2022 International Conference on Connected Vehicle and Expo (ICCVE 2022)

Lakeland, Florida, USA 7 – 9 March 2022



IEEE Catalog Number: CFP22CVE-POD **ISBN:**

978-1-6654-1688-7

Copyright © 2022 by the Institute of Electrical and Electronics Engineers, Inc. All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

*** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

IEEE Catalog Number: ISBN (Print-On-Demand): ISBN (Online): ISSN: CFP22CVE-POD 978-1-6654-1688-7 978-1-6654-1687-0 2378-1289

Additional Copies of This Publication Are Available From:

Curran Associates, Inc 57 Morehouse Lane Red Hook, NY 12571 USA Phone: (845) 758-0400 Fax: (845) 758-2633 E-mail: curran@proceedings.com Web: www.proceedings.com



10:15 - 11:55 **ADAS/AV System Development/Cybersecurity** Session Chair: Jae Lee (Toyota) Room: 1067

Transnational Testing, Operation and Certification of Automated Driving Systems: Perspective from testEPS and Central System Eureka Projects...1

Jakob Reckenzaun (Virtual Vehicle Research GmbH) Luca Csanady (Almotive kft.) Arno Eichberger (Graz University of Technology, Institute of Automotive Engineering) Alexandre Engelstein (Almotive kft.) Leander Hörmann (Linz Center of Mechatronics) Tamas Kiss (Magyar Telekom) Patrick Luley (JOANNEUM RESEARCH Forschungsgesellschaft mbH) Matthias Rüther (JOANNEUM RESEARCH Forschungsgesellschaft mbH) Stefan Schwarz (Bernard Technologies GmbH) Selim Solmaz (Virtual Vehicle Research GmbH) Thomas Strasser-Krauss (TOM Robotics GmbH) Gabor Soos (Magyar Telekom) Viktor Tihanyi (BME Automated Drive) Attila Turoczi (AVL Hungary Kft.) Patrick Weissensteiner (Virtual Vehicle Research GmbH) Jinwei Zhou (Kontrol GmbH)

Vehicle-in-the-Loop Testing – a Comparative Study for Efficient Validation of ADAS/AD Functions...7

Christian Schyr (AVL Deutschland GmbH) Hideo Inoue (Kanagawa Institute of Technology) Yuji Nakaoka (AVL Japan K.K.)

Eagle Strategy with Local Search for Scenario Based Validation of Autonomous Vehicles...15

Quentin Goss (Embry-Riddle Aeronautical University) Mustafa Ilhan Akbaş (Embry-Riddle Aeronautical University)

Toward Prioritization of Test Infrastructure Investments for Proving Grounds to Test CAVs...21 Nils Katzorke (Mercedes-Benz AG)

Using RTK-Based Automated Vehicles to Pre-Mark Temporary Road Marking Patterns for Test Maneuvers of Automated Vehicles...23 Nils Katzorke (Prague University of Economics and Business) 10:15 - 11:55 **Cybersecurity** Session Chair: Klaus Schaaf (DLR) Room: 1068

Context-Aware Vehicle and Fleet Security Combining a Knowledge Graph and an Object-Oriented Model...28

Daniel Grimm (Karlsruhe Institute of Technology) Eric Sax (Karlsruhe Institute of Technology)

Supporting Confidentiality and Integrity on V2V Communications...36

Elaine Alves Da Rocha Pires (Federal University of Paraná) Ivan Luiz Pedroso Pires (University of Mato Grosso State) Luiz Carlos Pessoa Albini (Federal University of Paraná)

A Generative Adversarial Approach for Sybil Attacks Recognition for Vehicular Crowdsensing...42

Luis Jaimes (Florida Polytechnic University) Juan Calderon (Universidad Santo Tomas) Scott Shriver (Florida Polytechnic University) Antonio Hendricks (Florida Polytechnic University) Javier Lozada (Florida Polytechnic University) Sivasundaram Seenith (Bethune Cookman University) Harish Chintakunta (Florida Polytechnic University) 14:35 - 16:15 **Vehicles Sensors** Session Chair: Michael Woon (Retrospect) Room: 1067

Comparing a Linear Filter with a ML-Based Approach for Modeling Perception Errors of Automated Vehicles...49

Martin Sigl (BMW AG) Andreas Lebherz (Graz University of Technology) Christoph Schütz (BMW AG) Sebastian Wagner (BMW AG) Daniel Watzenig (Institute of Automation and Control at Graz University of Technology)

RainbowTag: a Fiducial Marker System with a New Color Segmentation Algorithm...56 Laszlo Egri (Concordia) Hamid Nabati (Concordia) Jia Yuan Yu (Concordia)

Integer Time Series Compression for Holistic Data Analytics in the Context of Vehicle Sensor Data...62

Christopher Vox (Volkswagen AG) David Broneske (German Centre for Higher Education Research and Science Studies) Jan Piewek (Volkswagen AG) Andreas Udo Sass (Volkswagen AG) Gunter Saake (Otto-von-Guericke-Universität Magdeburg)

Dynamic Update of Stand-Alone Lidar Model Based on Ray Tracing Using the Nvidia Optix Engine...69

Relindis Rott (Virtual Vehicle Research GmbH)

Use of Deep Learning Methods for People Counting in Public Transport...75

Daniel Baumann (Karlsruhe Institute of Technology) Martin Sommer (Karlsruhe Institute of Technology) Yannick Schrempp (Karlsruhe Institute of Technology) Eric Sax (Karlsruhe Institute of Technology)

Open Source Software for Teleoperated Driving...81

Andreas Schimpe (Institute of Automotive Technology (FTM) at Technical University of Munich (TUM)) Johannes Feiler (Institute of Automotive Technology (FTM) at Technical University of Munich (TUM)) Simon Hoffmann (Institute of Automotive Technology (FTM) at Technical University of Munich (TUM)) Domagoj Majstorović (Institute of Automotive Technology (FTM) at Technical University of Munich (TUM)) Frank Diermeyer (Institute of Automotive Technology (FTM) at Technical University of Munich (TUM))

Safe Corridor: a Trajectory-Based Safety Concept for Teleoperated Road Vehicles...87 Simon Hoffmann (Technical University of Munich) Domagoj Majstorović (Technical University of Munich) Frank Diermeyer (Technical University of Munich)

Development, Verification and KPI Analysis of Infrastructure-Assisted Trajectory Planners...93

Martin Rudigier (Virtual Vehicle Research GmbH) Selim Solmaz (Virtual Vehicle Research GmbH) Georg Nestlinger (Virtual Vehicle Research GmbH) Kailin Tong (Virtual Vehicle Research GmbH)

A Comparison of Architecture Paradigms for Dynamic Reconfigurable Automotive Networks...99

Marc Schindewolf (Karlsruhe Institute of Technology) Hannes Stoll (Karlsruhe Institute of Technology) Houssem Guissouma (Karlsruhe Institute of Technology) Andreas Puder (Karlsruhe Institute of Technology) Andreas Vetter (Mercedes-Benz AG) Marcel Rumez (Karlsruhe University of Applied Sciences) Jacqueline Henle (FZI Research Center for Information Technology) Eric Sax (Karlsruhe Institute of Technology)

Development of a self-Learning Automotive Comfort function: an Adaptive Gesture Control with few-shot-Learning...106

Marco Stang (Karlsruher Institut für Technologie (KIT)) Simon Stock (Karlsruher Institut für Technologie (KIT)) Simon Müller (Karlsruher Institut für Technologie (KIT)) Eric Sax (Karlsruher Institut für Technologie (KIT)) Wilhelm Stork (Karlsruher Institut für Technologie (KIT))

10:30 - 11:50 **Cooperative Driving** Session Chair: David Merritt (Transtec) Room: 1067

Characterizing Minimum Admissible Separation Distances in Heavy Duty Vehicle Platoons...114

Vivek Sujan (Oak Ridge National Laboratory) P.T. Jones (Oak Ridge National Laboratory) Adam Siekmann (Oak Ridge National Laboratory)

Heavy Duty Commercial Vehicle Platooning Benefits for Conventional and Electrified Powertrains...120

Vivek Sujan (Oak Ridge National Laboratory) P.T. Jones (Oak Ridge National Laboratory) Adam Siekmann (Oak Ridge National Laboratory)

Application of Nonlinear Control for Hard Truck Platooning...126

David Franklin (Southwest Research Institute) Michiel Ashley (Texas A&M University) Swaminathan Gopalswamy (Texas A&M University)

Three Connected V2V Applications Based on DSRC Basic Safety Messages...132

Omkar Dokur (University of South Florida) Srinivas Katkoori (University of South Florida)

10:30 - 11:50 **Traffic Data Management/Autonomous Vehicle Operations** Session Chair: Thomas Guntschnig (AVL) Room: 1068

A Framework for the Determination of Realistic Usage Profiles for Automated Shuttle Pods...138

Stephanie Grubmüller (Virtual Vehicle Research GmbH) Pamela Innerwinkler (Virtual Vehicle Research GmbH)

Integration of Unmanned Aerial Vehicles and LTE: A Scenario-Dependent Analysis...144

Mumin Ozpolat (Cranfield University) Saba Al-Rubaye (Cranfield University) Alex Williamson (Cranfield University) Antonios Tsourdos (Cranfield University)

Improving Sensing Coverage in Vehicular Crowdsensing Using Location Diversity...150 Harish Chintakunta (Florida Polytechnic University) Xin Wang (Florida Polytechnic University) Luis Jaimes (Florida Polytechnic University)

Perspective-Corrected Extraction of Trajectories from Urban Traffic Camera Using CNN...156

Julian Strosahl (Elektronische Fahrwerksysteme GmbH) Joerg Sichermann (Elektronische Fahrwerksysteme GmbH) Maximilian Jesch (Elektronische Fahrwerksysteme GmbH) David Spieler (University of Applied Sciences Munich) 14:30 - 15:50 **Vehicle Safety** Session Chair: Ronnie Chowdhury (Clemson University) Room: 1067

Spatio-Temporal Clustering of Road Obstacles...163

Julian Kreibich (Technical University of Munich) Mario Kuppel (Technical University of Munich)

Automated Vehicle Safety and Deployment: Lessons from Human Crashes...171

Akhil Shetty (University of California Berkeley) Hamidreza Tavafoghi (Google) Alex Kurzhanskiy (University of California Berkeley) Kameshwar Poolla (University of California Berkeley) Pravin Varaiya (University of California Berkeley)

A Grid-Based Surrogate Safety Measure for Traffic Safety Assessment...177

Enrico Del Re (Johannes Kepler University Linz) Pavlo Tkachenko (Johannes Kepler University Linz)

Safety Toolkit for Automated Vehicle Shuttle - Practical Implementation of Digital Twin...183

Raivo Sell (Tallinn University of Technology) Ehsan Malayjerdi (Tallinn University of Technology) Mohsen Malayjerdi (Tallinn University of Technology) Baris Cem Baykara (Tallinn University of Technology)

14:30 - 15:50 **Sustainable Mobility** *Session Chair: Jan Cantryn (IEEE SA) Room: 1068*

A Reliable and Simple Method to Estimate the Electric-Vehicle Battery State-of-Health...189

Vanessa Quintero (Universidad Tecnológica de Panamá) Claudio Estevez (Universidad de Chile) Marcos Orchard (Universidad de Chile) Aramis Pérez (University of Costa Rica) Jia Yuan Yu (Concordia University) Xiang Yu (Nanchang Institute of Technology)

EV Ensembles for QoS Based Mitigation of Renewable Production Risk...195

Stephen Allen (Statkraft Markets) Robert Shorten (Imperial College London)

A Non-Invasive tyre-Emission Mitigation Strategy for Vehicles with Over-Actuated Traction Control...203 Robert Shorten (ICL)

A Robust Approach for Inter-Turn Fault Detection of PMSM Used for Autonomous Vehicles...205

Maliheh Hashemi (Graz University of Technology Dept) Mohammad Ali Golkani (Graz University of Technology Dept) Daniel Watzenig (Graz University of Technology Dept)