

Foreword

Huaqun Guo has introduced the emerging areas of vehicular networks in the forms of Intra-Vehicle, Vehicle-to-Vehicle, and Vehicle-to-Infrastructure communications and edited this new book to reflect the advance information technologies that shape the modern automobiles. These new technologies on automotive informatics and communicative systems will enable a variety of applications for safety, traffic efficiency, driver assistance, as well as infotainment to be incorporated into modern automobile designs.

Over the last century, the design, manufacture and operation of the automobile have grown into complex system integration paradigms cutting across applications of traditional disciplines in physical sciences, engineering, social and behavioral sciences and business. Today, this complexity is compounded and accelerated by the advent of enabling technologies in advanced materials, sensing, actuation, computing, controls, diagnostics, electronics and software, all amid myriad – and often conflicting – policy changes. This creates new possibilities and challenges in simultaneously providing effective means of transportation - with a high degree of driver and occupant safety - along with reduced energy use and environmental impact.

Informatics, telematics, electronics and communication systems play an ever increasing role in the advancement of the automobile and are critical from a number of perspectives. The advances that are most easily noticed by a consumer are vehicle options such as infotainment systems, navigation systems, and connectivity such as Bluetooth. However, other onboard systems such as active stability control, engine control, and the several supporting in-vehicle communication networks and protocols are the real technologies that are propelling the automobile into the 21st Century. Such systems are key elements in achieving the desired operational characteristics of the vehicle such as performance, emissions, safety and fuel efficiency. To achieve these ever more stringent desired characteristics in a cost effective manner, the amount of information and processing that occurs on a typical vehicle is staggering. Most vehicles today have well over 50 processors on board, and the number continues to grow. Indeed, electronics can account for over 40% of the vehicle's cost and this percentage will continue to grow.

Onboard systems are only part of the explosion of automotive informatics and commutations. Infrastructure -to-vehicle and vehicle-to-vehicle communicants are enabling a host of new frontiers related to safety, traffic control and maintenance. Onboard navigation systems can now route an individual vehicle through significant traffic jams or disruptions. However, in the near future, coordinated efforts between the traffic infrastructure and multiple vehicles may distribute the traffic load to minimize congestion or the effects of construction or a traffic accident. Furthermore, information from adjacent vehicles may be used to avoid collisions. For example, vehicles that are rapidly decelerating on a highway might warn subsequent cars of an impending “stopped traffic hazard.” From a maintenance perspective, connectivity has already enabled the vehicle to communicate its health status and potential failures to service personnel. Such information is not only critical to keep a vehicle functioning properly, but also enables fleet manufacturers to track potential problems, and address them as rapidly as possible. Furthermore, this information can easily and rapidly be utilized in improving next generation vehicles.

For both onboard systems and supporting infrastructure systems, the acceleration of technological change is driving vehicle designers, manufacturers and consumers to rethink how the automobile is developed from conceptualization to production to service to end of life. The rapidly changing electronics and informatics sector has pushed vehicle system design and integration to a new level of agility. The consumer desires state-of-the-art capabilities, and automobile producers no longer have several years to incorporate the latest technology into their products. This is fostering a change in the way vehicles are designed and perceived. Indeed, if one looks at the automobile, it is changing rapidly and the pace of change is ever increasing. The car of today is vastly different from its predecessors of 30 or 40 years ago, and next generation vehicles will continue to change dramatically driven by multiple issues of which many are related to informatics and communication systems.

This book has provided fundamental principles, as well as practice, and new research/trend for vehicular networks and advanced information technologies applied in the automotive area. First, this book presents the impact of drive-by-wire systems on vehicle safety and performance, and electromagnetic compatibility issues affecting automotive communications. It then introduces Intra-vehicle networks like LIN (Local Interconnect Network), CAN (Controller Area Network), MOST (Media-Oriented Systems Transport), Flexray, power-line communication, and so forth. It also describes in-vehicle network architecture for the next-generation vehicles and elaborates the potential applications and related technical challenges in achieving secure remote monitoring and control of vehicles via CAN.

Second, this book presents the technologies related to Vehicle-to-Vehicle, and Vehicle-to-Infrastructure communications by describing the current medium access control (MAC) and routing protocols for vehicular networks, and the role of communications in cyber-physical vehicle applications. Furthermore, it incorporates the characteristics of traffic flow into the interference issue in the communication layer of VANETs (Vehicular Ad Hoc Networks), and presents new research into proactive traffic merging algorithms and the potential benefits of applying sensor-enabled cars. The book has also captured the state-of-the-art in the area of traffic control with the assistance of VANETs, and reviewed the problem of estimating in real-time the position of a vehicle for use in land navigation system.

Last but not least, privacy, security and reliability as key requirements in deploying VANETs are addressed, as well as simulation architectures and simulation tools implementation methods with the aim to improve the traffic safety and control. Through all chapters, this book has discussed the future trends for the automotive informatics and communicative systems in each individual domain.

I highly recommend Dr. Guo's timely book. I believe it will benefit many readers and be a good reference.

Thomas R. Kurfess

International Center for Automotive Research, Clemson University, USA

Thomas R. Kurfess received his SB, SM and PhD degrees in mechanical engineering from M.I.T. in 1986, 1987 and 1989, respectively. He also received an SM degree from MIT in electrical engineering and computer science in 1988. Following graduation, he joined Carnegie Mellon University where he rose to the rank of associate professor. In 1994 he moved to the Georgia Institute of Technology where he rose to the rank of Professor in the George W. Woodruff School of Mechanical Engineering. In 2005 he was named Professor and BMW Chair of Manufacturing in the Department of Mechanical Engineering at Clemson University. He is also the Director of the Campbell Graduate Engineering Center at Clemson University's International Center for Automotive Research. He has served as a special consultant of the United Nations to the Government of Malaysia in the area of applied mechatronics and manufacturing, and as a participating guest at the Lawrence Livermore National Laboratory in their Precision Engineering Program. His research focuses on the design and development of advanced systems targeting the automotive sector (OEM and supplier) including vehicle and production systems. He has significant experience in high precision manufacturing and metrology systems. He has received numerous awards including a National Science Foundation (NSF) Young Investigator Award, an NSF Presidential Faculty Fellowship Award, the ASME Pi Tau Sigma Award, SME Young Manufacturing Engineer of the Year Award, the ASME Blackall Machine Tool and Gage Award, the ASME Gustus L. Larson Award. He is a Fellow of the SME and of the ASME.