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The Connected Autonomous Vehicle and its Environment

An Introduction to Real and Reduced-Scale Autonomous Vehicles

Jacques Ehrlich

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Preface

The rise of autonomous and connected vehicles is part of a fascinating yet complex technological and societal landscape. These vehicles are not merely standalone systems; they are integral components of a broader ecosystem known as Intelligent Transport Systems. This systemic nature necessitates a multidisciplinary approach, where engineering sciences play a central role while also considering the crucial contributions of human and social sciences. Acceptability, regulation, and deployment strategies are non-technical dimensions that directly influence the future of these technologies.

Providing a comprehensive overview of this field is a significant challenge. This book, therefore, focuses primarily on the technological aspects while also offering insights into the roadmap for deploying autonomous vehicles. It is the result of over fifteen years of experience within a research laboratory dedicated to Advanced Driver Assistance Systems (ADAS) and Connected and Autonomous Vehicles (CAV), drawing on the expertise of a team of researchers specialized in key disciplines.

Intended for technicians, engineers, and innovation enthusiasts, this book serves as an introduction to complex concepts, aiming to make them accessible without oversimplification. The topics covered are diverse: understanding human driving behavior, which can be used as a model for autonomous vehicles; the necessity of vehicular communications; key technical functions; embedded electronic implementation; failure analysis; and, finally, a proposal for designing a scaled-down (1:10) autonomous vehicle. This last element, both entertaining and educational, provides a valuable platform for experimentation and research.

One of the essential aspects that cannot be overlooked is the growing relationship between autonomous vehicles and infrastructure. These vehicles can no longer be conceived as independent objects. As automation levels increase, so do the safety imperatives, making collaboration with infrastructure a critical factor. There are significant win-win synergies to be leveraged between automotive manufacturers and road operators. Effective coordination between these stakeholders will be key to ensuring the seamless and secure integration of autonomous vehicles into the transportation network.

The structure of this book is inspired by courses taught in the “Smart Mobility” Master’s program at Institut Polytechnique de Paris, as well as training sessions designed for engineers in the automotive industry. Presenting this content to a diverse audience, especially industry professionals, has helped confirm its relevance and alignment with current industry trends.

May this book provide readers with a clear and in-depth understanding of the challenges surrounding autonomous and connected vehicles and inspire them in their own technological and scientific explorations.

Finally, my sincere gratitude goes to all those who accompanied me on this professional journey, as well as to those who contributed to improving this book through their valuable insights, careful review, and help with editing. Their support and expertise have been instrumental in refining this work — their dedication is deeply appreciated.

Jacques Ehrlich