

Preface

Recently designed and built “Intelligent” robots are becoming more and more powerful in terms of human-like abilities in terms of perception, cognition, and decision-making. While humans have far superior intellectual abilities as compared to machines and robots, the advantages of “intelligent” robots remain in their excellent way for connecting and communicating with other machines, robots, or devices. These facts result in the so-called “networked robots” which are connected to different external sensor arrays, cameras, or even other robots. The robots can extend their information source and overcome intelligence of humans. So in fact we live in an era when humans with highly developed intellect are being compared with multisource supported robots with ability to get pieces of information from cyberspace or any kind of local and remote sensors in real-time manner.

This is the fourth edition that aims at serving the researchers and practitioners in related fields with a timely dissemination of the recent progress on robot intelligence technology and its applications, based on a collection of papers presented at the 4th International Conference on Robot Intelligence Technology and Applications (RiTA), held in Bucheon, Korea, December 14–16, 2015. For better readability, this edition has the total of 49 articles grouped into three parts: Part I: Ambient, Behavioral, Cognitive, Collective, and Social Robot Intelligence, Part II: Computational Intelligence and Intelligent Design for Advanced Robotics, Part III: Applications of Robot Intelligence Technology, where individual chapters, edited by Fakhri Karray, Jun Jo, Peter Sincak, Hyun Myung along with Jong-Hwan Kim, begin with a brief introduction.

Part I: Ambient, Behavioral, Cognitive, Collective, and Social Robot Intelligence

RiTA conference is one of the few conferences which addresses **Robot Intelligence Theory and Applications**. These perspectives of robots intelligence technology including ambient, behavioral, cognitive, collective, genetic, and social intelligences are very important in creating an alternative to single self-learning robot. In the first sentence of this part we have written the word Intelligence in quotes so honestly believe that the notion “robot intelligence” is going to evolve and the artificial intelligence in many of their various forms is a key factor for creating robots as machines with different levels of intelligence related to given task from humans or companionship with humans.

In this first part, we find 24 chapters dealing with various partial contributions to ambience, cognition, behavioral modeling, social robots and collective intelligence. The chapters can be categorized into four sections;

- A. Robot Navigations, Localization, Path Planning, and Related Problems in Various Environments
 1. Behavior and Path Planning for the Coalition of Cognitive Robots in Smart Relocation Tasks
 2. Trajectory Generation Using RNN with Context Information for Mobile Robots
 3. Fast and Smooth Replanning for Navigation in Partially Unknown Terrain: The Hybrid Fuzzy-D*lite Algorithm
 4. Accurate Localization in Urban Environments Using Fault Detection of GPS and Multi-sensor Fusion
 5. Simultaneous Localization and Mapping with a Dynamic Switching Mechanism (SLAM-DSM)
 6. ROSLAM—A Faster Algorithm for Simultaneous Localization and Mapping (SLAM)
 7. Adaptive Computation Algorithm for Simultaneous Localization and Mapping (SLAM)
 8. Interactive Markerless Augmented Reality System Based on Visual SLAM Algorithm
- B. Robot Movement and Related Problems of Control
 1. Control Strategy Design for Throw-in Challenge in a Humanoid Robot Soccer Game
 2. Study on a Two-Stage Control of a Lower-Limb Exoskeleton Performing Standing-Up Motion from a Chair
 3. Adaptive Control for Directional Drilling Systems with Delay and Parameter Uncertainty
 4. Design and FPGA Implementation of a Fuzzy-PI Controller for Omnidirectional Robot System

5. Android Based Mobile Robotic Platform Performance Testing for Real-Time Navigation
 6. Implementation and Control of a Bistable Two wheeled Inverted Pendulum-Type Mobile Robot
 7. Autonomous Control of a Drone in the Context of Situated Robotics
 8. Fast MAV Control by Control/Status OO-Messages on Shared-Memory Middleware.
- C. Robot Behaviors, Agent System for Complex Tasks
1. Framework and Modeling of a Multi-robot Simulator for Hospital Logistics
 2. Emotion in Robot Decision Making
 3. Multi-robot Task Allocation Using Clustering Method
- D. Human Robot Interaction and Related Topics
1. Modeling of Violin Playing Robot Arm with MATLAB/SIMULINK
 2. Gaze Control of Humanoid Robot for Learning from Demonstration
 3. A Novel Design of a Full Length Prosthetic Robotic Arm for the Disabled
 4. Preliminary Study in a Novel Robotic-Assisted Femoral Shaft Fracture Reduction System
 5. Pet Care Robot for Playing with Canines

Generally we can consider these chapters as contributions to the selected issues of Robot Intelligence from Theory and Applications. These are extremely important since communities in Artificial Intelligence and Robotics tend to be isolated and we do need to prevent the re-invention of artificial intelligence in robotics community to help science, research and technology. On the other hand the practical application of artificial intelligence in Robotics can give a valuable feedback to artificial intelligence researchers to rethink the theory since applications are providing an important experience and data for the theory. Both communities need to be in a closer contact and benefit from each other while sharing the obtained knowledge for better future of mankind.

Part II: Computational Intelligence and Intelligent Design for Advanced Robotics

This part consists of two segments of different topics which cover broad spectrum of topics related to robot intelligence: Computational Intelligence and Intelligent robot design.

The *Computational Intelligence* is a methodology involving computing that exhibits an ability to learn or to deal with new situations. It usually comprises of soft computing techniques such as evolutionary computation, neural networks, and fuzzy systems.

By representing a problem with a chromosome and genes, and describing fitness of this chromosome in the form of objective function, evolutionary computation effectively solves a problem using meta-heuristics inspired by genetics. The problems hard to be solved due to their inherent complexity, or the problems that do not have mathematical model necessary for classical optimization methods or hard computing techniques, can be candidates for the application of computational intelligence approach. The robots that use these problem solving capabilities can be regarded as having computational intelligence. The following chapters illustrate very well these approaches.

A. Computational Intelligence

1. Making a More Reliable Classifier via Random Crop Pooling
2. Learning with Learning Robots: A Weight-Lifting Project
3. Ensemble of Vector and Binary Descriptor for Loop Closure Detection
4. Learning with Small Autonomous Robots

The rest of the chapters in this part are dedicated to the *Design of Intelligent Robots* using intelligent perception and sensing capabilities. These robots can be also designed to be used as educational purposes as can be seen in the following chapters:

B. Design of Intelligent Robots

1. Design and Implementation of Double Passing Strategy for Humanoid Robot Soccer Game
2. Development of Motion Management System for the Robot Soccer Using Multiple Humanoid robots
3. Small-Size Robot Platform as Test and Validation Tool for the Development of Mechatronic Systems
4. Soft Robotics Technology and a Soft Table for Industrial Applications
5. Golf Playing DARwIn-OP: A Theoretical Approach
6. An Advanced Spider-Like Rocker-Bogie Suspension System for Mars Exploration Rovers
7. System of 3-D Printed Components for the Rapid Prototyping of Legged Robots

Part III: Applications of Robot Intelligence Technology

There are so many aspects of life that robots may be applied to make everyday life safer and more convenient. Robots should be intelligent enough to go beyond simple preprogrammed reactions to environmental stimuli. Intelligent robots should be able to solve complicated problems, self-learn and perform actions that were not explicitly programmed, and thus be able to participate in complex interactions with humans or other robots. This part presents 14 chapters that will introduce some of the many possible applications of robots with intelligent technologies. The intelligent technologies utilized in the chapters are as follows:

A. Computer Algorithms and Computational Intelligence techniques

1. A Rigid and Soft Combined Robot that Is Designed to Be Used in Confined Spaces
2. Design and Experimental Research of Pneumatic Soft Humanoid Robot Hand

B. Computer Vision and Image Processing

1. Concept of Distributed Processing System of Image Flow
2. A Likelihood-Based Data Fusion Model for the Integration of Multiple Sensor Data: A Case Study with Vision and Lidar Sensors
3. A Vision-Based 6-DOF Displacement Measurement Method for Assembling PC Bridge Structures Using a Planar Marker
4. A Color Constancy Algorithm Using Photodetector Characteristics of a Camera for Indoor Scenes
5. Real-Time Ball Detection and Following Based on a Hybrid Vision System with Application to Robot Soccer Field
6. Toward Autonomous UAV Landing Based on Infrared Beacons and Particle Filtering
7. Local Obstacle Avoidance Using Obstacle-Dependent Gaussian Potential Field for Robot Soccer
8. Methods of Visual Navigation of the UAV Flying Over the Nonplanar District

C. Various Sensor Technologies/Devices other than cameras

1. Porting Experiment of Robotic Machining Application Using ORiN SDK and Design of 3D Printer-Like Interface
2. Rotation Vector Sensor-Based Remote Control of a Mobile Robot via Google Glass

D. Wireless Technologies

1. A Comparative Study of Wi-Fi and Bluetooth for Signal Strength-Based Localisation

E. Cloud Computing, Simulation, Mechanical Structure and Solar Energy

1. Cloud-Based Robots and Intelligent Space Teleoperation Tools

We do hope that readers find the Fourth Edition of Robot Intelligence Technology and Applications, RiTA 4, stimulating, enjoyable and helpful for their research endeavors.

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