

Preface

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.

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