from the driver simulator.

Results, given in Table 1, show that the results of the MWW test for *impaired* drivers were not in the allowable range (±2.58). However, for *unimpaired* drivers, they were in the allowable range.

TABLE 1: The Mann-Whitney-Wilcoxon Test

| Type of driver | MWW test | |
|---|---|---|
| | Speed | Following Distance |
| Unimpaired | -2.35 | -0.40 |
| Impaired | -3.53 | -0.60 |

a) Following distance b) Speed

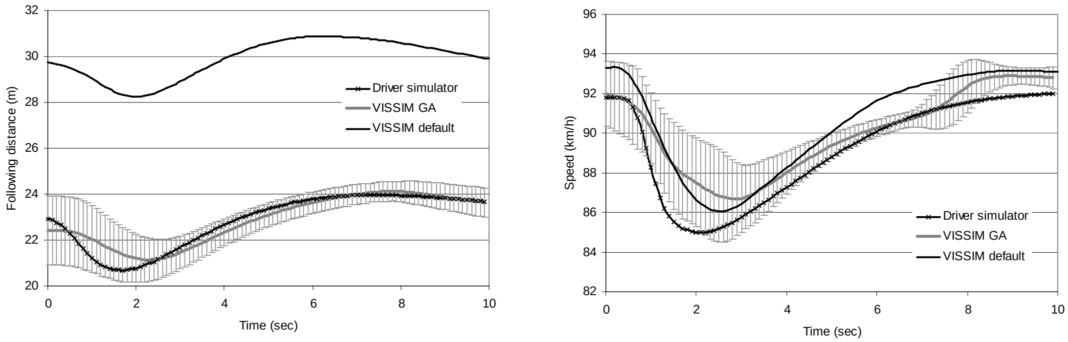


FIGURE 3: Following distance and speed for *unimpaired* drivers

a) Following distance b) Speed

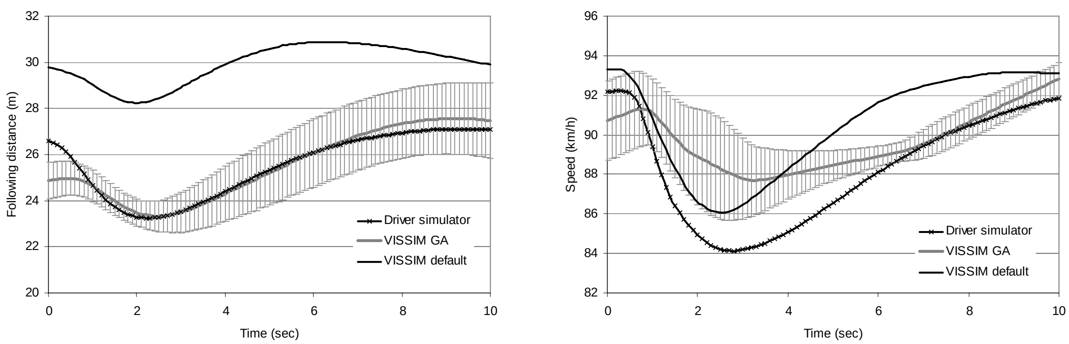


FIGURE 4: Following distance and speed for *impaired* drivers

**Conclusions**

Our conclusions from the results, shown on Figures 3 and 4 and in Table 1, can be summarized as:

1) VISSIM's car following model can be calibrated to replicate accurately both speed and following distance from the physical simulator for *unimpaired* drivers. However, when calibration is conducted for *impaired* drivers VISSIM's car-following model generates results which are significantly different than those from the physical simulator. These results confirmed the assumption that car-following models traditionally used in microsimulation models are calibrated for 'regular' drivers, whose attention during the driving is not impaired by any secondary activities. Considering estimates of the impaired drivers in the driving population these findings raise a question of accuracy of results generated by traffic microsimulation software. In other words: Would results coming from microsimulation tools be more realistic had we had opportunity to model various driving behavior types in the microsimulation models?
2) Figures 3 and 4 show that the GA calibration procedure generated speed and following distance curves which are much closer to the targeted curves from the driver simulator than the initial curve when the default set of VISSIM parameters was used. These results prove the importance of proper calibration of the car-following parameters in VISSIM.
3) The fact that one of the best microsimulation tools on the market cannot be calibrated to mimic car-following behavior of impaired drivers shows a potential direction in which the microsimulation models can be improved to provide more reliable estimates of traffic activities in a multi-type driver population.

## Adaptive Traffic Control Systems in the Micro Simulation Environment

*Submitted by Peter T. Martin and Aleksandar Z. Stevanovic - Utah Traffic Lab, University of Utah*

The University of Utah Traffic Lab researches Adaptive Traffic Control Systems (ATCS) in micro simulation environment. The first integration of an ATCS in microsimulation was established through connecting SCOOT (Split Cycle Offset Optimization Technique) to CORSIM in the late 90's. We investigated the performance of SCOOT under various traffic conditions such as congestion levels and accidents. SCOOT's performance was compared to fixed-time control systems and the results showed SCOOT's superiority. We switched from CORSIM to VISSIM to enable us to model and investigate transit priority features in SCOOT. We have continued to maintain the SCOOT – VISSIM interface to bring it to the latest SCOOT version, (MC3). We extended our ATCS research developing the first practical interface between SCATS (Sydney Coordinated Adaptive Traffic System) and VISSIM.

### *SCOOT – VISSIM: HILS & EILS*

The SCOOT – VISSIM interface is a combined Hardware-in-the-Loop Simulation (HILS) and Emulation-in-the-Loop Simulation (EILS) setup. SCOOT's central control (the kernel) is located in the DEC Alpha computer (operating with Open VMS) while the local controllers are emulated in a NEMA-based environment. We recently improved the interface to support the latest version of SCOOT, MC3 and its features. Also, we substantially improved the handling of the local controllers and their communication with SCOOT. Our earlier interface did not support more than four phases in local controllers, which were implementing SCOOT decisions all the time. Our current interface supports up to eight phases in a NEMA-like setup, with corresponding overlaps and phase-skipping based on the local traffic actuations. Consequentially, the new setup enables using SCOOT with detectors located both upstream (the traditional SCOOT configuration) and at the stop lines (triggering overlaps and phase-skipping). With these new features, local controllers do not always implement SCOOT decisions, e.g. when there is no traffic detected at the stop-line. However, SCOOT is always provided with feedback from local controllers, which is then used to adjust future signal timings in SCOOT.

### *SCATS – VISSIM: SILS & EILS*

The SCATS – VISSIM interface represent a combination of Software-in-the-Loop Simulation (SILS) and high integrity Emulation-in-the-Loop Simulation (EILS). The SCATS's central control is implemented through SILS while the local controllers use an emulated version of the Australian Road Traffic Authority (RTA) standard controller. The new SCATS – VISSIM interface version was developed recently by PTV VISSIM developers and the RTA, and is now available in VISSIM 4.30. The Utah Traffic Lab and TRANSCORE cooperated to test the new interface version on a VISSIM model of Park City, Utah. We have been using the real-world SCATS installation in Park City to establish SCATS traffic control in micro simulation. SCATS uses data from vehicle detectors to determine cycle times, phase splits, phase sequences and coordination offsets. To get more information about Utah Traffic Lab's research on ATCS visit our website at:
http://www.trafficlab.utah.edu/Adaptive_Signal_Control.php

## Development of simulation-based ITS analysis tools for the Hudson Valley TMC

Submitted by *Constantinos Antoniou, Moshe Ben-Akiva, Yang Wen*, Massachusetts Institute of Technology, and *Maggie Cusack,* New York State Department of Transportation

### Background

The New York State DOT (NYSDOT), in collaboration with a number of public and private sector partners, is developing a state-of-the-art ITS installation on the Hudson Valley road network. Traffic surveillance and monitoring devices such as loop detectors and CCTV cameras are very substantially augmented by the deployment of a network of TRANSMIT detectors on the Lower Hudson Valley (LHV) highways and bridges, many of which have high fractions of EZ-PASS users. The extent and quality of the real-time traffic data that will be available from this equipment may well prove to be unique in the world.

This information will form the basis for providing very effective travel guidance to network users, especially in the context of diversion strategies in response to non-recurring congestion. The ITS infrastructure of the Hudson Valley Traffic Management Center (HVTMC) includes stationary and portable Variable Message Signs (VMS) and Highway Advisory Radio (HAR) transmitters installed at key network locations. These are intended both for routine guidance use as well as to assist with Maintenance and Protection of Traffic (MPT) activities during projects such as the Cross Westchester Expressway (CWE) reconstruction. Because of the complexity of travel guidance issues in the network, the Lower Westchester County (LWC) ITS Integration Program has partnered with the Massachusetts Institute of Technology's Intelligent Transportation Systems Program (MIT ITS) to assist in the analysis of the ITS installation. MIT ITS' DynaMIT software package (described in detail later in this article) is being used to analyze equipment placement options and to generate real-time guidance for dissemination by VMS and HAR.

The first phase of this cooperation involved the off-line evaluation of DynaMIT using archived surveillance data from the network. The principal objectives of this project phase included generation of the necessary inputs for the application of the DynaMIT software system in the LWC network; Calibration of the DynaMIT software system so that it can replicate and predict traffic conditions in the LWC network with a precision sufficient for ITS purposes; and illustration of the use of the calibrated DynaMIT system by applying it to investigate a number of incident response strategies for the LWC network.

The successful completion of this phase signaled the commencement of the next phases of the project that include operationally linking DynaMIT with the HVTMC and evaluating it in tandem and on-line with the Traffic Management Center (TMC). One key activity in this process was the development of interfaces that would allow for the seamless, real-time exchange of information between DynaMIT and the HVTMC. Operational integration of DynaMIT with the HVTMC is a very complicated operation that requires careful organization, preparation and validation. On-line evaluation of transportation systems is very costly so there is a need to simulate traffic conditions to evaluate the DTA tools before implementation in the field. Therefore, a simulation environment has been developed that allows the TMC operators to simulate the operation (and expected impact) of their TMC (including the development and application of different traffic management and control strategies) without actually implementing them.

Besides being a practical operational tool, this environment has many other uses, such as training and planning. For example, the tools can also prove useful in the event of natural or man-made disasters, such as floods or fires, during which it is imperative to quickly evacuate a very large number of people, while at the same time ensuring that emergency response personnel can still access the affected area. They are also being used to support planning for future capital expenditures.

### Description of the simulation-based ITS analysis tools

DynaMIT (Dynamic Network Assignment for the Management of Information to Travelers, Ben-Akiva et al., 2002) is a simulation-based, real-time system designed for the generation of consistent, anticipatory route guidance for transportation networks. Anticipatory information (based on predicted network states) has been shown effective in eliminating driver overreaction (Balakrishna et al., 2005, Ben-Akiva et al., 1996). DynaMIT combines real-time surveillance data with historical data in order to estimate current network state, predict future traffic conditions and generate consistent and unbiased information. Consistency ensures that the network conditions experienced by drivers coincide with the predicted conditions on which the information is based. Unbiasedness means that the information provided to any driver is based on the best knowledge of future network conditions.

DynaMIT's state estimation and prediction capabilities rely on the accurate replication of the interactions between the demand and supply simulators. The estimation process must ensure that the estimated O-D flows are consistent with the surveillance observations. Similarly, the prediction and guidance generation process must achieve consistency between the guidance strategy and the network conditions that drivers will experience when they receive (and react to) the guidance. Both processes require the solution of fixed-point problems. DynaMIT employs an algorithm to obtain consistent estimates of current and future states (Bottom et al., 1999).

MITSIMLab is a simulation-based laboratory that was developed for evaluating the impacts of alternative traffic management system designs at the operational level and assisting in subsequent refinement. Examples of systems that can be evaluated with MITSIMLab include advanced traffic management systems (ATMS) and route guidance systems. MITSIMLab was developed by the MIT ITS Program (Yang and Koutsopoulos, 1996, Yang et al., 1999).

MITSIMLab is a synthesis of a number of different models and has the following characteristics that allow it to:

- Represent a wide range of traffic management system designs;
- Model the response of drivers to real-time traffic information and controls; and,

- Incorporate the dynamic interaction between the traffic management system and the drivers on the network.

The software interfaces that have been developed to operationally link DynaMIT with the HVTMC (and with MITSIMLab, when it acts as a proxy to the TMC) provide a seamless and streamlined facility for the exchange of information between DynaMIT and the TMC in real-time. This operation is called a "closed-loop" operation, because the information flows continuously in a loop, without the need for external interference or assistance. Figure 1 shows the high-level flow of information between DynaMIT and the TMC (respectively MITSIMLab). The information that periodically flows from the TMC to DynaMIT includes surveillance information (including loop detector counts, TRANSMIT measurements, etc), accident reports (location, duration, severity), and traffic messages disseminated to the drivers (e.g. through Variable Message Signs, VMS, or Highway Advisory Radio, HAR). DynaMIT uses this information to estimate and predict traffic conditions and generate guidance, which is in turn transmitted back to the TMC, where it is used to generate new traffic management strategies that will be disseminated to the drivers, thus affecting the surveillance that will be collected and transmitted to DynaMIT. This constant flow of information is the closed-loop functionality.
The development of the software interfaces between DynaMIT and the TMC builds directly upon the significant experience of the MIT ITS program. While literature concerning the interface of Dynamic Traffic Assignment Systems with the TMC, or with ground-truth simulators, is quite limited, the MIT ITS program has experience implementing two such prototypes (Yang et al., 1999, Florian et al., 2006). The presented interfaces build upon these prototypes to develop a flexible, reliable and robust system (Wen et al., 2006).

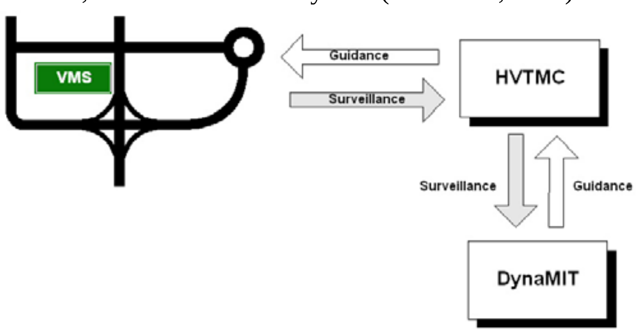


***Figure 1. Overview of exchange of information between DynaMIT and the TMC***

## Application

The developed closed-loop ITS analysis environment has been successfully applied to the Lower Westchester County network (Figure 2), where it has been used for the generation and evaluation of diversion strategies in response to selected incident scenarios. Both systems (MITSIMLab and DynaMIT) have been calibrated on a large-scale network in Lower Westchester County, NY, and practical aspects and difficulties of model calibration associated with this network have been addressed. A multi-step data processing and analysis approach has been developed that overcomes limitations associated with the available data. An interesting aspect of this application is the use of a multi-class OD matrix to model parkway access restrictions for heavy vehicles. The calibration results show that this process is successful in matching prevailing traffic conditions (Balakrishna et al., 2007).
The available sensor data for Westchester County is currently sparse relative to the number of links in the network. However, such sensor coverage levels are not uncommon in real-world situations, underlining the need for a calibration methodology that can extract maximum information from limited data. In this context, the proposed methodology efficiently estimates all model parameters of interest, simultaneously. An important advantage of the developed calibration method is its ability to handle any type and amount of sensor data. Therefore, TRANSMIT data that has recently become available can be easily incorporated into the model. With several large installation projects on the horizon, more data will be available for calibration as sensor coverage improves, and increased accuracy is expected.

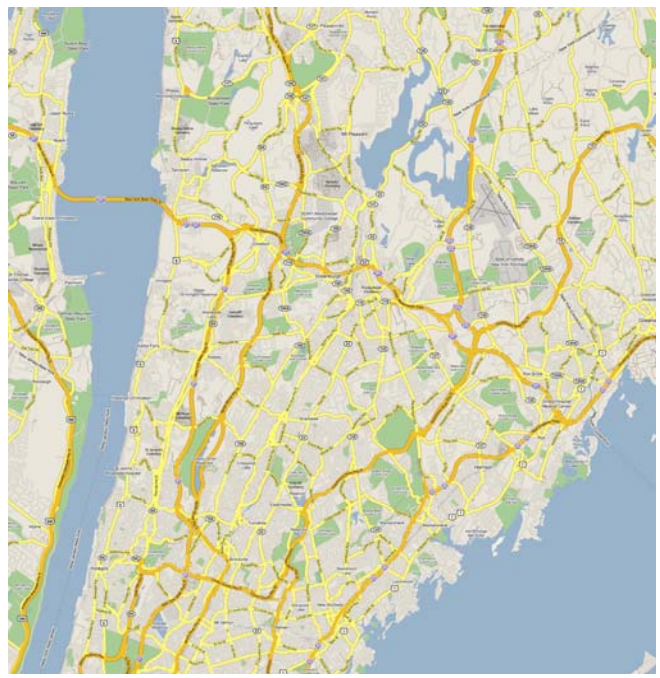

***Figure 2. Lower Westchester County map (source: Google Maps)***

The closed loop setup has been used to generate and evaluate incident response traffic guidance for the Lower Westchester County. Two peak-hour scenarios have been evaluated (one on the Sprain Brook Parkway and one on Interstate-95). In both cases it has been found that the provision of predictive guidance (generated by DynaMIT) via VMS can significantly reduce travel time delays through the efficient utilization of residual capacity at available alternate routes. Naturally, the magnitude of this improvement depends on many parameters, such as the congestion level and the type of the information provided (e.g. frequency update interval). Empirical analysis of the number of prediction iterations performed within DynaMIT to achieve prediction consistency indicates that (as expected) the quality of predictive information improves with the number of prediction iterations; however, in this application it was found that satisfactory results were obtained already with three prediction iterations and the marginal benefits after that point were less significant.

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# VISGAOST – Optimization Tool for Transit Signal Priority

*Submitted by Jelka Stevanovic, Aleksandar Z. Stevanovic, and Peter T. Martin, Utah Traffic Lab, University of Utah*

Transit Signal Priority (TSP) strategies have been known as efficient methods to decrease delay of transit vehicles at signalized intersections. However, the TSP strategies may have a negative impact on performance of non-transit traffic. On the other hand, TSP strategies implemented on signal timings optimized for general traffic may not bring full benefits for transit vehicles.

One way to find the best signal timings for the whole system (both transit and general traffic) is to optimize signal timings (including TSP) for a person-based performance. This approach, where basic signal timings are simultaneously optimized with TSP timings, gives more priority to transportation mode which has more users in the system. However, TSP strategies are sometimes used to give transit vehicles preferential treatment to increase their ridership. In such cases optimization of the signal timings (both basic and TSP) is performed to provide the best service for transit vehicles. Finally, sometimes the goal of the optimization is to provide the best TSP strategies for the existing signal timing plans, which work well for private vehicles. All these cases, which include optimization or adjustment of TSP signal timings, are not available in the conventional signal timing optimization tools. Here we present a tool which supports optimization of basic signal timings and TSP timings for the cases described above. We shortly describe our program and some initial experiments on a real-world corridor in Albany, NY.

## *VISSIM-based Genetic Algorithm Optimization of Signal Timings (VISGAOST)*

VISGAOST is a program which uses Genetic Algorithm (GA) to optimize signal timings based on their evaluations in VISSIM. VISGAOST can optimize basic signal timing parameters (i.e. cycle length, green splits, offsets and phase sequence) simultaneously (or separately) with the TSP settings. Comprehensiveness of VISSIM outputs makes VISGAOST unique optimization tool which can be used for various purposes (e.g. VISGAOST can optimize signal timings to reduce pollutant traffic emissions. Current VISGAOST features also include the optimization of: multiple coordinated systems and uncoordinated intersections, fully-actuated isolated intersections, and multiple time periods. VISGAOST's Graphical User Interface (GUI) is shown in Figure 1. In the GUI users can define both settings for optimization of signal timings and GA parameters.

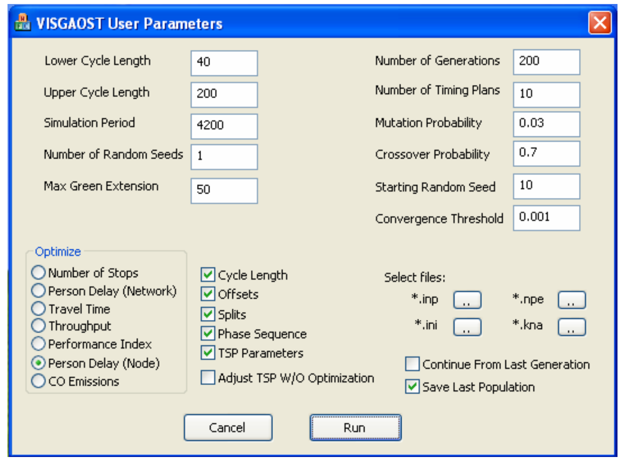

**Fig 1. VISGAOST input dialog window**

## *Study Area*

A VISSIM model of an urban corridor in Albany, NY, shown in Figure 2, is used to test optimization of the TSP settings in VISGAOST. The corridor is approximately 1.2 miles long and includes seven signalized and four unsignalized intersections, as well as nineteen driveways. All signalized intersections operate with TSP operations enabled. The model was properly calibrated and validated. Transit routes in the model included Capital District Transportation Authority (CDTA) bus routes 1 and 55. These two routes both had headways of fifteen minutes (for both directions) which represented 8 bus departures per hour.

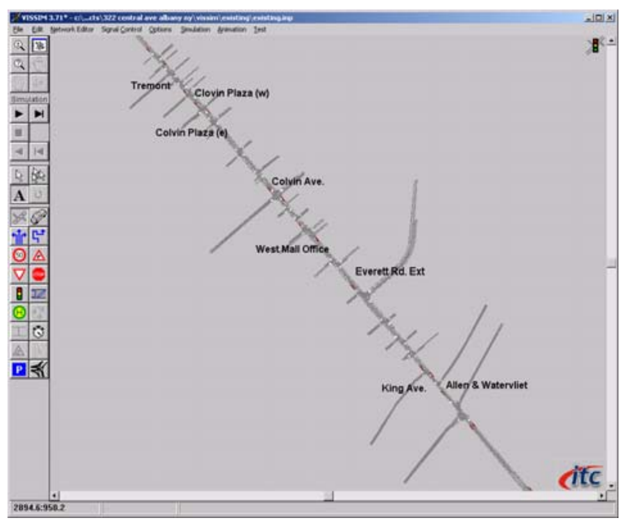

**Fig 2. VISSIM model of Central Ave. in Albany**

## *TSP Operations*

To model the TSP operations, we used standard NEMA emulator in VISSIM with specific LMD 9200 emulator for TSP operations. The LMD 9200 emulator provides enhanced service to transit vehicles by modifying the signal timings to favor the selected vehicles. Usually, when the TSP service is applied, the coordination of the intersections is maintained and no phase is skipped. Basically, TSP strategies only give a little extra green time to the priority phases while truncating the green time of the non-priority phases. The priority operation is initiated when a TSP vehicle is detected while approaching the intersection. Depending of the moment in the cycle when the vehicle is approaching, two different types of priority are provided.

If the priority vehicle is detected during red, the non-TSP intermediate phases will be shortened to allow the TSP phase to get green light as soon as possible (Early Green). In the example in Figure 3 the priority eastbound-westbound phase get green light 6 seconds earlier than without TSP service. The southbound-northbound phase is truncated 4 seconds while the cross street left turns phase is truncated 2 seconds.

Conversely, if the priority vehicle approaches intersection at the end of its green interval, the phase will be extended to enable the vehicle to pass through intersection (Green Extension). In the example in Figure 4 the priority phase is extended 7 seconds while three following non-TSP phases are truncated 2, 4 and 1 second(s).

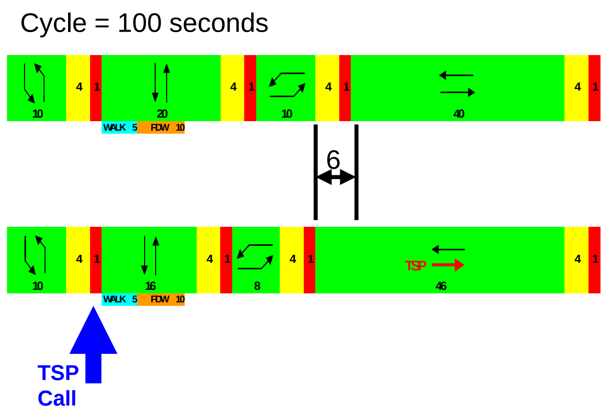


**Fig 3. LMD 9200 Early Green strategy**

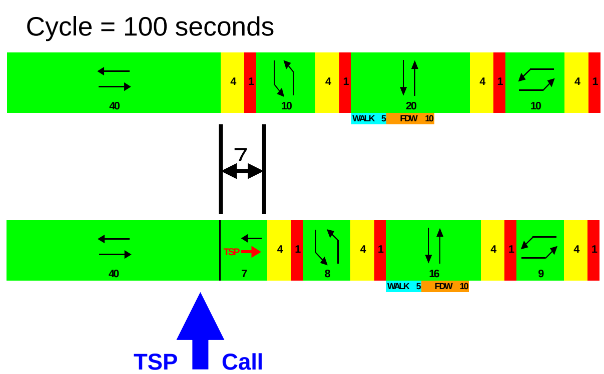


**Fig 4. LMD 9200 Green Extension strategy**

Special timings, in LMD 9200, used to define these strategies are: Group Max, Group Walk, and Max Extend. We provide here their basic definitions:

**Group Max** is used to specify limits for the early green TSP strategy. By defining this value we restrict how much a running non-TSP phase can be truncated when a TSP call is placed. The Group Max is specified in seconds – 0 to Max Green.

**Group Walk** defines new walk to serve during early green service. The Group Walk is typically set shorter than normal walk and will be generally used to time out the phase walk quicker to get to a TSP phase (values from 0 to Walk).

**Max Extend** defines maximum green time that a priority call can extend. This parameter is used for the green extension strategy and it will operate only if a vehicle which is given TSP priority called for the TSP service while the light given to TSP phase was green. This value establishes the time in seconds (0-255seconds) that the transit priority phase can extend beyond its normal max or force off.

### *Optimization Experiments*

The main objective of the VISGAOST testing for the Albany model was to show that VISGAOST can find better signal timings (both basic and TSP) than the signal timings developed by engineers. As a performance measure we used average person delay (seconds). To optimize signal timings based on the average person delay for all transportation modes, three different VISGAOST optimizations were performed.

In the first, existing basic signal timings (cycle length, offset, splits, and phase sequence) remain unchanged whereas TSP parameters are optimized. In the second optimization, only basic signal timings were optimized whereas the TSP signal timings remain unchanged. Finally, in the third optimization both basic signal timings and TSP signal timings were optimized.

All optimizations were based on 70-minutes VISSIM runs: 10 minutes of warming up and 60 minutes of evaluation. All optimizations were based on the same initial scenario, with TSP operations implemented, and were using the same random seeds for all evaluation runs. Each of the optimizations had 2000 evaluations – 10 timing plans and 200 generations.

### *Results*

Results from testing VISGAOST on a corridor with active TSP service are shown in Figure 5. Each of the three optimizations found better signal timings than the initial signal timings. All optimizations reached the optimal solutions (probably local optima) after approximately 750 evaluations. Results show that the lowest delay per person is achieved when both basic signal timings and TSP settings are optimized simultaneously. These results were expected because any of the two partial optimizations (only basic signal timings or only the TSP settings) puts some constraints on the set of the parameters which are optimized. When both parameter sets are optimized these constraints are released and the better signal timing plans are achieved.

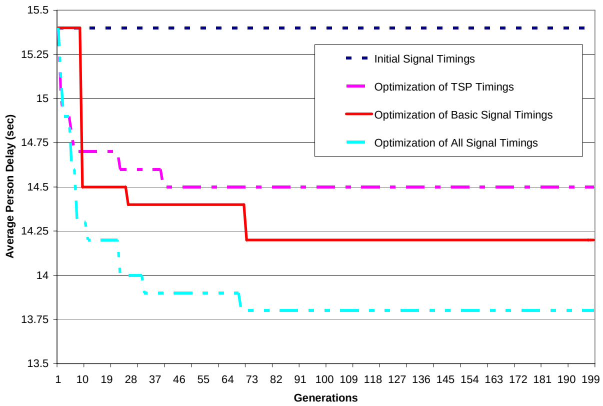


**Fig 5. VISGAOST optimizations of person delay**

Optimization of only basic signal timings also brought significant improvement to average person delay. Finally, if only TSP settings are optimized the benefits of such an optimization are lowest but still significant. The results show that one could save around 1 second per person per hour if VISGAOST was used to optimize only the TSP settings without changing basic signal timing parameters. Such small difference, although statistically significant can be attributed to two factors. Figure 5 shows delays after 30 random seed evaluations after the optimization. These delays are somewhat different than the ones achieved during the optimization. Reason for this discrepancy is that evaluations during the optimizations were done only for a single random seed. Second, transit activity in the network during one hour of the evaluation was not very high. Had we had more buses running during the evaluation period the benefits of optimizing TSP would be higher.

## *Conclusions*

Initial results of testing VISGAOST, a new GA-based signal optimization program, are presented. We used VISGAOST to optimize four basic signal timing parameters and the TSP settings of the Peek LMD 9200 traffic controller. The results showed that each of the three optimization scenarios improved overall traffic service and reduced person delays. The greatest benefits came from a simultaneous optimization of both basic and TSP signal timings. However, the general conclusion is that optimization of the TSP settings is important and it should not be neglected when optimizing traffic control for networks with mixed traffic and transit operations.

## Data Repository to Support Traffic Simulation Research and Development - Data Needs

Submitted by the Research Needs and Resources Task Group
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### Introduction

The traffic simulation community has been discussing for some time the needs for collecting and storing data to support transportation system research and development. This article produced by the Research Needs and Resources Task Group (the Group) of the Transportation Research Board (TRB) Joint Traffic Simulation Subcommittee (SimSub), identifies the types of the needed data. It also includes a call to the members of the traffic simulation community to submit data to the Group for possible inclusion in the SimSub simulation data repository.

The principal goal of creating this repository is to support the research and development of operational models, tactical route execution models, and strategic traveler decision models. Operational models incorporate traveler decisions that take less than five seconds to make and execute. They require data on lane changing maneuvers, car following and gap acceptance behavior, and queue discharge, among others. Tactical driving behavior models deal with traveler decisions that take between five and 30 seconds to make and execute. They require data on lane selection, cooperative and non-cooperative driving, and parking maneuvers. Strategic Behavior data describes how travelers respond to network conditions in the presence and absence of real-time en-route and pre-trip traveler information. Traveler responses include route diversion, mode shift, time shift, and/or possibly trip cancellation (forgone demand).

Some of the needed types of data exist and can be collected from a number of sources. Other types of data may become available in the future with the advancements of Intelligent Transportation Systems (ITS), including Vehicle Infrastructure Integration (VII) technologies. In general, four types of data are needed: trajectory data, strategic behavior data, data on the impacts of influencing factors, and input files to simulation programs. Below are descriptions of these data types.

### Trajectory Data

Trajectory data is needed to analyze tactical and operational driving behaviors under different conditions and to develop and validate models that simulate these behaviors. Trajectory data is the most difficult and expensive type of data to collect. Very limited amount of this type of data currently exists, although it is essential for the development and validation of simulation models.

An example of existing trajectory data sets is the “I-405 Northbound at Mulholland Drive, Los Angeles” dataset collected in a 1985 study, which was conducted by JHK Associates for the Federal Highway Administration (FHWA).

The FHWA NGSIM project has invested significant resources to collect vehicle trajectory data and to make the data available to the simulation research community. Several researchers not directly affiliated with the NGSIM program have utilized this data in a number of research studies.

### Strategic Behavior Data

Strategic behavior data is needed for simulation models with dynamic traffic assignment capabilities. These models are particularly useful to model the effects of advanced traveler information strategies such as the use of dynamic message signs (DMS), in-vehicle and pre-trip traveler information systems, managed lane, congestion pricing and evacuation management strategies.

Although considerable numbers of studies have been conducted to collect behavioral data, these data are still not sufficient to provide accurate and reliable information about traveler’s responses to network conditions and/or traveler information. For example, limited knowledge exists regarding how drivers respond to different types or contents of DMS messages.

In general two techniques have been used to collect strategic traveler behavior data: stated preference and revealed preference surveys. The results obtained from these studies could vary widely. A large proportion of past studies on the subject have used stated preference surveys since they are easier to use. Revealed preference surveys produce more accurate results since they measure how drivers actually behave rather than relying on what they say they will do. However, the instruments for collecting revealed preference data are difficult to construct because the instruments need to collect both the driver’s decisions as well as all relevant traffic and control data that are associated with the decision point.

Recognizing the existence of several prior data collection efforts, it is recommended that a review of these studies should be included in the SimSub data repository. Good reviews may already exit. Studies that investigate driver behaviors, as part of industry simulation and demand modeling projects may not have been published in journals or presented in conferences. It may be possible, however, to identify these additional studies based on inputs from the SimSub members.

### Data on Influencing Factors

Data on major factors influencing the performance of transportation networks is needed.. Combining these factors with measured system-state data (e.g., travel time, traffic volume, throughput, detector occupancy, and speed), trajectory data, and/or behavioral data will allow better understanding of the influences of these factors.

Below is a brief description of the categories of the influencing factors

- Transportation Network Physical Characteristics: This type of data includes the geometric information of highway facility elements, such as free-flow speed/speed limits, cross-section elements, alignment, length and width of auxiliary lanes, etc.

- Transit Network: This type of data includes data related to the transit lines, stops, busway/bus lane design, signal preemption, and bus bay configuration.

- Control/ITS Systems: This type of data includes intersection controls, ramp metering, lane closure signal, detour (trailblazer) signs, and toll plazas, and traveler information systems

- Driver characteristics: These include elements such as driver aggressiveness, willingness to cooperate with other drivers, speed limit acceptance, perception and reaction times of drivers, and so on .

- Vehicle Characteristics: This data type includes vehicle static, kinematic, and dynamic characteristics for all simulated vehicle categories.

- Special Events: These include traffic incidents, weather events, emergency evacuation, construction zones, and other special events on the simulated systems.

Two types of information are useful to assess the impact of the influencing factors and are recommended for inclusion in the SimSub data respiratory:

- Reviews of relationships reported in previous studies
- Data obtained from previous studies that can be useful to allow researchers to derive new relationships.

**Data Collected Using ITS**

Data collected using ITS devices can be considered as one specific type of system-state data and impact of influencing factor data, described in the previous section. ITS devices provide the opportunity of collecting system-state data at higher spatial and temporal resolutions compared to the traditional methods. Point traffic sensors (e.g. loop detectors, video image detectors, and microwave detectors) have been installed in many ITS deployments to collect information such as traffic volumes, travel time, speed, and occupancy. Probe vehicles that use automatic vehicle identification (AVI) technologies such as electronic toll transponder, license plate readers, and potentially cellular phone tracking and vehicle-infrastructure integration (VII) technologies provide better estimates of travel time compared to point traffic detectors. Such data also facilitate the estimation of time-dependent origin-destination information, if privacy concerns are overcome. The SimSub data repository should include web links and/or contact information for researchers to obtain useful ITS data. It should however be noted that deriving information based on ITS data for simulation research applications, particularly in the case of strategic behavior modeling, still needs further development and research.

**Input Data Sets**

In many traffic simulation research projects, researchers need case studies to test and illustrate the effectiveness of their models and/or methods. The researchers would like to have data sets coded in input files for one or more of the leading simulation tools available in the markets. These datasets should reflect real-world conditions, and can correspond to transportation systems of different sizes, with different features, parameters and traffic control scenarios. It would be useful to include such input files and the associated supporting documentations in the SimSub data repository website. Effort should be made to encourage researchers, public agencies, and private consulting organizations to donate some of the simulation datasets from previous studies to be stored in the SimSub committee data repository website.

**Call for Information**

The Research Needs and Resources Task Group would like to invite the Simsub members and friends and the simulation community to:

- Provide comments/additions regarding the data needs identified above
- Provide data for inclusion in the SimSub data repository

The Task Group will research possible incentive to facilitation the donation/submission of these data. Possible insensitive include: (1) recognition of the donors at the Data SimSub data repository website. (2) Requiring the users of the datasets to acknowledge the source of the data in their research.

The enclosed form can be used to provide information about the required data.

**Potential Data Sources Questionnaire**

Name: ______________________________ Title:____________________________

Affiliation:____________________________________________________________

E-mail Address:________________________________________________________

Please: Provide information and datasets to Dr. Mohammed Hadi (hadim@fiu.ed)

1. Please identify trajectory data that should to be stored in the SimSub simulation data repository (other than the NGSIM dataset), provide a short description of the data, and a contact information/reference/web address for the data source

2. Please identify research study reports or papers to include in the SimSub data repository that include a good review of the strategic behavior of travelers with and without travel information provision.

3. Please identify research study reports or papers to include in the SimSub data repository that include a good review of the impacts of influencing factors

4. Please identify calibrated input files for leading simulation tools that should to be stored in the SimSub simulation data repository

5. Please provide information about any data that can help researches assess the impacts of influencing factors.

6. Please, provide links/contact information for ITS data that are useful for transportation system simulation research.