Autonomous Vehicles and V2V/V2I Communications SET

Edited by Ronald K. Jurgen
Self-driving cars are no longer in the realm of science fiction, thanks to the integration of numerous automotive technologies that have matured over many years. Technologies such as adaptive cruise control, forward collision warning, lane departure warning, and V2V/V2I communications are being merged into one complex system.

The papers in this compendium were carefully selected to bring the reader up to date on successful demonstrations of autonomous vehicles, ongoing projects, and what the future may hold for this technology. It is divided into three sections: overview, major design and test collaborations, and a sampling of autonomous vehicle research projects.

This book will be of interest to a wide range of readers: engineers at automakers and electronic component suppliers; software engineers; computer systems analysts and architects; academics and researchers within the electronics, computing, and automotive industries; legislators, managers, and other decision-makers in the government highway sector; traffic safety professionals; and insurance and legal practitioners.

About the editor

After graduating from Rensselaer Polytechnic Institute with a BEE, Ronald K. Jurgen held various technical magazine editorial staff positions, including 30 years with IEEE Spectrum. Now retired, he is the editor of the Automotive Electronics Handbook and the Digital Consumer Electronics Handbook, and assistant editor of the Electronics Engineers’ Handbook, Fourth Edition. He is also the editor of more than a dozen SAE International books on automotive electronics.
# Table of Contents

## Introduction ................................................................. 1

## Overview: ................................................................. 3

  Autonomous Driving – A Practical Roadmap (2010-01-2335)
  Jeffrey D. Rupp and Anthony G. King ................................. 5

## Major Design and Test Collaborations: ................................. 27

  Arturo Dávila and Mario Nombela ..................................... 29

  Ohio State University Experiences at the DARPA Challenges (2008-01-2718)
  Keith A. Redmill, Umit Ozguner, Scott Biddlestone, Alex Hsieh, and John Martin .............. 35

  Low-Cost Autonomous Vehicles for Urban Environments (2008-01-2717)
  Mahesh K. Chengalva, Richard Bletsis, and Bernard P. Moss ........................................ 43

  Farid Ahmed-Zaid, Hariharan Krishnan, Michael Maile, Lorenzo Caminiti, Sue Bai, and Steve VanSickle ......................................................... 55

## A Sampling of Autonomous Vehicle Research Projects: ............... 73

  Distributed System Architecture of Autonomous Vehicles and Real-Time Path Planning Based on the Curvilinear Coordinate System (2012-01-0740)
  Keonyup Chu, Junsoo Kim, and Myoungho Sunwoo ......................................................... 75

  Development of a Semi-Autonomous System for Testing with Somnolent Drivers (2011-01-0589)
  Jaime Lopez, Jose Manuel Barrios, and Mario Nombela ................................................. 83

  Rachana Ashok Gupta, Wesley Snyder, and W. Shepherd Pitts ......................................... 89

  An Autonomous and Car-Following System via DSRC Communication (2012-01-0741)
  Chan Wei Hsu, Ming Kuan KO, Min Huai Shih, and Shih Chieh Huang ................................ 99

  Integrated Controller Design for Path Following in Autonomous Vehicles (2011-01-1032)
  Behrooz Mashadi, Pouyan Ahmadizadeh, and Majid Majidi ........................................... 109

  Autonomous Vehicle Control in Urban Environment by Map-Based Driving Lane Detection (2011-28-0035)
  Takanori Yoshizawa, Pongsathorn Raksincharoensak, and Masao Nagai ............................ 119

  Navigation Control in an Urban Autonomous Ground Vehicle (2011-01-1037)
  Bapiraju Surampudi and Joe Steiber .............................................................................. 125

## About the Editor ............................................................... 131
V2V/V2I Communications for Improved Road Safety and Efficiency

Edited by Ronald K. Jurgen
Table of Contents

Introduction

New Driver Accident Avoidance Aids Are on the Way. ........................................ 3
Ronald K. Jurgen, Editor

Overviews

On the Cusp of Connected Cars ................................................................. 7
Steven Ashley

BMW Demonstrates Left-Turn Drivers’ Aid .............................................. 11
Steven Ashley

Safer Cars Talk to Each Other ................................................................. 13
Steven Ashley

V2V, GPS Integration Could Improve Safety ............................................ 15
Terry Costlow

Debating IntelliDrive’s Future ................................................................. 17
Terry Costlow

V2V and V2I Technical Papers

An Autonomous and Car-Following System
via DSRC Communication (2012-01-0741) .............................................. 21
Chan Wei Hsu, Ming Kuan KO, Min Huai shih, and Shih Chieh Huang

DSRC Performance Comparison with and without Antenna
Diversity Using Different Transmission Power (2012-01-0491) ................. 31
Sue Bai and Radovan Miucic

Reliability and Safety/Integrity Analysis for
Vehicle-to-Vehicle Wireless Communication (2011-01-1045) .................. 43
Arkadeb Ghosal, Fan Bai, Rami Debouk, and Haibo Zeng

Multi-Sensor System for Vehicle Positioning in
Dense Urban Areas (2011-01-1035) ...................................................... 53
Zeljko Popovic, Andrey Soloviev, and Yutaka Mochizuki

Vehicle Safety Communications – Applications: Multiple
On-Board Equipment Testing (2011-01-0586) ........................................ 79
Farid Ahmed-Zaid, Harisharan Krishnan, Michael Maile, Lorenzo Caminiti,
Sue Bai, Joseph Stinnett, Steve VanSickle, and Drew Cunningham

Understanding Driver Perceptions of a Vehicle to Vehicle (V2V)
Communication System Using a Test Track Demonstration (2011-01-0577) . 95
Christopher Edwards, Jon Hankey, Raymond Kiefer, Donald Grimm, and Nina Leask