

**Unsettled Topics
Concerning Automated
Driving Systems and the
Development Ecosystem**

Dr. Rahul Razdan

Unsettled Topics Concerning Automated Driving Systems and the Development Ecosystem

Dr. Rahul Razdan

Advanced Mobility Institute, Florida Polytechnic University

EDGE DEVELOPMENT TEAM

William Mahoney, *Research Applications
Laboratory at National Center for
Atmospheric Research*

Eshel Haritan, *Synopsys, Inc.*

Apurva Kalia,
Cadence Design Systems, Inc.

Jamie Smith, *National Instruments*

Tony Zarola, *Analog Devices, Inc.*

M. Ilhan Akbas,
Embry-Riddle Aeronautical University

Joachim Taiber, *International Transportation
Innovation Center and International Alliance
for Mobility Testing and Standardization*

Edward Straub, *SAE International*

Raivo Sell,
Tallinn University of Technology, Estonia





About the Publisher

SAE International® is a global association of more than 128,000 engineers and related technical experts in the aerospace, automotive, and commercial-vehicle industries. Our core competencies are lifelong learning and voluntary consensus standards development. Visit sae.org

SAE EDGE™ Research Report Disclaimer

SAE EDGE™ Research Reports focus on topics that are dynamic, in which knowledge is incomplete, and which have yet to be standardized. They represent the collective wisdom of a group of experts and serve as a practical guide to the reader in understanding unsettled subject matter. They are not meant to provide a recommended practice or protocol. The experts have assembled as a community of practitioners to contribute and collectivize their thoughts and points of view; these are not the positions of the institutions or businesses with which they are affiliated nor one contributor's perspective advanced over other contributors. SAE EDGE™ Research Reports are the property of SAE International and SAE alone is responsible for their content.

About This Publication

SAE EDGE™ Research Reports provide state-of-the-art and state-of-the-industry examinations of the most significant topics in mobility engineering. SAE EDGE™ contributors are experts from research, academia, and industry, who have come together to explore and define the most critical advancements, challenges, and future direction in areas such as vehicle automation, unmanned aircraft, cyber security, advanced propulsion, advanced manufacturing, Internet of Things, and connectivity.

Related Resources

SAE MOBILUS® Automated & Connected Knowledge Hub
<https://saemobilus.sae.org/automated-connected>

SAE Team

Frank Menchaca, Chief Product Officer
Michael Thompson, Director, Standards, Information, and Research Publications
Monica Moghira, Acquisitions Director
Beth Ellen Nebeler, Product Manager
William Jancinski, Managing Technical Editor

Copyright © 2020 SAE International. All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, distributed, or transmitted, in any form or by any means without the prior written permission of SAE International. For permission and licensing requests, contact SAE Permissions, 400 Commonwealth Drive, Warrendale, PA 15096-0001 USA; e-mail: copyright@sae.org; phone: +1-724-772-4028; fax: +1-724-772-9765.

Printed in USA

Information contained in this work has been obtained by SAE International from sources believed to be reliable. However, neither SAE International nor its authors guarantee the accuracy or completeness of any information published herein and neither SAE International nor its authors shall be responsible for any errors, omissions, or damages arising out of use of this information. This work is published with the understanding that SAE International and its authors are supplying information but are not attempting to render engineering or other professional services. If such services are required, the assistance of an appropriate professional should be sought.

EPR2020004

ISSN 2640-3536

e-ISSN 2640-3544

ISBN 978-1-4606-0100-6

To purchase bulk quantities, please contact: SAE Customer Service

E-mail: CustomerService@sae.org

Phone: 877-606-7323 (inside USA and Canada)

+1-724-776-4970 (outside USA)

Fax: +1-724-776-0790

<https://www.sae.org/publications/edge-research-reports>

About the Editor



Dr. Rahul Razdan is Senior Director of Special Projects at Florida Polytechnic University in Lakeland, Florida. In this role, he serves as advisor to the president of the university and helps to manage the Advanced Mobility Institute, an applied research center for the development and testing of autonomous vehicle (AV)-related technology. Named on more than 24 issued patents, Razdan earned a Doctorate (PhD) in Computer Science from Harvard University and both a Master of Science in Computer Engineering and a Bachelor of Science in Electrical and Computer Engineering from Carnegie Mellon University.

Razdan boasts 35 years of experience in startups, academia, and Fortune 500 companies working in such areas as science, technology, engineering, and mathematics education; AV technology; and semiconductor design. The Association for Computing Machinery and the Institute of Electrical and Electronics Engineers have recognized him with “Hall of Fame” induction. Razdan has also won numerous best-paper awards and has led several successful startups in areas such as electronic design automation (EDA), wireless power, artificial intelligence (AI), and machine learning.

contents

About the Editor

Unsettled Topics Concerning Automated Driving Systems and the Development Ecosystem.

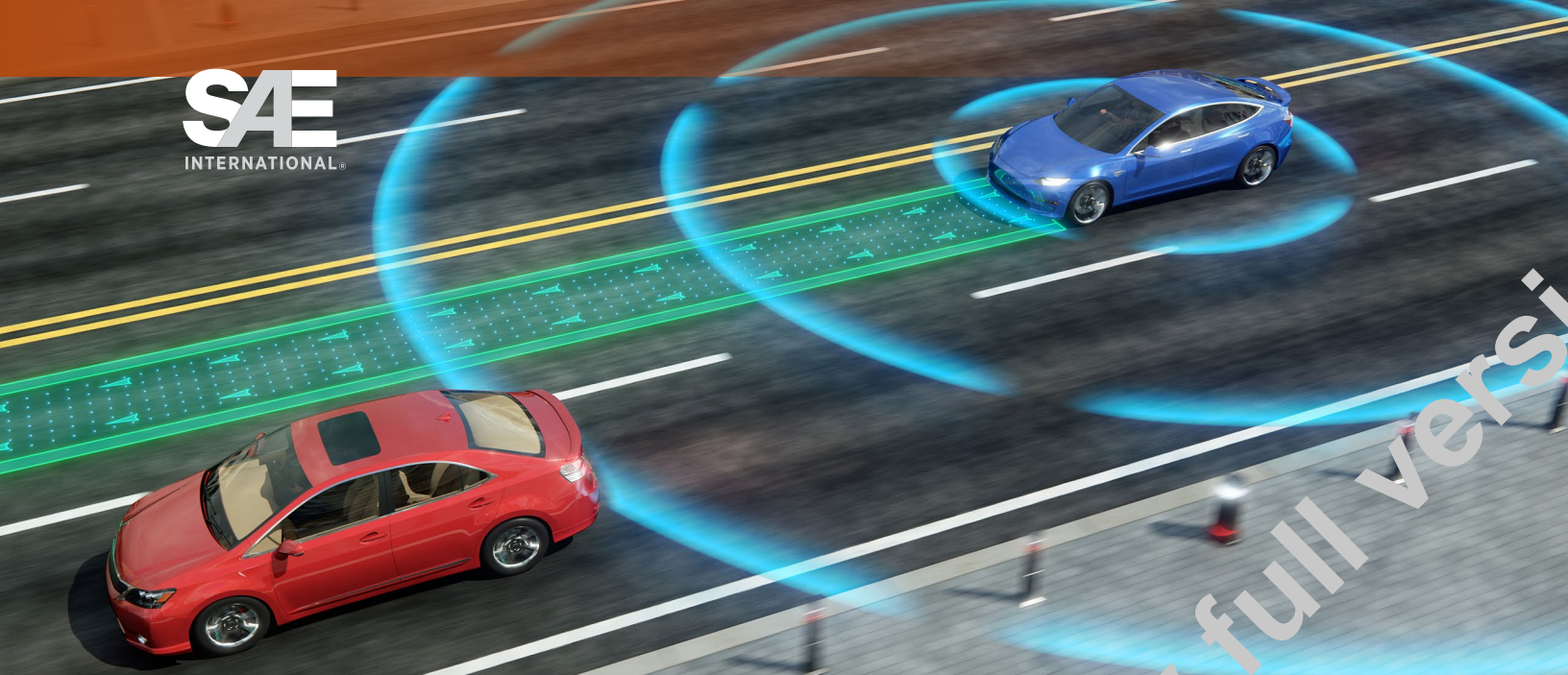
Introduction	4
<i>Unsettled Topics Concerning Automated Driving Systems and the Development Ecosystem</i>	6
Infrastructure	7
<i>Recommendations</i>	8
Electronics Supply Chain	8
<i>Recommendations</i>	9
V&V Tools	10
<i>Recommendations</i>	11
Test and Measurement	11
Summary	13
<i>SAE EDGE™ Research Reports</i>	13
<i>Next Steps for Automated Driving Systems and the Development Ecosystem</i>	13
<i>Recommendations</i>	13

Appendix A: Bridging the V&V Worlds of Automotive and Digital.

<i>Continuous Systems</i>	14
<i>Analyzable Digital Systems</i>	15
<i>Non-Analyzable Digital Systems</i>	16
<i>Scaled Shadow-Mode Driving for V&V</i>	16
<i>Scenario Databases and Model-Centric Testability Optimization</i>	16

Appendix B: Long Lifecycle Products (Semiconductor and Automotive Industry).

<i>Evolvability</i>	18
<i>Reliability</i>	18
<i>Supply Chain Integrity</i>	18
<i>Impact on the Automotive Marketplace</i>	18
<i>Development</i>	18
<i>Acknowledgments</i>	19
<i>References</i>	20
<i>Contact Information</i>	20



Unsettled Topics Concerning Automated Driving Systems and the Development Ecosystem

Abstract

With over 100 years of operation, the current automotive industry has settled into an equilibrium with the development of methodologies, regulations, and processes for improving safety. In addition, a nearly \$2 trillion market operates in the automotive ecosystem with connections into fields ranging from insurance to advertising. Enabling this ecosystem is a well-honed, tested supply chain and an established development environment.

Autonomous vehicle (AV) technology is a leap forward for the existing automotive industry; now the automobile is expected to manage perception and decision-making tasks. The safety technologies associated with these tasks were presented in an earlier SAE EDGE™ Research Report, “Unsettled Technology Areas in Autonomous Vehicle Test and Validation.” In a later SAE Edge Research Report, “Unsettled Topics Concerning Automated Driving Systems and the Transportation Ecosystem,” senior executives from the automotive ecosystem explored the impact of AV technology as they faced the prospect of this disruptive technology entering their marketplace. Interestingly, stable use-models and market penetration were all gated primarily by the confirmation of AV safety. Building on these previous verification and validation (V&V)-related reports, “Unsettled Topics Concerning Automated Driving Systems and the Development Ecosystem” explores the open issues in the shift of the development and supplier environment toward a new AV-enabled future.

NOTE: SAE EDGE™ Research Reports are intended to identify and illuminate key issues in emerging, but still unsettled, technologies of interest to the mobility industry. The goal of SAE EDGE™ Research Reports is to stimulate discussion and work in the hope of promoting and speeding resolution of identified issues. SAE EDGE™ Research Reports are not intended to resolve the challenges they identify or close any topic to further scrutiny.

DR. RAHUL RAZDAN

*Advanced Mobility Institute,
Florida Polytechnic University*

Edge Development Team

William Mahoney, *Research Applications*

*Laboratory at National Center for
Atmospheric Research*

Eshel Haritan, *Synopsys, Inc.*

Apurva Kalia,

Cadence Design Systems, Inc.

Jamie Smith, *National Instruments*

Tony Zarola, *Analog Devices, Inc.*

M. Ilhan Akbas,

Embry-Riddle Aeronautical University

Joachim Taiber,

International Transportation Innovation

Center and International Alliance for

Mobility Testing and Standardization

Edward Straub, *SAE International*

Raivo Sell,

Tallinn University of Technology, Estonia

ISSN 2640-3536