

Preface

The *Fifth Biennial Workshop on Digital Signal Processing (DSP) for In-Vehicle Systems* took place in Kiel, Germany, on September 4–7, 2011. The workshop was organized by the *Digital Signal Processing and System Theory* research group at Kiel University, Germany. As mentioned above, this biennial is the fifth in a series. It was organized first in 2003 in Nagoya (Japan), followed by events in Sesimbra (Portugal) in 2005, in Istanbul (Turkey) in 2007 and in Dallas (Texas, USA) in 2009. World-class experts from a wide spectrum of research fields have participated and shared cutting-edge studies on driver behavior and in-vehicle technologies just as they did in earlier workshops.

The workshop at Kiel University formed a communication platform among researchers, automotive manufacturers, government foundations, and legislators for road safety and on future in-vehicle technologies as well as focusing on driver behavior. Contributions came from signal processing, control engineering, multi-modal audio–video processing, biomechanics, 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 automobiles,
- speech dialog, hands-free, and in-car communication systems (algorithms and evaluation),
- driver-status monitoring and distraction/stress detection,
- in-vehicle dialog systems and human–machine interfaces,
- challenges in video and audio processing for in-vehicle products,
- multisensor fusion for driver identification and robust driver monitoring,
- vehicle-to-vehicle and vehicle-to-infrastructure wireless technologies
- human factors and cognitive science in enhancing safety, and
- transportation engineering.

From this workshop, 15 papers and one additional contribution stemming from a tutorial, which was held at the start of the workshop, were selected and expanded with even newer material. These 16 chapters make up this book. Chapters are

grouped into five parts, each addressing key areas within in-vehicle digital signal processing arena:

- Part I: Sensor and Data Fusion,
- Part II: Speech and Audio Processing,
- Part III: Driver Distraction,
- Part IV: Driving Behavior and User Profiling,
- Part V: Driving Scene Analysis.

First, Part I consists of four chapters that cover the fusion of sensor signals or data in general. The first chapter considers the estimation of the direction of arrival in automotive RADAR. Special emphasis is put here on computational aspects. The second chapter investigates stereo camera systems for estimating three-dimensional motion fields in real time for applications such as automotive driver assistance systems, robotics, or surveillance. It is followed by an overview on vehicle-assistance systems that acquire, process, and evaluate environmental data. Several state-of-the-art systems are described here. Chapter 4 addresses the design, the perception, and decision algorithms of the so-called unmanned ground vehicles. Special focus is put on the *Otonobil*, the first autonomously driven vehicle of Turkey.

The next five chapters make up Part II of the textbook which focuses on speech and audio processing for in-vehicle systems. Chapter 5 presents an overview about testing and optimization of hands-free equipment in cars and Chap. 6 focuses on combined fast-converging echo cancellation and residual echo and noise suppression schemes for wideband automotive hands-free systems. Chapter 7 deals with the systems that improve the (speech) communication within the passenger compartment. Next, Chap. 8 discusses the acoustic concept of a *room in a room*, which allows for recording and playback of sound fields with a multitude of microphones and loudspeakers. The last chapter in this second part of the book is about a novel post-processing scheme that can be applied after a conventional filterbank. It *refines* the original short-term spectra and allows for improved pitch estimation or improved convergence speed or complexity reduction of echo cancellation filters.

Part III is on driver distraction with two chapters. Chapter 10 focuses on understanding how drivers react to various secondary tasks such as phone calls, and creating text messages. The CAN bus is used then for analyzing the distraction effect of such actions. The second chapter provides the definition of reference labels for perceptual evaluations from external evaluators, and the consistency and effectiveness of using a visual-cognitive space for subjective evaluations are investigated.

The next two chapters form Part IV concentrating on driver behavior and user profiling. Chapter 12 is about evaluation methods of safe driving skills. The second chapter of this part is on the impact of emotions on driving behavior with special emphasis on pre- and post-accident situations.

The last portion of the book is Part V which addresses driving scene analysis. In Chap. 14 two driving scene analysis systems are proposed: The first system

measures the similarities between driving behavior signals in driving scenes involving stops, starts, and right and left turns. The second system measures the similarities between environmental driving signals, focusing on surrounding vehicles and driving road configuration. In Chap. 15 studies are presented on algorithms that use front cameras or, in particular, motion vectors of standard video encoding algorithms to detect various driving events. The detection results can be used to gain understanding of the driving dynamics, and eventually to support driver decisions and improve driving safety. In the last chapter of the book, in Chap. 16, automotive radar systems for estimation of target shapes are described. Special focus is put on a two-stage approach for combining high-resolution techniques with conventional Fourier-based methods.

We hope that this book provides an up-to-date perspective on automotive signal processing, with novel ideas for researchers, engineers, and scientists in the field. We wish to thank all those who participated in the 2011 workshop. We wish to express our continued appreciation of Springer Publishing for a smooth and efficient publication process for this book. Specifically, we would like to thank Alex Greene and Ms. Ania Levinson of Springer Publishing for their extensive efforts 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.

Kiel, Germany
San Diego, CA, USA
Nagoya, Japan
Dallas, TX, USA

Gerhard Schmidt
Huseyin Abut
Kazuya Takeda
John H.L. Hansen

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