Over the years, the field of intelligent vehicles has become a major research theme in intelligent transportation systems since traffic accidents are serious and growing problems all over the world. The goal of an intelligent vehicle is to augment vehicle autonomous driving either entirely or partly for the purposes of safety, comfortability, and saving energy. Indeed, many technologies of intelligent vehicles root in autonomous mobile robots. The tasks of intelligent vehicles become even more challenging compared to indoor mobile robots for two reasons. First, real-time dynamic complex environment perception and modeling will challenge current indoor robot technologies. Autonomous intelligent vehicles have to finish the basic procedures: perceiving and modeling environment, localizing and building maps, planning paths and making decisions, and controlling the vehicles within limit time for real-time purposes. Meanwhile, we face the challenge of processing large amounts of data from multi-sensors, such as cameras, lidars, radars. This is extremely hard in more complex outdoor environments. Toward this end, we have to implement those tasks in more efficient ways. Second, vehicle motion control faces the challenges of strong nonlinear characteristics due to high mass, especially in the processes of high speed and sudden steering. In this case, both lateral and longitudinal control algorithms of indoor robots do not work well.

This book presents our recent research work on intelligent vehicles and is aimed at the researchers and graduate students interested in intelligent vehicles. Our goal in writing this book is threefold. First, it creates an updated reference book of intelligent vehicles. Second, this book not only presents object/obstacle detection and recognition, but also introduces vehicle lateral and longitudinal control algorithms, which benefits the readers keen to learn broadly about intelligent vehicles. Finally, we put emphasis on high-level concepts, and at the same time provide the low-level details of implementation. We try to link theory, algorithms, and implementation to promote intelligent vehicle research.

This book is divided into four parts. The first part **Autonomous Intelligent Vehicles** presents the research motivation and purposes, the state-of-art of intelligent vehicles research. Also, we introduce the framework of intelligent vehicles. The second part **Environment Perception and Modeling** which includes **Road detection**
and tracking, Vehicle detection and tracking, Multiple-sensor based multiple-object tracking introduces environment perception and modeling. The third part Vehicle Localization and Navigation which includes An integrated DGPS/IMU positioning approach, Vehicle navigation using global views presents vehicle navigation based on integrated GPS and INS. The fourth part Advanced Vehicle Motion control introduces vehicle lateral and longitudinal motion control.

Most of this book refers to our research work at Xi’an Jiaotong University and Carnegie Mellon University. During the last ten years of research, a large number of people had been working in the Springrobot Project at Xi’an Jiaotong University. I would like to deliver my deep respect to my Ph.D advisor, Professor Nanning Zheng, who led me into this field. Also I would like to thank: Yuehu Liu, Xiaojun Lv, Lin Ma, Xuetao Zhang, Junjie Qin, Jingbo Tang, Yingtuan Hou, Jing Yang, Li Zhao, Chong Sun, Fan Mu, Ran Li, Weijie Wang, and Huub van de Wetering. Also, I would like to thank Jie Yang at Carnegie Mellon University who supported Hong Cheng’s research work during his stay at this university and Zicheng Liu at Microsoft Research who helped Hong Cheng discuss vehicle navigation with global views. I also would like to thank our sincere and deep thanks to Zhongjun Dai who helped immensely with figure preparation and with the typesetting of the book in LaTeX. Many people have helped by proofreading draft materials and providing comments and suggestions, including Nana Chen, Rui Huang, Pingxin Long, Wenjun Jing, Yuzhuo Wang. Springer has provided excellent support throughout the final stages of preparation of this book, and I would like to thank our commissioning editor Wayne Wheeler for his support and professionalism as well as Simon Rees for his help.

Chengdu, People’s Republic of China

Hong Cheng
Autonomous Intelligent Vehicles
Theory, Algorithms, and Implementation
Cheng, H.
2011, X, 154 p., Hardcover
ISBN: 978-1-4471-2279-1