U.S.Department of Transportation
Federal Highway Administration

Office of Operations
Research and Development

TECHBRIEF

Publication No. FHWA-HRT-17-027 | HRDO-20/1-17(200)E
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Open Source Surrogate Safety Assessment Model, 2017 Enhancement and Update: SSAM v3.0

This document is a technical summary of the Enhanced Surrogate Safety Assessment Model (SSAM) software; originally developed by the Federal Highway Administration (FHWA), FHWA-HRT-08-051.

OBJECTIVE

This TechBrief describes the development of an open source surrogate safety assessment model (SSAM) software with improved safety measures, 3D conflict graphics, and advanced computing enhancements.

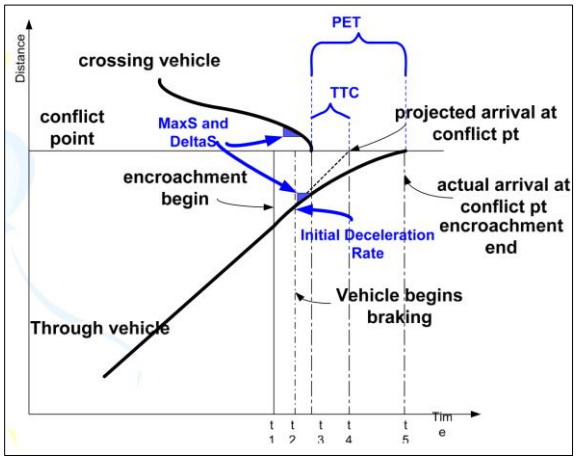
INTRODUCTION

The ETFOMM (Enhanced Transportation Flow Open Source Microscopic Model) Cloud Service (ECS) is a software product sponsored by the U.S. Department of Transportation in conjunction with the "Microscopic Traffic Simulation Models and Software—An Open Source Approach" project. ETFOMM's primary components are the core microscopic traffic Simulation Engine (ESE), a graphical user input editor (ETEditor), a 3D traffic visualization tool (ETAnimator), and a database in cloud service environment. Moreover, the SSAM is being converted into open source software, enhanced, and integrated as part of ESE.

SSAM is a popular safety tool box that utilizes the microscopic traffic simulation vehicle trajectories to generate safety performance measures such as:

- Minimum time to collision (TTC).
- Minimum post-encroachment time (PET).
- Initial deceleration rate (DR).
- Maximum speed (MaxS).
- Maximum relative speed difference (DeltaS).
- Location of the conflict event (CLSP, CLEP).
- Maximum "post collision" DeltaV (MaxDeltaV).

These safety performance measures are shown on a vehicle trajectory plot, graphing time vs. distance in figure 1.



Source: FHWA

Figure 1. SSAM Safety Measure.

OPEN SOURCE SSAM FEATURES

Integrated with ETFOMM

Vehicle trajectories from ETFOMM are collected and converted into SSAM input files; the trajectories are then analyzed by the SSAM program.

Re-implemented in C++

The SSAM algorithm source code was reprogramed from Java to C++ and restructured to separate declaration and definition of classes. Referenced Java libraries are replaced with C++ libraries, and memory management modules were added. The C++ version of SSAM has reduced analysis time up to 50 percent.

Parallel Computing

The C++ source code was designed to facilitate parallel computing by using OpenMP directives. The new parallel computing capabilities decreases the computation time up to 90 percent. Table 1 shows the analysis time improvement.

Table 1. Computation Time Improvement with Updated SSAM Software

Vehicle Trajectory Records Used in Comparison	Improvement (percent) *
119,458	90.63
656,710	88.91
694,527	88.45
67,472,183	87.69

*Percent improvement represents the improvement of computation time from the original SSAM 2.16 in Java to the new parallel implementation in C++.

3D Conflict Map

The conflict map from the original SSAM was converted from 2D Java graphics into a 3D display, programmed using OpenSceneGraph library based on OpenGL. Conflict points are illustrated on detailed intersections generated from the ETFOMM Intersection Model. An optional image can be imported as the background map, as shown in figure 2.

Original Photo: © Google®

Figure 2. SSAM 3D Conflict Map.[1]

New Features in SSAMs

- Bar chart, heat map, and contour map to illustrate conflicts.
- Zooming capability in the conflict map.
- Multiple PET (mPET), add multiple TTC (mTTC), and probability of unsuccessful evasive action P(UEA).
- API functions for data input, safety measure exporting, and interfacing with traffic simulation software.

OPEN-SOURCE SOURCE CODE DOWNLOAD

- http://www.itsforge.net/ssam[2]
- http://www.sourceforge.net/etfomm/[3]
- http://www.etfomm.org[4]

REFERENCES

1) "Clays Mill Rd & Cecil Way, Lexington, KY" Map. Lexington, KY. January 7, 2014. Accessed January 7, 2014. http://maps.google.com. Scale: 1:500 ft. The original map is the copyright property of Google® Earth™. Colored dots have been added to create the SSAM conflict map.
2) Federal Highway Administration. "Open Source Application Development Portal: SSAM." Website. McLean, VA. http://www.itsforge.net/ssam. Last accessed December 2, 2016.
3) NGSIM: Source Forge. (Updated 2014). "ETFOMM." Website. https://sourceforge.net/projects/etfomm/. Last accessed December 2, 2016.
4) New Global Systems for Intelligent Management Corp. (September 2016). "Enhanced Transportation Opensource Flow Microscopic Model (ETFOMM)." Website. http://www.etfomm.org. Last accessed December 2, 201

Researchers—This software was developed by New Global Systems for Intelligent Management Corporation, Contract No. SBIR DTRT5715C10005. The president is: Dr. Li Zhang (662–341–5725, ngsim@ngsim.com). The FHWA Contracting Office Representative is Joe Bared (202–493–3314, joe.bared@dot.gov); contact him with any questions.

Distribution—This TechBrief is being distributed according to a standard distribution. Direct distribution is being made to FHWA Division Offices and Resource Centers.

Availability—The publication associated with this TechBrief is "Surrogate Safety Assessment Model (SSAM) and Validation: Final Report", Report No. FHWA-HRT-08-051. It is available in print for specific distribution, and online at www.fhwa.dot.gov/publications/research/safety/08051/08051.pdf.

Keywords— Surrogate Safety Assessment Model, vehicle conflict analysis, and traffic simulation.

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