

# **Communications in Computer and Information Science**

**1015**

*Commenced Publication in 2007*

Founding and Former Series Editors:

Phoebe Chen, Alfredo Cuzzocrea, Xiaoyong Du, Orhun Kara, Ting Liu,  
Krishna M. Sivalingam, Dominik Ślęzak, Takashi Washio, and Xiaokang Yang

## **Editorial Board Members**

Simone Diniz Junqueira Barbosa

*Pontifical Catholic University of Rio de Janeiro (PUC-Rio),  
Rio de Janeiro, Brazil*

Joaquim Filipe

*Polytechnic Institute of Setúbal, Setúbal, Portugal*

Ashish Ghosh

*Indian Statistical Institute, Kolkata, India*

Igor Kotenko

*St. Petersburg Institute for Informatics and Automation of the Russian  
Academy of Sciences, St. Petersburg, Russia*

Junsong Yuan

*University at Buffalo, The State University of New York, Buffalo, NY, USA*

Lizhu Zhou

*Tsinghua University, Beijing, China*

More information about this series at <http://www.springer.com/series/7899>

Jong-Hwan Kim · Hyung Myung ·  
Seung-Mok Lee (Eds.)

# Robot Intelligence Technology and Applications

6th International Conference, RiTA 2018  
Kuala Lumpur, Malaysia, December 16–18, 2018  
Revised Selected Papers

*Editors*

Jong-Hwan Kim  
Korea Advanced Institute of Science  
and Technology (KAIST)  
Daejeon, Korea (Republic of)

Hyung Myung  
Korea Advanced Institute of Science  
and Technology (KAIST)  
Daejeon, Korea (Republic of)

Seung-Mok Lee  
Keimyung University  
Daegu, Korea (Republic of)

ISSN 1865-0929

ISSN 1865-0937 (electronic)

Communications in Computer and Information Science

ISBN 978-981-13-7779-2

ISBN 978-981-13-7780-8 (eBook)

<https://doi.org/10.1007/978-981-13-7780-8>

© Springer Nature Singapore Pte Ltd. 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd  
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

# Preface

The 6th edition of the International Conference on Robot Intelligence Technology and Applications (RiTA 2018) was held in Putrajaya, Malaysia, during December 16–18, 2018. The event was organized by the Korea Advanced Institute of Science and Technology (KAIST) and the Innovative Manufacturing, Mechatronics and Sports (iMAMS) Laboratory, Universiti Malaysia Pahang (UMP). RiTA aims at serving researchers and practitioners in related fields with timely dissemination of the recent progress on robot intelligence technology and its application.

The sixth edition of the conference had the theme of “Robotics and Machine Intelligence: Building Blocks for Industry 4.0.” The Fourth Industrial Revolution (IR 4.0) brought technological disruption, unlike its predecessors. Just as innovations in manufacturing processes and systems led previous industrial revolutions, the advancement of IR 4.0 will be driven by a smart, interconnected, and pervasive environment with data being one of its main currencies as well as robotics and automation being the central pillar of its growth.

RiTA 2018 received 80 submissions from eight different countries with mainly from South Korea and Malaysia. All submissions were reviewed in a single-blinded manner, and the best 20 papers recommended by the reviewers are published in this volume. The editors would like to thank all the authors who submitted their work, as the papers are of good quality and represented good progress in robot intelligence and its applications especially in facing the fourth industrial revolution.

The editors would also like to thank Prof. Junmo Kim for delivering his plenary speech entitled “Recent Advances and Challenges in Deep Learning for Computer Vision” as well as Associate Professor Marcelo H. Ang Jr. (National University Singapore, Singapore), Prof. Etienne Burdet (Imperial College London, UK), Prof. Elmer P. Dadios, Assistant Professor João Sequeira (Technical University of Lisbon, Portugal), Dr. Eysin Chew (Cardiff Metropolitan University, UK), Associate Professor Dr. Hanafiah Yussof (Universiti Teknologi MARA, Malaysia) for delivering their speeches at the conference.

The editors hope that readers find this volume informative. We thank Springer for undertaking the publication of this volume. We also would like to thank the conference Organizing Committee for their hard work in realizing the conference.

March 2019

Jong-Hwan Kim  
Hyung Myung  
Seung-Mok Lee

# Organization

## Honorary General Chair

|               |                    |
|---------------|--------------------|
| Jong-Hwan Kim | KAIST, South Korea |
|---------------|--------------------|

## General Chairs

|             |                    |
|-------------|--------------------|
| Zahari Taha | UMP, Malaysia      |
| Hyun Myung  | KAIST, South Korea |

## Program Chairs

|                               |                    |
|-------------------------------|--------------------|
| Dato' Sri Daing Nasir Ibrahim | UMP, Malaysia      |
| Rizalman Mamat                | UMP, Malaysia      |
| Han-Lim Choi                  | KAIST, South Korea |

## Organizing Chairs

|                             |                                     |
|-----------------------------|-------------------------------------|
| Ahmad Shahrizan Abdul Ghani | UMP, Malaysia                       |
| Muhammad Aizzat Zakaria     | UMP, Malaysia                       |
| Ahmad Fakhri Ab. Nasir      | UMP, Malaysia                       |
| Junmo Kim                   | KAIST, South Korea                  |
| Weiliang Xu                 | University of Auckland, New Zealand |
| Eric T. Matson              | Purdue University, USA              |
| Jun Jo                      | Griffith University, Australia      |
| Fakhri Karray               | University of Waterloo, Canada      |

## Special Session Chairs

|                         |                                |
|-------------------------|--------------------------------|
| Ahmad Najmuddin Ibrahim | UMP, Malaysia                  |
| Gourab Sen Gupta        | Massey University, New Zealand |

## Workshop/Tutorial Chair

|             |                                      |
|-------------|--------------------------------------|
| Taesup Moon | Sungkyunkwan University, South Korea |
|-------------|--------------------------------------|

## Plenary Session Chair

|             |   |
|-------------|---|
| Ah Hwee Tan | Nanyang Technological University, Singapore |
|-------------|---|

## Awards Committee Chair

Serin Lee

KYRA, USA

## Local Arrangements Chairs

Rabiu Muazu Musa

UMP, Malaysia

Mohd Fadzil Abdul Rahim

UMP, Malaysia

Ash Choong Chun Sern

UMP, Malaysia

Dong Eui Chang

KAIST, South Korea

## Publications Chairs

Anwar P. P. Abdul Majeed

UMP, Malaysia

Mohd Hasnun Arif Hassan

UMP, Malaysia

Jessnor Arif Mat Jizat

UMP, Malaysia

Jin-Woo Jung

Dongguk University, South Korea

Seungmok Lee

Keymyung University, South Korea

## Exhibition Chairs

Nafrizuan Mat Yahya

UMP, Malaysia

Zubair Khalil

UMP, Malaysia

Nurul Akmal Che Lah

UMP, Malaysia

Donghwa Lee

Daegu University, South Korea

Donghan Kim

Kyunghee University, South Korea

## Secretariat

Nurul Qastalani Radzuan

UMP, Malaysia

Nur Fahriza Mohd Ali

UMP, Malaysia

A. J. Ahn

MSREP, KAIST, South Korea

## Local Program Committee

Shahrul Na'im Sidek

IIUM, Malaysia

Zulkifli Mohamed

UiTM, Malaysia

Mohd Zaid Abdullah

USM, Malaysia

Musa Mailah

UTM, Malaysia

Noor Azuan Abu Osman

UMT, Malaysia

Ali Yeon Md Shakaff

UNIMAP, Malaysia

Kamarul Hawari Ghazali

UMP, Malaysia

Ponnambalam Sivalinga

UMP, Malaysia

Govinda Rajan

Zamberi Jamaludin

UTeM, Malaysia

Mohd Rizal Arshad

USM, Malaysia

Muhammad Azmi Ayub  
 Ishkandar Baharin  
 Rosziati ti Ibrahim  
 Zainal Alimuddin Zainal  
 Alauddinn

UITM, Malaysia  
 MyRAS, Malaysia  
 UTHM, Malaysia  
 USM, Malaysia

## International Program Committee

Abdelghani Chibani  
 Alan Wee-Chung Liew  
 Anna Friesel  
 Azizi Abdullah  
 Bela Stantic  
 Brijesh Verma  
 Bumjoo Lee  
 David Claveau  
 Donald G. Bailey  
 Guangming Xie  
 Hongliang Ren  
 Hyun-Taek Choi  
 Igor Verner  
 Julia Taylor  
 Joao Sequeira  
 Kaori Yoshida  
 Kojiro Iizuka  
 Maki K. Habib  
 Marley Maria B. R. Vellasco  
  
 Meng Cheng Lau  
 Muhammad Hafidz  
 Fazli Md Fauadi  
 Nak Yong Ko  
 Nak-Yong Chong

Paris Est Creteil University, France  
 Griffith University, Australia  
 Technical University of Denmark, Denmark  
 UKM, Malaysia  
 Griffith University, Australia  
 CQUniversity, Australia  
 Myung-Ji University, South Korea  
 California State University Channel Islands, USA  
 Massey University, New Zealand  
 Peking University, China  
 NUS, Singapore  
 KRISO, South Korea  
 Technion – Israel Institute of Technology, Israel  
 Purdue University, USA  
 ISR – Instituto Superior Técnico, Portugal  
 Kyushu Institute of Technology, Japan  
 Shibaura Institute of Technology, Japan  
 The American University in Cairo, Egypt  
 Pontifical Catholic University of Rio de Janeiro,  
 Brazil  
 University of Manitoba, Canada  
 UTeM, Malaysia  
  
 Chosun University, South Korea  
 Japan Advanced Institute of Science  
 and Technology, Japan  
 National Kaohsiung Normal University, Taiwan  
 TU Kosice, Slovakia  
 Chukyo University, Japan  
 IIUM, Malaysia  
 IIT Kanpur, India  
 KAIST, South Korea  
 Chungnam National University, South Korea  
 KAIST, South Korea  
 ETRI, South Korea  
 Beijing Jiaotong University, China  
 KAIST, South Korea

Pei-Chen Sun  
 Peter Sincak  
 Pitoyo Hartono  
 Rini Akmeliawati  
 Rituparna Datta  
 Sang Wan Lee  
 Seul Jung  
 Sung-eui Yoon  
 Sunglok Choi  
 Tangwen Yang  
 Wan Chul Yoon

XiaoPing Chen

University of Science and Technology of China,  
China

Yuchi Ming

Huazhong University of Science and Technology,  
China

# Contents

|  |     |
|--|-----|
| Data-Driven Neuroendocrine-PID Tuning Based on Safe Experimentation Dynamics for Control of TITO Coupled Tank System with Stochastic Input Delay . . . . . | 1   |
| <i>Mohd Riduwan Ghazali, Mohd Ashraf Ahmad, and Raja Mohd Taufika Raja Ismail</i>  |     |
| Neuro-Fuzzy Sampling: Safe and Fast Multi-query Randomized Path Planning for Mobile Robots . . . . .   | 13  |
| <i>Weria Khaksar, Md Zia Uddin, and Jim Torresen</i>   |     |
| Hierarchical Attention Networks for Different Types of Documents with Smaller Size of Datasets . . . . .   | 28  |
| <i>Hon-Sang Cheong, Wun-She Yap, Yee-Kai Tee, and Wai-Kong Lee</i>   |     |
| Social Robot Intelligence and Network Consensus. . . . .   | 42  |
| <i>João Silva Sequeira</i>   |     |
| UDLR Convolutional Network for Adaptive Image Denoiser . . . . .   | 55  |
| <i>Sungmin Cha and Taesup Moon</i>   |     |
| Robust Feedback Controller Design Using Cuckoo Search Optimization to Maximize Stability Radius . . . . .  | 62  |
| <i>Mahmud Iwan Solihin and Rini Akmeliawati</i>  |     |
| Chaos-Based Reinforcement Learning When Introducing Refractoriness in Each Neuron. . . . .   | 76  |
| <i>Katsuki Sato, Yuki Goto, and Katsunari Shibata</i>  |     |
| Integration of Semantic and Episodic Memories for Task Intelligence . . . . .  | 85  |
| <i>Ue-Hwan Kim and Jong-Hwan Kim</i>   |     |
| Human Robot Social Interaction Framework Based on Emotional Episodic Memory . . . . .  | 101 |
| <i>Won-Hyong Lee, Sahng-Min Yoo, Jae-Woo Choi, Ue-Hwan Kim, and Jong-Hwan Kim</i>  |     |
| Convolutional Neural Network-Based Collaborative Filtering for Recommendation Systems . . . . .  | 117 |
| <i>Yat Hong Low, Wun-She Yap, and Yee Kai Tee</i>  |     |
| A Pedestrian Dead Reckoning System with Error Correction by Landmark Recognition . . . . .   | 132 |
| <i>Khanh Nguyen-Huu and Seon-Woo Lee</i>   |     |

|  |     |
|--|-----|
| Effective Indoor Robot Localization by Stacked Bidirectional LSTM<br>Using Beacon-Based Range Measurements. . . . .  | 144 |
| <i>Hyungtae Lim and Hyun Myung</i>   |     |
| Track Management for Distributed Multi-target Tracking<br>in Sensor Network . . . . .  | 152 |
| <i>Woo-Cheol Lee and Han-Lim Choi</i>  |     |
| Deregulating the Electricity Market for the Peninsula Malaysian Grid<br>Using a System Dynamics Approach. . . . .  | 164 |
| <i>Darren Teck Liang Lee, Andrew Huey Ping Tan, Eng Hwa Yap,<br/>and Kim-Yeow Tshai</i>  |     |
| ArUcoRSV: Robot Localisation Using Artificial Marker . . . . .   | 189 |
| <i>Izwan Azmi, Mohamad Syazwan Shafei, Mohammad Faizul Nasrudin,<br/>Nor Samsiah Sani, and Abdul Hadi Abd Rahman</i>   |     |
| Spike Encoding Modules Using Neuron Model in Neural Networks . . . . .   | 199 |
| <i>Yeeun Kim, Seunghye Lee, Wonho Song, and Hyun Myung</i>   |     |
| The Classification of EEG Signal Using Different Machine Learning<br>Techniques for BCI Application . . . . .  | 207 |
| <i>Mamunur Rashid, Norizam Sulaiman, Mahfuzah Mustafa,<br/>Sabira Khatun, and Bifta Sama Bari</i>  |     |
| The Identification of <i>Oreochromis niloticus</i> Feeding Behaviour Through<br>the Integration of Photoelectric Sensor and Logistic Regression Classifier . . . | 222 |
| <i>Mohamad Radzi Mohd Sojak, Mohd Azraai Mohd Razman,<br/>Anwar P. P. Abdul Majeed, Rabiul Muazu Musa,<br/>Ahmad Shahrizan Abdul Ghani, and Ismed Iskandar</i>   |     |
| Motion Planning to Reduce the Thrust of Underwater Robot<br>Using Null-Space Compliance . . . . .  | 229 |
| <i>Junbo Chae, Youngeon Lee, Yeongjun Lee, Hyun-Taek Choi,<br/>and Tae-Kyeong Yeu</i>  |     |
| Match Outcomes Prediction of Six Top English Premier League Clubs<br>via Machine Learning Technique . . . . .  | 236 |
| <i>Rabiul Muazu Musa, Anwar P. P. Abdul Majeed,<br/>Mohd Azraai Mohd Razman, and Mohd Ali Hanafiah Shaharudin</i>  |     |
| Author Index . . . . .   | 245 |

## About the Editors

**Jong-Hwan Kim** (FIEEE 2009) received his PhD degree in electronic engineering from Seoul National University, South Korea, in 1987. Since 1988, he has been with the School of Electrical Engineering, KAIST, South Korea, where he leads the Robot Intelligence Technology Laboratory as professor. Dr. Kim is Director for both the KoYoung-KAIST AI Joint Research Center and the Machine Intelligence and Robotics Multi-Sponsored Research and Education Platform. His research interests include intelligence technology, machine intelligence learning, and AI robots. He has authored five books and five edited books, two journal special issues, and around 400 refereed papers in technical journals and conference proceedings.

**Hyun Myung** received his BS, MS, and PhD degrees from the Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea, in 1992, 1994, and 1998, respectively, all in electrical engineering. He was a senior researcher with the Electronics and Telecommunications Research Institute, Daejeon, from 1998 to 2002; CTO and Director of the Digital Contents Research Laboratory, Emersys Corporation, Daejeon, from 2002 to 2003; and a principal researcher with the Samsung Advanced Institute of Technology, Yongin, South Korea, from 2003 to 2008. From 2008 to 2018, he was a professor with the Department of Civil and Environmental Engineering, KAIST, where he is currently a professor with the School of Electrical Engineering and the head of the KAIST Robotics Program. His current research interests include structural health monitoring using robotics, artificial intelligence, simultaneous localization and mapping, robot navigation, machine learning, deep learning, and swarm robots.

**Seung-Mok Lee** received his PhD degree in civil and environmental engineering (Robotics Program) from the Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea, in 2014. He was a post-doctoral fellow with the Urban Robotics Laboratory, KAIST, Daejeon, from 2014 to 2015, a senior research engineer with the Intelligent Safety Technology Center, Hyundai Motor Company, Hwaseong, South Korea, from 2015 to 2017. Since 2017, he has been Assistant Professor with the Department of Mechanical and Automotive Engineering, Keimyung University, Daegu, South Korea. His current research interests include soft computing, autonomous vehicles, simultaneous localization and mapping, and robot navigation.