Raghavan Srinivasan PhD

Senior Transportation Research Engineer

Professional Experience

Dr. Srinivasan has conducted projects for many agencies including NCHRP, FHWA, NHTSA, and state agencies for more than 30 years. He is well versed in state of the art statistical and machine learning methods in crash prediction and estimation of crash modification factors. Dr. Srinivasan led FHWA's initial efforts on developing realistic artificial datasets (RAD) as part of the HSIS effort. He has also conducted research using the SHRP2 naturalistic driving study (NDS) and roadway information database (RID). Dr. Srinivasan has conducted multiple research studies on safety of intersections and roadway segments in rural and urban areas including roadway departure. Dr. Srinivasan developed the USLIMIT2 expert system for setting speed limits, and currently leading the NCHRP project to develop the next generation USLIMITS2 program. Srinivasan is the recipient of TRB's 2008 D. Grant Mickle Award.

Education

Ph.D. (Civil Engineering) University of California, Davis, 1996.

M.S. (Civil Engineering) University of Virginia, 1990.

Bachelors (Civil Engineering) Indian Institute of Technology, Chennai, 1988.

Employment History

Associate Director of Engineering and Data Sciences, UNC Highway Safety Research Center, 2017 to present.

Senior Transportation Research Engineer, UNC Highway Safety Research Center, 2002 to present.

Assistant Professor of Transportation, Dowling College, 1996 to 2002.

Post-Graduate Research Engineer, University of California, 1990 to 1996.

Research Assistant, University of Virginia, 1988 to 1990.

Professional Appointments

Past Member of TRB Committee on Safety Performance Analysis.

Editorial Advisory Board, Journal of Safety Research.

Selected Project Experience

Highway Safety Information System (until February 2021) – Dr. Srinivasan was the Task Order Principal Investigator (PI) for this effort. HSIS obtains data from 7 States and 1 urban in the United States, processes the data, and gives the data out to researchers all over the world. HSIS also involves conducting research for FHWA. Research projects include studying the impact of intersection skew angle on safety for stop controlled intersections and safety on transverse rumble strips.

Developing Safety Performance Functions for Rural Two-Lane Highways that Incorporate Speed Measures, Senior Research Engineer (NCHRP 17-92). Co-Principal Investigator. The objective of this research was to develop a predictive methodology for rural two-lane, two-way highways, for consideration by the AASHTO HSM Steering Committee that incorporates speed measures (or surrogates for speed measures) to estimate crash frequency and severity.

Update of Crash Modification Factors for the Highway Safety Manual (NCHRP 17-72), Principal Investigator. The initial objectives of this research were to: (1) Assess the current criteria and existing process for evaluating and identifying the quality of CMFs for appropriate use with the HSM; (2) Develop proposed revisions to the criteria and process, including how existing and new CMFs may be incorporated in the HSM. Provide guidance for practitioner application of the revised process; (3) Apply the evaluation criteria to identify and assess CMFs and develop a list of appropriate CMFs for the HSM. The scope of this project has expanded to include single (common) state calibration of the prediction models before they are included in the 2nd edition of the HSM.

Next Generation of the USLIMITS2 Speed Limit Setting Expert System (NCHRP 03-139) (ongoing), Principal Investigator. The objectives of this ongoing research are to (1) determine what updates are needed for the USLIMITS2 decision algorithm to establish safe, credible, and enforceable speed limits for a variety of facility types and contexts, including high, moderate, and low speed facilities that serve all roadway users; (2) update the algorithm and conduct user testing; (3) identify and incorporate potential enhancements that will increase the user base; and (4) develop an implementation and training plan.

HSRC developed USLIMITS2 as part of NCHRP Project 03-67 in 2006. This effort is a follow-on to develop the next generation of the USLIMITS2 program.

Traffic Safety Evaluation (MNDOT and HDR) (ongoing) (PI for HSRC). This effort is developing CMFs for a variety of engineering treatments for MNDOT as a subcontractor to HDR. One recent task included the before-after empirical Bayes evaluation of the increase in speed limits on rural two-lane roads from 55 to 60 mph. HSRC conducted the evaluation and wrote a technical report of the findings.

Evaluation of the Interaction Between Horizontal and Vertical Alignment on Rural Two-Lane Roads: An Investigation Using the SHRP2 Naturalistic Driving Study, Principal Investigator, (NCDOT, FHWA, AASHTO). The objective of this effort was to investigate driver performance associated with horizontal and vertical alignment on rural two-lane roads. The SHRP2 Roadway Information Database (RID) and the Naturalistic Driving Study (NDS) data were used to develop models relating driver performance (including speed and position) with roadway characteristics, weather, and driver characteristics.

Understanding and Communicating Reliability of Crash Prediction Models (NCHRP 17-78)– Principal Investigator. The objectives of this research were to develop guidance for: (1) the quantification of the reliability of crash prediction models including crash modification factors and/or functions (CMFs) and safety performance functions (SPFs) for practitioner use; (2) user interpretation of model reliability; and (3) the application of crash prediction models accounting for, but not limited to assumptions, data ranges, and intended and unintended uses.

Contributing Factors for Focus Crash Types and Facility Types (FHWA) (HSRC Principal Investigator), The main goal of this project was to identify focus crash types, focus facility types, and their associated contributing factors to inform applications of systemic safety improvements. To achieve this goal, the research team executed three main technical tasks: identification of focus crash types and facility types (FCFTs), identification of contributing factors associated with the FCFTs, and development of guidance to assist safety practitioners in making informed choices regarding countermeasures to address the focus crash types. The research team used three different data sources to conduct the contributing factor analysis – HSIS (crash and roadway inventory), NOAA (climate), and U.S. Census Bureau (socioeconomic characteristics). The analysis consisted of random forests in combination with plots of the random forest predicted crash frequencies as a function of variables with the most predictive power to provide the information needed to identify contributing factors and to inform countermeasure identification.

Evaluation of Safety Strategies at Signalized Intersections (NCHRP 17-35), Principal Investigator. The objective of this project was to develop reliable accident modification factors (AMFs) for selected strategies identified in Vol. 12 of NCHRP Report 500, *Guidance for the Implementation of the AASHTO Strategic Highway Safety Plan, A Guide for Reducing Collisions at Signalized Intersections*. One of the strategies evaluated was the flashing yellow arrow. State of the art methods including the empirical Bayes method were utilized. The final report was published as NCHRP Report 705.

Older Drivers, Self-Screening Tools and Evaluating on Road Performance, Senior Statistician (NHTSA). This study addressed two related topics that impact older driver safety and produced two Final Reports. One report dealt with the validity and older drivers' attitudes toward self-screening tools for older drivers. The other report compared two means of evaluating older drivers' safety: a professional evaluation by a CDRS and using data collected automatically by an in-car device.

Development of Crash Modification Factors, Senior Research Engineer (FHWA). This project developed CMFs for a variety of treatments. Srinivasan was the HSRC Principal Investigator and managed the development of CMFs for many treatments including pedestrian count-down signals, flashing yellow arrow, curve realignment, median barriers, and flashing beacons at stop-controlled intersections.

Safety Performance Function Guidance, Principal Investigator (FHWA). The objective of this effort was to develop and provide information to assist state and local agencies calibrate the SPFs in the HSM and/or develop their own SPFs for their state or region. This project developed two guidebooks: the first is a report to help States choose between calibration SPFs from the HSM versus develop jurisdiction-specific SPFs. The second guidebook is a 'how to' guide for states to develop jurisdiction specific SPFs.

North Carolina Speed and Safety, Senior Research Engineer (NCDOT). This project developed a comprehensive set of speed management programs and countermeasures recommendations for North Carolina DOT and partner stakeholders. The recommendations and final report were based on literature review, problem analysis from data and stakeholder input. We organized an international Speed and Safety Symposium to share knowledge of how international agencies are furthering speed management and reducing fatalities and injuries and organized a stakeholder work session. We also developed screening methods for prioritizing corridors for speed and safety review based on available data elements.

Automated Enforcement: A Compendium of Worldwide Evaluations of Results, Senior Research Engineer (NHTSA). This effort was led by TransAnalytics. We performed a critical review of international literature to determine the safety impacts of automated enforcement programs, primarily automated speed and red-light enforcement. A NHTSA report and TRB paper synthesized findings from worldwide automated enforcement programs and safety impacts.

Selected Publications and Reports

- H. Yi, C. Bizon, D. Borland, M. Watson, M. Satusky, R. Rittmuller, R. Radwan, ***R. Srinivasan***, and A. Krishnamurthy (2021), AI Tool with Active Learning for Detection of Rural Roadside Safety Features, *Proceedings of 2021 IEEE International Conference on Big Data (Big Data)*, Orlando, Florida, USA, Pages: 5317-5326, DOI Bookmark: 10.1109/BigData52589.2021.9671360.
- Kumfer, W., Harkey, D., Lan, B., ***Srinivasan, R***., Carter, C., Nujjetty, A. P., Eigen, A. M., & Tan, C. (2019). Identification of Critical Intersection Angle through Crash Modification Functions. *Transportation Research Record, Journal of the Transportation Research Board*, Vol. 2673, Issue 2, pp. 531-543, Washington, D.C.
- ***R. Srinivasan***, B. Lan, D. Carter, S. Smith, and K. Signor (2018), Crash Modification Factors for the Flashing Yellow Arrow Treatment at Signalized Intersections, *Transportation Research Record: Journal of the Transportation Research Board* 2672 (30).
- ***R. Srinivasan***, D. Carter, B. Lan, and K. Signor (2018), Investigation of Driver Performance in Different Horizontal and Vertical Curve Combinations Using SHRP2 Naturalistic Driving Data, *Advances in Transportation Studies: an international journal*, Special Issue Vol.1, 2018, pp. 121-136.
- ***R. Srinivasan***, D. Carter, C. Lyon, and M. Albee (2018), Before-After Evaluation of the Realignment of Horizontal Curves on Rural Two-Lane Roads, *Transportation Research Record: Journal of the Transportation Research Board* 2672 (30).
- ***R. Srinivasan*** and D. Carter, *Solving Safety Problems* (Unit 4), *Road Safety Fundamentals: Concepts, Strategies, and Practices that Reduce Fatalities and Injuries on the Road*, Report FHWA-SA-18-003, Federal Highway Administration, November 2017.
- C. Zegeer, C. Lyon, ***R. Srinivasan***, B. Persaud, B. Lan, S. Smith, D. Carter, N.J. Thirsk, J. Zegeer, E. Ferguson, R. Van Houten, and C. Sundstrom (2017), Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments, *Transportation Research Record: Journal of the Transportation Research Board* 2636, pp. 1-8, Washington, D.C.
- J.E. Hummer, C.M. Cunningham, ***R. Srinivasan***, S. Warchol, B. Claros, P. Edara, and C. Sun (2016), Safety Evaluation of Seven of the Earliest Diverging Diamond Interchanges Installed in the United States, *Transportation Research Record: Journal of the Transportation Research Board* 2583, pp. 25-33, Washington, D.C.

- ***R. Srinivasan***, M. Colety, G. Bahar, B. Crowther, and M. Farmen (2016), Estimation of Calibration Functions for Predicting Crashes on Rural Two Lane Roads in Arizona, *Transportation Research Record: Journal of the Transportation Research Board* 2583, pp. 17-24, Washington, D.C.
- ***R. Srinivasan***, F. Gross, B. Lan, and G. Bahar (October 2016), *Reliability of Safety Management Methods: Network Screening*, FHWA Report FHWA-SA-16-037, Federal Highway Administration, Washington, D.C.
- ***R. Srinivasan***, F. Gross, and G. Bahar (March 2016), *Reliability of Safety Management Methods: Safety Effectiveness Evaluation*, FHWA Report FHWA-SA-16-040, Federal Highway Administration, Washington, D.C.
- B. Lan and ***R. Srinivasan*** (2013), Safety Evaluation of Discontinuing Late Night Flash Operations at Signalized Intersections, *Transportation Research Record: Journal of the Transportation Research Board,* 2398, pp. 1-8, Washington, D.C.
- ***R. Srinivasan***, D. Carter, and K. Bauer (2013), *Safety Performance Function Decision Guide: SPF Calibration versus SPF Development*, Report FHWA-SA-14-004, Federal Highway Administration, Washington, D.C., September 2013.
- ***R. Srinivasan*** and K. Bauer (2013), *Safety Performance Function Development Guide: Developing Jurisdiction-Specific SPFs*, Report FHWA-SA-14-005, Federal Highway Administration, Washington, D.C., September 2013.
- ***R. Srinivasan***, D. Carter, S. Smith, and B. Lan (2013), Safety Evaluation of Converting Traffic Signals from Incandescent to LED Bulbs, *Transportation Research Record: Journal of the Transportation Research Board* 2398, pp. 9-18, Washington, D.C.
- Gross, F., C. Lyon, B. Persaud, and ***R. Srinivasan***, Safety Effectiveness of Converting Signalized Intersections to Roundabouts, *Accident Analysis and Prevention*, Vol. 50, January 2013, pp. 234-241.
- ***R. Srinivasan***, C. Lyon, B. Persaud, J. Baek, F. Gross, S. Smith, and C. Sundstrom, Crash Modification Factors for Changing Left Turn Phasing, *Transportation Research Record: Journal of the Transportation Research Board* 2279, pp. 108-117, Washington, D.C., 2012.
- ***R. Srinivasan***, C. Lyon, B. Persaud, J. Baek, F. Gross, S. Smith, and C. Sundstrom, Crash Modification Factors for Changing Left Turn Phasing, *Transportation Research Record: Journal of the Transportation Research Board* 2279, pp. 108-117, Washington, D.C., 2012.
- ***Srinivasan, R.***, F.M. Council, C. Lyon, F. Gross, N.X. Lefler, and B. Persaud (2008), Evaluation of the Safety Effectiveness of Selected Treatments at Urban Signalized Intersections, *Transportation Research Record: Journal of the Transportation Research Board* 2056, pp. 70-76 (Winner of 2008 D. Grant Mickle Award).
- Thomas, L., ***R. Srinivasan***, L.E. Decina, and L. Staplin (2008). Safety Effects of Automated Speed Enforcement Programs: A Critical Review of International Literature, *Transportation Research Record: Journal of the Transportation Research Board* 2078, pp. 117-126.