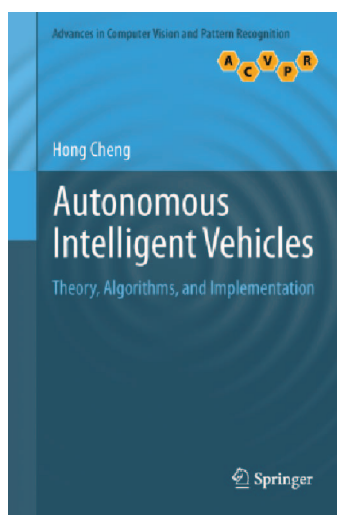# Review of the Book *Autonomous Intelligent Vehicles*

Dr. Hong Cheng is a Professor in the School of Automation Engineering and the Director of the Pattern Recognition and Machine Intelligence Institute at the University of Electronic Science and Technology of China. This book summarizes his recent research work on Intelligent Vehicles. The target audience of the book is researchers, professionals and graduate students interested in a broad scientific field that includes not only basic principles, such as signal-image processing and pattern recognition, but also targeted fields of application, such as Intelligent Transportation Systems (ITS) and, more specifically, Intelligent Vehicles (IVs). The field of IVs includes a wide range of technologies spanning from vehicle dynamics to information, communications, hardware, computer vision, artificial intelligence, ergonomics and human factors.

According to the author, the goal of this book is threefold. Firstly, it aims at offering an updated reference book on IVs and the relative technologies, which provide precise signals to artificial intelligence systems (e.g. car safety systems and self-contained autonomous electro-mechanical sensors generating signals) that can be transmitted within a specified targeted range. Secondly, the book extends its coverage to issues like longitudinal and lateral control algorithms, beyond the heavily addressed (in the literature) problem of obstacle detection. As a final goal, Prof. Cheng states the emphasis given on linking theory (algorithms, models, ideas) with practice (implementations, systems and applied research).

Title: *Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation*
Author: Hong Cheng
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978-1-4471-2279-1
Springer, 2011
Price: €85.55
WWW link: http://www.springer.com/computer/image+processing/book/978-1-4471-2279-1

Autonomous Intelligent Vehicles is organized in four parts, as shown below.

Part 1 deals with the framework of autonomous intelligent vehicles from A to Z. Specifically, intelligent vehicles are addressed as a set of intelligent agents, which integrate multi-sensor fusion based on distinctive modules, such as environment perception and modeling, localization and map building, path planning, decision-making and motion control. Each and every one of these modules are presented and analyzed, providing the references for the related work and further reading.

The largest part of the book (part 2) highlights the benefits of computer vision systems for road detection and tracking. Road detection is analyzed as the identification of road boundaries with the aim of image processing techniques (for structured or unstructured roads). This module is crucial to many ITS, especially those that operate on board (i.e. in the vehicle). To this end, lane detection methods that were proposed by the author and his research team are analytically described, including particle filtering, lane model, dynamic model (imaging and geometry) and algorithms (CONDENSATION and Mean Shift). Part 2 ends with the presentation of a vehicle detection approach that operates in two basic phases (hypothesis generation and

Special Issue on
Perception and Planning for Autonomous Vehicles

IEEE Intelligent Transportation Systems Magazine
Call for Papers

Scope & Topics of interest:

The special issue on "Perception and Planning for Autonomous Vehicles" addresses all topics related to the challenging problems of autonomous driving in open and dynamic environments. Technologies related to application fields such as unmanned outdoor vehicles or intelligent road vehicles will be considered from both the theoretical and technological point of view. Among the many application areas that we are addressing, transportation of people and goods seem to be a domain that will dramatically benefit from intelligent automation. Fully automated driving is emerging as the approach to dramatically improve efficiency while at the same time leading to the goal of zero fatalities. This issue shall cover the related technologies, which are at the very core of this major shift in the automobile paradigm.

Topics include the following techniques relevant to autonomous vehicles:

- Real-time perception
- Detection, tracking and classification
- Road scene understanding
- Lane detection and lane keeping
- Pedestrian and vehicle detection
- Cooperative perception
- Mapping and maps for navigation
- Vehicle localization
- 3D Modeling and reconstruction
- Information fusion
- Autonomous navigation
- Real-time motion planning in dynamic environments
- Multi-agent based architectures
- Cooperative unmanned vehicles
- Automated vehicle control
- Multiple autonomous vehicles studies, models, techniques and simulations

Manuscript Submission & Publication Process

Prospective authors are invited to submit contributions reporting on their original research. Each paper will be analyzed by several reviewers of the IEEE Intelligent Transportation Systems Magazine according to the relevance, contribution, scientific originality and quality. Accepted papers will be published in the IEEE Intelligent Transportation Systems Magazine special issue on "Perception and Planning for Autonomous Vehicles". Manuscripts must be submitted electronically at http://mc.manuscriptcentral.com/t-its indicating submission to the special issue on "Perception and Planning for Autonomous Vehicles" of the IEEE Intelligent Transportation Systems Magazine.

Important Dates

First paper submission deadline: Jan 31st, 2014
Notification of first decision: Mar 31st, 2014
Revision submission deadline: May 31st, 2014
Notification of final decision: July 15th, 2014
Camera ready manuscript due: Aug 31st, 2014

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Christos-Nikolaos E. Anagnostopoulos was born in Athens, Greece in 1975. He received his Mechanical Engineering Diploma from the National Technical University of Athens (NTUA) in 1998, and the Ph.D. degree from the Electrical and Computer Engineering Dpt., NTUA in 2002.

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validation). In the hypothesis generation phase, the Regions of Interest (ROI) in an image are determined according to lane vanishing points. From the analysis of horizontal and vertical edges in the image, vehicle hypothesis lists are generated for three kinds of ROI (near, middle distance and far). Finally, a hypothesis list for the whole image is obtained by combining these three lists. In the hypothesis validation phase, Support Vector Machines (SVMs) and Gabor features are used.

Part 3 refers to Vehicle Localization and Navigation Systems. These are very challenging issues, because for autonomous navigation the vehicles must be capable of determining their global and local positions within their environment, which may be extremely dynamic, unpredictable and unstable. Personally, I found the method of enhancing situation awareness by dynamically providing the drivers with a global view of their surroundings, to be extremely interest-ing. The surrounding environment of a vehicle is captured by an omnidirectional vision system located at the top of the vehicle, rather than catadioptric cameras used by most of the existing systems for intelligent vehicles.

Finally, part 4 deals with Advanced Vehicle Motion Control, introducing lateral and longitudinal motion control. Important issues are covered, such as the relationship between motor pulses and the front wheel lean angle (for lateral control) and first-order lag systems in longitudinal control.

Summarizing this brief review, *Autonomous Intelligent Vehicles* could serve as a decent handbook for engineers to be introduced to specific issues in the field of Intelligent Vehicles and to be informed on the cutting edge technology in the field. It could also be a good reference book for experienced researchers and an extremely valuable aid to graduate students of computer science and robotics, who are interested in intelligent vehicles.

ITS