



Safety, Security, and Reliability of Autonomous Vehicle Software

W. Eric Wong, University of Texas at Dallas

Zijiang Yang, Xi'an Jiaotong University

Digital Object Identifier 10.1109/MC.2021.3084655
Date of current version: 30 July 2021

This special issue is focused on the safety, security, and reliability of autonomous vehicle software. Among all of the submissions, five articles were accepted covering different topics of the scope.

Autonomous vehicles are becoming ubiquitous and are having a greater impact on our everyday life. A dependable and reliable autonomous driving system that will not only reduce the number of accidents but also minimize driving-related human stress is in demand. However, recent fatal accidents due to the application of immature and unreliable autonomous vehicle software have undermined our trust in these systems. In response, this theme issue solicits original work that makes important contributions to ensure the safety, security, and reliability of autonomous vehicle software.

Below is a summary of the six articles accepted for this issue.

The first article is “Safety, Complexity, and Automated Driving: Holistic Perspectives on Safety Assurance” by Simon Burton, John McDermid, Philip Garnet, and Rob Weaver. The authors propose a framework to identify, analyze, and manage factors that impact the safety of complex automated driving systems.

The second article, “Blockchain-Based Continuous Auditing for Dynamic Data Sharing in Autonomous Vehicular Networks,” emphasizes that cloud servers have made it possible to share massive data between autonomous vehicles to improve the driving experience and service quality. Data security is an important issue that needs to be addressed. The authors are Haiyang Yu, Shuai Ma, Qi Hu, and Zhen Yang.

The third article, by Sachin Motwani, Tarun Sharma, and Anubha Gupta, is “Ethics in Autonomous Vehicle Software: The Dilemmas.” The ethical dilemma is a major challenge faced by the automobile industry while designing safe, secure, and reliable software for autonomous vehicles. The article presents some novel solutions to this problem.

ABOUT THE AUTHORS

W. ERIC WONG is a professor and the founding director of the Advanced Research Center for Software Testing and Quality Assurance in Computer Science at The University of Texas at Dallas, Richardson, Texas, 75080, USA. His research interests include software testing, debugging, risk analysis/metrics, safety, and reliability. Wong received a Ph.D. in computer science from Purdue University. Contact him at ewong@utdallas.edu.

ZIJIANG YANG is a professor at Xi'an Jiaotong University, Xi'an, Shaanxi, 710049, China. His research focuses on developing formal method-based tools to support the debugging, analysis, and verification of complex systems. Yang received a Ph.D. from the University of Pennsylvania. Contact him at zijiang@gmail.com.

The fourth article, “An Online Multistep-Forward Voltage-Prediction Approach Based on an LSTM-TD Model KF Algorithm,” is authored by Ye Ni, Zhilong Xia, Chunrong Fang, and Zhenyu Chen, and Fangtong Zhao. Since the existing approaches often take too much time to predict the remaining voltage for battery management in electronic vehicles, a multistep-forward approach combining a long short-term memory time distributed model and a Kalman filter algorithm is recommended for time-efficient voltage prediction.

The title of the fifth article is “Toward Improving Confidence in Autonomous Vehicle Software: A Study on Traffic Sign Recognition Systems,” with Koorosh Aslansefat, Sohag Kabir, Amr Abdullatif, Vinod Vasudevan Nair, and Yiannis Papadopoulos as the authors. It reviews the issue of distributional shift and its implications for the safety of learning-based classification tasks in autonomous vehicle software. SafeML II (an extension of SafeML) using a bootstrap-based p -value calculation

is presented to improve the empirical cumulative distribution function-based statistical distance measure.

The last article, by Jack Toohey, M S Raunak, and Dave Binkley, is “From Neuron Coverage to Steering Angle: Testing Autonomous Vehicles Effectively.” The authors explore the use of image transformation to create new test images and how these images impact the neuron coverage achieved by a deep neural network-based system for autonomous vehicle operations.

We would like to thank the authors of the six articles in this issue for sharing their knowledge and experiences on how to improve the safety, security, and reliability of autonomous vehicle software. We also thank all of the reviewers for helping us evaluate the articles and selecting those of high quality to be included in this theme issue. Special appreciation also goes to Dr. Jeffrey Voas, editor in chief of *Computer*, and IEEE staff members for their support during the preparation of this issue. 