

Preface

In June 2009, the *fourth Biennial Workshop on DSP (Digital Signal Processing) for In-Vehicle Systems and Safety* took place in Dallas, Texas, USA. The workshop was organized and hosted by the Center for Robust Speech Systems (CRSS): Speech/ Speaker Modeling and UTDrive In-Vehicle Groups from The University of Texas at Dallas (UTDallas). This workshop follows a series of workshops organized first in 2003 (Nagoya, Japan), 2005 (Sesimbra, Portugal), and 2007 (Istanbul, Turkey). World-class experts from a diverse series of branches encompassing in-vehicle signal processing participated and shared cutting edge studies on road safety, in-vehicle technologies, and demos of state-of-art systems.

This workshop at UTDallas was broader in scope, with contributions from various realms such as: signal processing, control engineering, multi-modal audio-video processing, bio-mechanics, human factors, and transportation engineering which opened doors for fruitful discussions and information exchange in an exciting interdisciplinary area. The main focus areas were as follows:

- DSP technologies in adaptive automobiles
- Driver status monitoring and distraction/stress detection
- In-vehicle dialogue systems and human machine interfaces
- Challenges in video and audio processing for in-vehicle products
- Multi-sensor fusion for driver ID and robust driver monitoring
- Vehicle to vehicle, vehicle to infrastructure wireless technologies
- Human factors and cognitive science in enhancing safety
- Transportation engineering venues

The workshop included three keynote talks from internationally recognized leaders. Bruce Magladry, Director of the Office of Highway Safety, U.S. National Transportation Safety Board (NTSB), Washington, DC, USA, gave the opening keynote talk entitled “Highway Safety, Where We Are and Where We Are Going.” The second keynote address was from Jon Hankey from VTTI (Virginia Tech. Transportation Institute), Blacksburg, Virginia, USA, with a presentation entitled “Improving Transportation Safety – The Role of Naturalistic Driving Data”. VTTI

has been a leader in this domain with their well-known 100 car study on naturalistic driving. That work has been credited with motivating the SHRP2 Program from the U.S. National Transportation Board which will have +1,500 vehicles recorded continuously for 2 years. The third keynote speech was by Gerhard Schmidt, from SVOX and Darmstadt University, Germany, which focused on “Recent Trends for Improving Automotive Speech Communication Systems.” A panel discussion was also organized which included Bruce Magladry (NTSB, USA), Jon Hankey (VTTI, USA), Gerhard Schmidt (SVOX, Darmstadt Univ., Germany), Hanseok Ko (Korea University, Korea), and Kazuya Takeda (Nagoya University, Japan) and offered opportunities for participants to engage in discussion on future directions for vehicle systems and safety. From this workshop, 21 papers and one additional contribution stemming from the next workshop were selected to make up the 22 chapters within this book. These chapters are grouped into four parts, each addressing key areas within in-vehicle digital signal processing:

Part A: Driver Behavior and Modeling Systems

Part B: In-Vehicle Interactive/Speech Systems

Part C: Vehicle Dynamics, Vision, Active Safety, and Corpora

Part D: Transportation, Vehicle Communications, and Next Generation Vehicle Systems

First, Part A consists of four chapters that consider driver behavior and modeling. The first chapter considers multi-modal signal processing based on speech, video, and CAN-Bus signals for robust stress detection in urban driving scenarios including multitasking, dialog system conversation, and medium-level cognitive tasks. The second chapter considers a classifier-based approach for assessing the emotion of a driver using speech into three emotions of anger, sadness, and happiness. The third chapter focuses on driving behavior signals stemming from vehicle control units such as gas/brake pedal use, steering wheel, etc. which differ among various driving tasks. Chapter 4 considers a hierarchical mode segmentation of observed driving behavioral data based on multiple levels of abstraction as applied to driving behavioral on an expressway.

The next nine chapters make up Part B of the textbook which focuses on In-Vehicle Interactive Systems. Chapter 5 considers advancements for in-car communication systems, and Chapter 6 focuses on wideband hands-free interaction in the car. Chapters 7 and 8 consider novel ways to start speech dialogs in cars, and cognitive dialog systems for dynamic environments respectively. Next, Chapter 9 considers corpus development for speech and vehicle noise for development of advancements on in-vehicle human-machine interactions. The next two chapters consider improved schemes for speech recognition in car environments, a necessary challenge in order to reduce distraction. The last two chapters in Part B focus on speech enhancement advancements for use in car environments. The next seven chapters make up Part C, which considers vehicle dynamics, vision, and active safety, and corpora. Chapter 14 develops advanced methods to generate reference views of traffic intersections. Chapter 15 considers computer vision systems for context-aware active safety and driver assistance. Chapter 16 investigates an

emerging area for integrating pedestrian detection and depth location with stereo cameras. Another safety area which is considered in Chapter 17 is driver overtaking judgments based on human perceptual for driver-assistant advancement. Driver emotional assessment based on multimedia using video/facial information is considered in Chapter 18. Meanwhile, Chapter 19 looks at modeling lane change trajectories using probabilistic strategies. An alternative scheme for active safety advancement is employing CAN-bus signal analysis based on stochastic models. The last portion of the book is Part D, which considers transportation, vehicle communications, and next generation vehicle systems. The highway driving infrastructure in many countries is expanding and become “smart”, as well as vehicle to vehicle and vehicle to infrastructure communications. Chapter 21 considers multimedia streaming data over inter-vehicle communication networks. The final chapter offers some unique perspectives of next generation intelligent transportation infrastructures. MATISSE is a large-scale multi-agent system for simulating traffic safety scenarios.

As co-editors, we hope this book provides an up-to-date perspective of vehicle-based signal processing, with novel ideas for researchers with a comprehensive set of references for engineers and scientists in the field. We wish to thank all those who participated in the 2009 workshop. We wish to acknowledge support from a number of groups, in particular NEDO in Japan, funding agencies both from the USA, Turkey, Japan, and across all countries and from participating researchers who recognize the importance of research advancements for in-vehicle systems and safety. The co-editors would like to recognize and sincerely thank *Rosarita Lubag*, University of Texas at Dallas, who served as publications coordinator for the book, and assisted in layout, proof-reading, and ensuring quality control on each of the chapters. Her tireless efforts significantly contributed to a final version of the book which reflects the quality of the authors and presentations that took place in the fourth Biennial Workshop. We wish to express our continued appreciation to Springer Publishing for a smooth and efficient publication process for this book. Specifically, we would like to thank both Alex Greene and Ms. Allison Michael of Springer Publishing for their extensive efforts to work to enhance the structure and content of this book, as well as providing our community a high-quality and scholarly platform to stimulate public awareness, scientific research, and technology development in this field.

Richardson, TX, USA
Istanbul, Turkey
Nagoya, Japan
San Diego, CA, USA

John H.L. Hansen
Pinar Boyraz
Kazuya Takeda
Hüseyin Abut

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