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# Intelligent Information and Database Systems


12th Asian Conference, ACIIDS 2020  
Phuket, Thailand, March 23–26, 2020  
Proceedings, Part II

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Ngoc Thanh Nguyen   
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King Mongkut's Institute  
of Technology Ladkrabang  
Bangkok, Thailand

Bogdan Trawiński   
Department of Applied Informatics  
Wrocław University of Science  
and Technology  
Wrocław, Poland

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# Preface

ACIIDS 2020 was the 12th event in a series of international scientific conferences on research and applications in the field of intelligent information and database systems. The aim of ACIIDS 2020 was to provide an international forum of research workers with scientific backgrounds on the technology of intelligent information and database systems and its various applications. The ACIIDS 2020 conference was co-organized by King Mongkut's Institute of Technology Ladkrabang (Thailand) and Wrocław University of Science and Technology (Poland) in cooperation with the IEEE SMC Technical Committee on Computational Collective Intelligence, European Research Center for Information Systems (ERCIS), The University of Newcastle (Australia), Yeungnam University (South Korea), Leiden University (The Netherlands), Universiti Teknologi Malaysia (Malaysia), BINUS University (Indonesia), Quang Binh University (Vietnam), and Nguyen Tat Thanh University (Vietnam). It took place in Phuket, Thailand during March 23–26, 2020.

The ACIIDS conference series is already well established. The first two events, ACIIDS 2009 and ACIIDS 2010, took place in Dong Hoi City and Hue City in Vietnam, respectively. The third event, ACIIDS 2011, took place in Daegu (South Korea), followed by the fourth event, ACIIDS 2012, in Kaohsiung (Taiwan). The fifth event, ACIIDS 2013, was held in Kuala Lumpur (Malaysia) while the sixth event, ACIIDS 2014, was held in Bangkok (Thailand). The seventh event, ACIIDS 2015, took place in Bali (Indonesia), followed by the eighth event, ACIIDS 2016, in Da Nang (Vietnam). The ninth event, ACIIDS 2017, was organized in Kanazawa (Japan). The 10th jubilee conference, ACIIDS 2018, was held in Dong Hoi City (Vietnam), followed by the 11th event, ACIIDS 2019, in Yogyakarta (Indonesia).

For this edition of the conference we received 285 papers from 43 countries all over the world. Each paper was peer reviewed by at least two members of the international Program Committee and the international board of reviewers. Only 105 papers with the highest quality were selected for an oral presentation and publication in these two volumes of the ACIIDS 2020 proceedings.

Papers included in these proceedings cover the following topics: knowledge engineering and Semantic Web; natural language processing; decision support and control systems; computer vision techniques; machine learning and data mining; deep learning models; advanced data mining techniques and applications; multiple model approach to machine learning; application of intelligent methods to constrained problems; automated reasoning with applications in intelligent systems; current trends in artificial intelligence; optimization, learning, and decision-making in bioinformatics and bio-engineering; computer vision and intelligent systems, data modeling and processing for industry 4.0; intelligent applications of the Internet of Things (IoT) and data analysis technologies; intelligent and contextual systems; intelligent systems and algorithms in information sciences; intelligent supply chains and e-commerce; privacy, security, and trust in artificial intelligence; and interactive analysis of image, video, and motion data in life sciences.

The accepted and presented papers focus on new trends and challenges facing the intelligent information and database systems community. The presenters showed how research work could stimulate novel and innovative applications. We hope that you found these results useful and inspiring for your future research work.

We would like to express our sincere thanks to the honorary chairs for their support: Prof. Suchatvee Suwansawat (President of King Mongkut's Institute of Technology, Ladkrabang, Thailand), Cezary Madryas (Rector of Wrocław University of Science and Technology, Poland), Prof. Moonis Ali (President of the International Society of Applied Intelligence, USA), and Prof. Komsan Maleesee (Dean of Engineering, King Mongkut's Institute of Technology, Ladkrabang, Thailand).

Our special thanks go to the program chairs, special session chairs, organizing chairs, publicity chairs, liaison chairs, and local Organizing Committee for their work towards the conference. We sincerely thank all the members of the international Program Committee for their valuable efforts in the review process, which helped us to guarantee the highest quality of the selected papers for the conference. We cordially thank the organizers and chairs of special sessions who contributed to the success of the conference.

We would like to express our thanks to the keynote speakers for their world-class plenary speeches: Prof. Włodzisław Duch from the Nicolaus Copernicus University (Poland), Prof. Nikola Kasabov from Auckland University of Technology (New Zealand), Prof. Dusit Niyato from Nanyang Technological University (Singapore), and Prof. Geoff Webb from the Monash University Centre for Data Science (Australia).

We cordially thank our main sponsors: King Mongkut's Institute of Technology Ladkrabang (Thailand), Wrocław University of Science and Technology (Poland), IEEE SMC Technical Committee on Computational Collective Intelligence, European Research Center for Information Systems (ERCIS), The University of Newcastle (Australia), Yeungnam University (South Korea), Leiden University (The Netherlands), Universiti Teknologi Malaysia (Malaysia), BINUS University (Indonesia), Quang Binh University (Vietnam), and Nguyen Tat Thanh University (Vietnam). Our special thanks are also due to Springer for publishing the proceedings and sponsoring awards, and to all the other sponsors for their kind support.

We wish to thank the members of the Organizing Committee for their excellent work and the members of the local Organizing Committee for their considerable effort. We cordially thank all the authors, for their valuable contributions, and the other participants of this conference. The conference would not have been possible without their support. Thanks are also due to many experts who contributed to making the event a success.

We would like to extend our heartfelt thanks to Jarosław Gowin, Deputy Prime Minister of the Republic of Poland and Minister of Science and Higher Education, for his support and honorary patronage of the conference.

March 2020

Ngoc Thanh Nguyen  
Kietikul Jearanaitanakij  
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16. *PSTrustAI 2020: Special Session on Privacy, Security and Trust in Artificial Intelligence*

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### Special Session on Cyber-Physical Systems in Healthcare: Applications and Challenges (CSHAC 2020)

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### Special Session on Advanced Data Mining Techniques and Applications (ADMTA 2020)

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### **Special Session on Computer Vision and Intelligent Systems (CVIS 2020)**

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### **Special Session on Multiple Model Approach to Machine Learning (MMAML 2020)**

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### **Special Session on Computational Imaging and Vision (CIV 2020)**

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| Ba-Ngu Vo          | Curtin University, Australia                                |
| Ba-Tuong Vo        | Curtin University, Australia                                |
| Du Yong Kim        | Curtin University, Australia                                |
| Benlian Xu         | Changshu Institute of Technology, China                     |
| Peiyi Zhu          | Changshu Institute of Technology, China                     |
| Mingli Lu          | Changshu Institute of Technology, China                     |
| Weifeng Liu        | Hangzhou Danzi University, China                            |
| Ashish Khare       | University of Allahabad, India                              |
| Moonsoo Kang       | Chosun University, South Korea                              |
| Goo-Rak Kwon       | Chosun University, South Korea                              |
| Sang Woong Lee     | Gachon University, South Korea                              |
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| Bakul Gohel        | DA-IICT, India  |
| Sathya Narayanan   | NTU, Singapore  |

### **Special Session on Intelligent Systems and Algorithms in Information Sciences (ISAIS 2020)**

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| Alexej Kolcun         | Institute of Geonics, ASCR, Czech Republic                                   |
| Roman Senkerik        | Tomas Bata University in Zlin, Czech Republic                                |
| Zuzana Kominkova      | Tomas Bata University in Zlin, Czech Republic                                |
| Oplatkova             |  |
| Katerina Kostolanyova | University of Ostrava, Czech Republic  |
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| Petr Dolezel          | University of Pardubice, Czech Republic                                      |
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| Eva Kurekova          | Slovak University of Technology in Bratislava,<br>Slovakia                   |

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| Jiri Pospichal   | The University of Ss. Cyril and Methodius (UCM),<br>Slovakia |
| Vladimir Bradac  | University of Ostrava, Czech Republic                        |
| Petr Pavel       | University of Pardubice, Czech Republic                      |
| Jan Capek        | University of Pardubice, Czech Republic                      |

### **Special Session on Internet of Things and Artificial Intelligence for Energy Efficiency-Recent Advances and Future Trends (IOTAI 2020)**

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| Andino Maselena    | Universiti Tenaga Nasional, Malaysia          |
| Amit Kumar Singh   | National Institute of Technology Patna, India |
| Valentina E. Balas | Aurel Vlaicu University of Arad, Romania      |

### **Special Session on Data Modelling and Processing for Industry 4.0 (DMPI-4.0 2020)**

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| Helena Dudycz        | Wroclaw University of Economics and Business,<br>Poland      |
| Marcin Fojcik        | Western Norway University of Applied Sciences,<br>Norway     |
| Du Haizhou           | Shanghai University of Electric Power, China                 |
| Marcin Hernes        | Wroclaw University of Economics and Business,<br>Poland      |
| Wojciech Hunek       | Opole University of Technology, Poland                       |
| Marek Krótkiewicz    | Wrocław University of Science and Technology,<br>Poland      |
| Florin Leon          | Technical University Asachi of Iasi, Romania                 |
| Jing Li              | Shanghai University of Electric Power, China                 |
| Jacek Piskowski      | West Pomeranian University of Technology Szczecin,<br>Polska |
| Khoulood Salameh     | American University of Ras Al Khaimah, UAE                   |
| Predrag Stanimirović | University of Nis, Serbia                                    |
| Krystian Wojtkiewicz | Wrocław University of Science and Technology,<br>Poland      |
| Feifei Xu            | Shanghai University of Electric Power, China                 |



### Special Session on Intelligent and Contextual Systems (ICxS 2020)

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| Goutam Chakraborty     | Iwate Prefectural University, Japan                          |
| Ha Manh Tran           | Ho Chi Minh City International University, Vietnam           |
| Hong Vu Nguyen         | Ton Duc Thang University, Vietnam                            |
| Hideyuki Takahashi     | Tohoku Gakuin University, Japan                              |
| Intisar Chowdhury      | University of Aizu, Japan                                    |
| Jerzy Świątek          | Wroclaw University of Science and Technology,<br>Poland      |
| Józef Korbicz          | University of Zielona Gora, Poland                           |
| Keun Ho Ryu            | Chungbuk National University, South Korea                    |
| Khanindra Pathak       | Indian Institute of Technology Kharagpur, India              |
| Kilho Shin             | Gakushuin University, Japan                                  |
| Maciej Huk             | Wroclaw University of Science and Technology,<br>Poland      |
| Marcin Fojcik          | Western Norway University of Applied Sciences,<br>Norway     |
| Masafumi Matsuhara     | Iwate Prefectural University, Japan                          |
| Min-Hsiung Hung        | Chinese Culture University, Taiwan                           |
| Miroslava Mikusova     | University of Žilina, Slovakia                               |
| Musa Ibrahim           | Chungbuk National University, South Korea                    |
| Nguyen Khang Pham      | Can Tho University, Vietnam                                  |
| Plamen Angelov         | Lancaster University, UK                                     |
| Qiangfu Zhao           | University of Aizu, Japan                                    |
| Quan Thanh Tho         | Ho Chi Minh City University of Technology, Vietnam           |
| Rafal Palak            | Wroclaw University of Science and Technology,<br>Poland      |
| Rashmi Dutta Baruah    | Indian Institute of Technology Guwahati, India               |
| Senthilmurugan Subbiah | Indian Institute of Technology Guwahati, India               |
| Sonali Chouhan         | Indian Institute of Technology Guwahati, India               |
| Takako Hashimoto       | Chiba University of Commerce, Japan                          |
| Tetsuji Kuboyama       | Gakushuin University, Japan                                  |
| Tetsuo Kinoshita       | RIEC, Tohoku University, Japan                               |
| Thai-Nghe Nguyen       | Can Tho University, Vietnam                                  |
| Zhenni Li              | University of Aizu, Japan                                    |

### **Special Session on Automated Reasoning with Applications in Intelligent Systems (ARAIIS 2020)**

|                    |  |
|--------------------|--|
| Yuichi Goto        | Saitama University, Japan                    |
| Shinsuke Nara      | Muraoka Design Laboratory, Japan             |
| Hongbiao Gao       | North China Electric Power University, China |
| Kazunori Wagatsuma | CIJ Solutions, Japan                         |
| Yuan Zhou          | Minjiang Teachers College, China             |

### **Special Session on Intelligent Supply Chains and e-Commerce (ISCEC 2020)**

|                         |  |
|-------------------------|--|
| Carlos Andres Romano    | Polytechnic University of Valencia, Spain  |
| Costin Badica           | University of Craiova, Romania   |
| Davor Dujak             | University of Osijek, Croatia  |
| Waldemar Koczkodaj      | Laurentian University, Canada  |
| Miklós Krész            | InnoRenew, Slovenia  |
| Paweł Pawlewski         | Poznan University of Technology, Poland  |
| Paulina Golińska-Dawson | Poznan University of Economics and Business, Poland                                  |
| Adam Koliński           | Łukasiewicz Research Network – The Institute<br>of Logistics and Warehousing, Poland |
| Marcin Anholcer         | Poznan University of Economics and Business, Poland                                  |

### **Special Session on Intelligent Applications of Internet of Things and Data Analysis Technologies (IAIOTDAT 2020)**

|                    |  |
|--------------------|--|
| Goutam Chakraborty | Iwate Prefectural University, Japan          |
| Bin Dai            | University of Technology Xiamen, China       |
| Qiangfu Zhao       | University of Aizu, Japan                    |
| David C. Chou      | Eastern Michigan University, USA             |
| Chin-Feng Lee      | Chaoyang University of Technology, Taiwan    |
| Lijuan Liu         | University of Technology Xiamen, China       |
| Kien A. Hua        | Central Florida University, USA              |
| Long-Sheng Chen    | Chaoyang University of Technology, Taiwan    |
| Xin Zhu            | University of Aizu, Japan                    |
| David Wei          | Fordham University, USA                      |
| Qun Jin            | Waseda University, Japan                     |
| Jacek M. Zurada    | University of Louisville, USA                |
| Tsung-Chih Hsiao   | Huaioiao University, China                   |
| Tzu-Chuen Lu       | Chaoyang University of Technology, Taiwan    |
| Nitasha Hasteer    | Amity University Uttar Pradesh, India        |
| Chuan-Bi Lin       | Chaoyang University of Technology, Taiwan    |
| Cliff Zou          | Central Florida University, USA              |
| Hendry             | Satya Wacana Christian University, Indonesia |

**Special Session on Current Trends in Artificial Intelligence, Optimization, Learning, and Decision-Making in Bioinformatics and Bioengineering (CTAIOLDMBB 2020)**

|                        |   |
|------------------------|---|
| Sajid Gul Khawaja      | National University of Sciences and Technology,<br>Pakistan |
| Tehmina Khalil         | Mirpur University of Sciences and Technology,<br>Pakistan   |
| Arslan Shaukat         | National University of Sciences and Technology,<br>Pakistan |
| Ani Liza Asmawi        | International Islamic University, Malaysia                  |
| Martin Augustynek      | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Martin Cerny           | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Klara Fiedorova        | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Habibollah Harun       | Universiti Teknologi Malaysia, Malaysia                     |
| Lim Kok Cheng          | Universiti Tenaga Nasional, Malaysia                        |
| Roliana Ibrahim        | Universiti Teknologi Malaysia, Malaysia                     |
| Jafreezal Jaafar       | Universiti Teknologi Petronas, Malaysia                     |
| Vladimir Kasik         | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Ondrej Krejcar         | University of Hradec Kralove, Czech Republic                |
| Jan Kubiček            | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Kamil Kuca             | University of Hradec Kralove, Czech Republic                |
| Petra Maresova         | University of Hradec Kralove, Czech Republic                |
| Daniel Barvík          | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| David Oczka            | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Dominik Vilimek        | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Sigeru Omatu           | Osaka Institute of Technology, Japan                        |
| Marek Penhaker         | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Lukas Peter            | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Alice Krestanova       | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Chawalsak Phetchanchai | Suan Dusit University, Thailand                             |
| Antonino Proto         | VŠB – Technical University of Ostrava,<br>Czech Republic    |
| Naomie Salim           | Universiti Teknologi Malaysia, Malaysia                     |
| Ali Selamat            | Universiti Teknologi Malaysia, Malaysia                     |

|                         |  |
|-------------------------|--|
| Imam Much Subroto       | Universiti Islam Sultan Agung, Indonesia                           |
| Lau Sian Lun            | Sunway University, Malaysia  |
| Takeru Yokoi            | Tokyo Metropolitan International Institute<br>of Technology, Japan |
| Hazli Mohamed Zabil     | Universiti Tenaga Nasional, Malaysia                               |
| Satchidananda Dehuri    | Fakir Mohan University, India                                      |
| Pradeep Kumar Mallick   | KIIT University, India   |
| Subhashree Mishra       | KIIT University, India   |
| Cem Deniz               | NYU Langone, USA   |
| P. V. Rao               | VBIT Hyderabad, India  |
| Tathagata Bandyopadhyay | KIIT University, India   |

### **Special Session on Interactive Analysis of Image, Video and Motion Data in Life Sciences (SAILS 2020)**

|                         |  |
|-------------------------|--|
| Artur Bąk               | Polish-Japanese Academy of Information Technology,<br>Poland |
| Grzegorz Borowik        | Warsaw University of Technology, Poland                      |
| Wayne Brookes           | University of Technology Sydney, Australia                   |
| Leszek Chmielewski      | Warsaw University of Life Sciences, Poland                   |
| Zenon Chaczko           | University of Technology Sydney, Australia                   |
| David Davis             | University of Technology Sydney, Australia                   |
| Aldona Barbara Drabik   | Polish-Japanese Academy of Information Technology,<br>Poland |
| Marcin Fojcik           | Western Norway University of Applied Sciences,<br>Norway     |
| Carlo Giampietro        | University of Technology Sydney, Australia                   |
| Katarzyna Musiał-Gabrys | University of Technology Sydney, Australia                   |
| Tomasz Górski           | Polish Naval Academy, Poland                                 |
| Adam Gudyś              | Silesian University of Technology, Poland                    |
| Doan Hoang              | University of Technology Sydney, Australia                   |
| Celina Imielińska       | Vesalius Technologies LLC, USA                               |
| Frank Jiang             | University of Technology Sydney, Australia                   |
| Henryk Josiński         | Silesian University of Technology, Poland                    |
| Anup Kale               | University of Technology Sydney, Australia                   |
| Sunil Mysore Kempegowda | University of Technology Sydney, Australia                   |
| Ryszard Klempous        | Wrocław University of Technology, Poland                     |
| Ryszard Kozera          | The University of Life Sciences - SGGW, Poland               |
| Julita Kulbacka         | Wrocław Medical University, Poland                           |
| Marek Kulbacki          | Polish-Japanese Academy of Information Technology,<br>Poland |
| Aleksander Nawrat       | Silesian University of Technology, Poland                    |
| Jerzy Paweł Nowacki     | Polish-Japanese Academy of Information Technology,<br>Poland |
| Eric Petajan            | LiveClips LLC, USA   |
| Andrzej Polański        | Silesian University of Technology, Poland                    |

|                             |   |
|-----------------------------|---|
| Andrzej Przybyszewski       | UMass Medical School Worcester, USA                       |
| Joanna Rossowska            | Polish Academy of Sciences, Poland                        |
| Jakub Segen                 | Gest3D LLC, USA   |
| Aleksander Sieroń           | Medical University of Silesia, Poland                     |
| Carmen Paz Suarez Araujo    | University of Las Palmas, Spain                           |
| José Juan Santana Rodríguez | University of Las Palmas, Spain                           |
| Adam Świtoński              | Silesian University of Technology, Poland                 |
| Agnieszka Szczęsna          | Silesian University of Technology, Poland                 |
| David Tien                  | Charles Sturt University, Australia                       |
| Konrad Wojciechowski        | Polish-Japanese Academy of Information Technology, Poland |
| Robin Braun                 | University of Technology Sydney, Australia                |

### **Special Session on Application of Intelligent Methods to Constrained Problems (AIMCP 2020)**

|                                  |  |
|----------------------------------|--|
| Peter Nielsen                    | Aalborg University, Denmark                          |
| Paweł Sitek                      | Kielce University of Technology, Poland              |
| Antoni Ligeza                    | AGH University of Science and Technology, Poland     |
| Sławomir Kłos                    | University of Zielona Góra, Poland                   |
| Grzegorz Bocewicz                | Koszalin University of Technology, Poland            |
| Izabela E. Nielsen               | Aalborg University, Denmark                          |
| Zbigniew Banaszak                | Koszalin University of Technology, Poland            |
| Małgorzata Jasiulewicz-Kaczmarek | Poznan University of Technology, Poland              |
| Robert Wójcik                    | Wrocław University of Science and Technology, Poland |
| Arkadiusz Gola                   | Lublin University of Technology, Poland              |
| Marina Marinelli                 | University of Leicester, UK                          |
| Masood Ashraf                    | Aligarh Muslim University, India                     |
| Ali Turkyilmaz                   | Nazarbayev University, Kazakhstan                    |
| Chandima Ratnayake               | University of Stavanger, Norway                      |
| Marek Magdziak                   | Rzeszów University of Technology, Poland             |

### **Special Session on Privacy, Security and Trust in Artificial Intelligence (PSTrustAI 2020)**

|                       |  |
|-----------------------|--|
| M. İlhan Akbas        | Embry-Riddle Aeronautical University, USA                |
| Christoph Benz Müller | Freie Universität Berlin, Germany                        |
| Roland Bouffanais     | Singapore University of Technology and Design, Singapore |
| Bernabe Dorronsoro    | University of Cadiz, Spain                               |
| Rastko Selmic         | Concordia University, Canada                             |
| Ronaldo Menezes       | University of Exeter, UK                                 |
| Apivadee Piyatumrong  | NECTEC, Thailand   |
| Khurum Nazir Junejo   | Ibex CX, Pakistan  |

|                          |   |
|--------------------------|---|
| Daniel Stolfi            | University of Luxembourg, Luxembourg                          |
| Juan Luis Jiménez Laredo | Normandy University, France                                   |
| Kittichai Lavangnananda  | King Mongkut's University of Technology Thonburi,<br>Thailand |
| Jun Pang                 | University of Luxembourg, Luxembourg                          |
| Marco Rocchetto          | ALES, United Technologies Research Center, Italy              |
| Jundong Chen             | Dickinson State University, USA                               |
| Emmanuel Kieffer         | University of Luxembourg, Luxembourg                          |
| Fang-Jing Wu             | Technical University Dortmund, Germany                        |
| Hannes Frey              | University Koblenz-Landau, Germany                            |
| Umer Wasim               | University of Luxembourg, Luxembourg                          |
| Christian M. Adriano     | University of Potsdam, Germany                                |

### **Intelligent Modeling and Simulation Approaches for Games and Real World Systems (IMSAGRWS 2020)**

|                   |   |
|-------------------|---|
| Alabbas Alhaj Ali | Frankfurt University of Applied Sciences, Germany |
| Costin Bădică     | University of Craiova, Romania                    |
| Petru Cașcaval    | Gheorghe Asachi Technical University, Romania     |
| Gia Thuan Lam     | Vietnamese-German University, Vietnam             |
| Florin Leon       | Gheorghe Asachi Technical University, Romania     |
| Doina Logofătu    | Frankfurt University of Applied Sciences, Germany |
| Fitore Muharemi   | Frankfurt University of Applied Sciences, Germany |
| Minh Nguyen       | Frankfurt University of Applied Sciences, Germany |
| Julian Szymański  | Gdańsk University of Technology, Poland           |
| Paweł Sitek       | Kielce University of Technology, Poland           |
| Daniel Stamate    | University of London, UK                          |

## Contents – Part II

### Application of Intelligent Methods to Constrained Problems

|  |    |
|--|----|
| Configuration of Employee Competences in IT Projects . . . . .                       | 3  |
| <i>Jarosław Wikarek and Paweł Sitek</i>  |    |
| Competence-Oriented Recruitment of a Project Team<br>Robust to Disruptions . . . . . | 13 |
| <i>Eryk Szwarc, Izabela Nielsen, Czesław Smutnicki,<br/>and Grzegorz Bocewicz</i>    |    |
| Constraint Programming for New Product Development<br>Project Prototyping . . . . .  | 26 |
| <i>Marcin Relich, Izabela Nielsen, Grzegorz Bocewicz,<br/>and Zbigniew Banaszak</i>  |    |

### Automated Reasoning with Applications in Intelligent Systems

|  |    |
|--|----|
| A Knowledge Base for Industrial Control Network Security Analysis<br>and Decision-Making with Reasoning Method . . . . . | 41 |
| <i>Hongbiao Gao, Jiaming Liu, Jianbin Li, and Jingde Cheng</i>   |    |
| An Extension of Formal Analysis Method with Reasoning for Anonymity . . .  | 53 |
| <i>Yating Wang and Yuichi Goto</i>   |    |
| An Extension of Reciprocal Logics for Trust Reasoning . . . . .  | 65 |
| <i>Sameera Basit and Yuichi Goto</i>   |    |

### Current Trends in Artificial Intelligence, Optimization, Learning, and Decision-Making in Bioinformatics and Bioengineering

|   |    |
|---|----|
| Linear Classifiers with the $L_1$ Margin from a Small Number<br>of High-Dimensional Vectors . . . . .   | 79 |
| <i>Leon Bobrowski and Tomasz Łukaszuk</i>   |    |
| A Quantitative and Comparative Analysis of Edge Detectors for Biomedical<br>Image Identification Within Dynamical Noise Effect . . . . .                          | 90 |
| <i>Dominik Vilimek, Kristyna Kubikova, Jan Kubiček,<br/>Daniel Barvik, Marek Penhaker, Martin Cerny, Martin Augustynek,<br/>David Oczka, and Jaroslav Vondrak</i> |    |

|  |     |
|--|-----|
| Monitoring and Statistical Evaluation of the Effect of Outpatient<br>Pleoptic-Orthoptic Exercises . . . . .                                | 102 |
| <i>Pavla Monsportova, Martin Augustynek, Jaroslav Vondrak,<br/>Jan Kubiček, Dominik Vilimek, Jaromír Konecny, and Juraj Timkovic</i>       |     |
| Quantitative Analysis and Objective Comparison of Clustering Algorithms<br>for Medical Image Segmentation. . . . .                         | 114 |
| <i>Alice Krestanova, Jan Kubiček, Jiri Skandera, Dominik Vilimek,<br/>David Oczka, Marek Penhaker, Martin Augustynek, and Martin Cerny</i> |     |
| <b>Computer Vision and Intelligent Systems</b>   |     |
| Locally Adaptive Regression Kernels and Support Vector Machines<br>for the Detection of Pneumonia in Chest X-Ray Images. . . . .           | 129 |
| <i>Ara Abigail E. Ambita, Eujene Nikka V. Boquio,<br/>and Prospero C. Naval Jr.</i>  |     |
| Deep Feature Extraction for Panoramic Image Stitching . . . . .  | 141 |
| <i>Van-Dung Hoang, Diem-Phuc Tran, Nguyen Gia Nhu, The-Anh Pham,<br/>and Van-Huy Pham</i>  |     |
| Video-Based Traffic Flow Analysis for Turning Volume Estimation<br>at Signalized Intersections . . . . .                                   | 152 |
| <i>Khac-Hoai Nam Bui, Hongsuk Yi, Heejin Jung, and Jiho Cho</i>  |     |
| Slice Operator for Efficient Convolutional Neural Network Architecture . . . .   | 163 |
| <i>Van-Thanh Hoang and Kang-Hyun Jo</i>  |     |
| Weighted Stable Matching Algorithm as an Approximated Method<br>for Assignment Problems . . . . .  | 174 |
| <i>Duc Duong Lam, Van Tuan Nguyen, Manh Ha Le, Manh Tiem Nguyen,<br/>Quang Bang Nguyen, and Tran Su Le</i>                                 |     |
| <b>Data Modelling and Processing for Industry 4.0</b>  |     |
| User-Friendly MES Interfaces: Recommendations for an AI-Based Chatbot<br>Assistance in Industry 4.0 Shop Floors . . . . .                  | 189 |
| <i>Soujanya Mantravadi, Andreas Dyrøy Jansson, and Charles Møller</i>  |     |
| Modelling Shipping 4.0: A Reference Architecture<br>for the Cyber-Enabled Ship . . . . .   | 202 |
| <i>Georgios Kavallieratos, Sokratis Katsikas, and Vasileios Gkioulos</i>   |     |
| Effective Data Redistribution Based on User Queries in a Distributed<br>Graph Database . . . . .   | 218 |
| <i>Lucie Svitáková, Michal Valenta, and Jaroslav Pokorný</i>   |     |



|   |            |
|---|------------|
| <b>The Functionalities of Cognitive Technology in Management Control System. . . . .</b>  | <b>230</b> |
| <i>Andrzej Bytniewski, Kamal Matouk, Anna Chojnacka-Komorowska, Marcin Hernes, Adam Zawadzki, and Agata Kozina</i>                                      |            |
| <b>Towards the Continuous Processes Modeling of Grain Handling in Storage Facility Using Unified Process Metamodel . . . . .</b>                        | <b>241</b> |
| <i>Krystian Wojtkiewicz, Rafał Palak, Marek Krótkiewicz, Marcin Jodłowiec, Wiktoria Wojtkiewicz, and Katarzyna Szwedziak</i>                            |            |
| <b>Intelligent Applications of Internet of Things and Data Analysis Technologies</b>  |            |
| <b>Applications of Fuzzy Inference System on V2V Routing in Vehicular Networks. . . . .</b>   | <b>255</b> |
| <i>Yung-Fa Huang, Teguh Indra Bayu, Shin-Hong Liu, Hui-Yu Huang, and Wen Huang</i>  |            |
| <b>A kNN Based Position Prediction Method for SNS Places . . . . .</b>  | <b>266</b> |
| <i>Jong-Shin Chen, Huai-Yi Huang, and Chi-Yueh Hsu</i>  |            |
| <b>Performance of Particle Swarm Optimization on Subcarrier Allocation for Device-to-Device Multicasting in Wireless Communication Systems. . . . .</b> | <b>274</b> |
| <i>Yung-Fa Huang, Tan-Hsu Tan, Chuan-Bi Lin, Yung-Hoh Sheu, Ching-Mu Chen, and Song-Ping Liu</i>  |            |
| <b>Comparative Analysis of Restricted Boltzmann Machine Models for Image Classification . . . . .</b>   | <b>285</b> |
| <i>Christine Dewi, Rung-Ching Chen, Hendry, and Hsiu-Te Hung</i>  |            |
| <b>Intelligent and Contextual Systems</b>   |            |
| <b>AQM Mechanism with Neuron Tuning Parameters . . . . .</b>  | <b>299</b> |
| <i>Jakub Szygula, Adam Domański, Joanna Domańska, Tadeusz Czachórski, Dariusz Marek, and Jerzy Klamka</i>   |            |
| <b>Deep Reconstruction Error Based Unsupervised Outlier Detection in Time-Series . . . . .</b>  | <b>312</b> |
| <i>Tsatsral Amarbayasgalan, Heon Gyu Lee, Pham Van Huy, and Keun Ho Ryu</i>   |            |
| <b>VAR-GRU: A Hybrid Model for Multivariate Financial Time Series Prediction. . . . .</b>   | <b>322</b> |
| <i>Lkhagvadorj Munkhdalai, Meijing Li, Nipon Theera-Umpon, Sansanee Auephanwiriyaikul, and Keun Ho Ryu</i>  |            |

|   |     |
|---|-----|
| Contextual Anomaly Detection in Time Series Using Dynamic Bayesian Network . . . . .  | 333 |
| <i>Achyut Mani Tripathi and Rashmi Dutta Baruah</i>   |     |
| Stochastic Optimization of Contextual Neural Networks with RMSprop . . . . .  | 343 |
| <i>Maciej Huk</i>   |     |
| Soft Dropout Method in Training of Contextual Neural Networks . . . . .   | 353 |
| <i>Krzysztof Wolk, Rafał Palak, and Erik Dawid Burnell</i>  |     |
| The Impact of Constant Field of Attention on Properties of Contextual Neural Networks . . . . .                                       | 364 |
| <i>Erik Dawid Burnell, Krzysztof Wolk, Krzysztof Waliczek, and Rafał Kern</i>   |     |
| <b>Intelligent Systems and Algorithms in Information Sciences</b>   |     |
| Soft Computing-Based Control System of Intelligent Robot Navigation . . . . .   | 379 |
| <i>Eva Volná, Martin Kotyrba, and Vladimír Bradac</i>   |     |
| End-to-End Speech Recognition in Agglutinative Languages . . . . .  | 391 |
| <i>Orken Mamyrbayev, Keylan Alimhan, Bagashar Zhumazhanov, Tolganay Turdalykzy, and Farida Gusmanova</i>                              |     |
| Approach the Interval Type-2 Fuzzy System and PSO Technique in Landcover Classification . . . . .                                     | 402 |
| <i>Dinh Sinh Mai, Long Thanh Ngo, and Le Hung Trinh</i>   |     |
| <b>Intelligent Supply Chains and e-Commerce</b>   |     |
| Logistics Value and Perceived Customer Loyalty in E-commerce: Hierarchical Linear Modeling Analysis . . . . .                         | 417 |
| <i>Arkadiusz Kawa and Justyna Światowiec-Szczepańska</i>  |     |
| Technology-Based Value Index to Outline e-Shopper Characteristics . . . . .   | 428 |
| <i>Sergiusz Strykowski and Bartłomiej Pierański</i>   |     |
| Visualized Benefit Segmentation Using Supervised Self-organizing Maps: Support Tools for Persona Design and Market Analysis . . . . . | 437 |
| <i>Fumiaki Saitoh</i>   |     |
| Food Safety Network for Detecting Adulteration in Unsealed Food Products Using Topological Ordering . . . . .                         | 451 |
| <i>Arpan Barman, Amrita Namtirtha, Animesh Dutta, and Biswanath Dutta</i>   |     |

## Privacy, Security and Trust in Artificial Intelligence

|  |     |
|--|-----|
| A Proof of Concept to Deceive Humans and Machines at Image Classification with Evolutionary Algorithms . . . . . | 467 |
| <i>Raluca Chitic, Nicolas Bernard, and Franck Leprévost</i>  |     |
| Scenario Generation for Validating Artificial Intelligence Based Autonomous Vehicles . . . . .                   | 481 |
| <i>Christopher Medrano-Berumen and Mustafa İlhan Akbaş</i>   |     |
| Privacy Protection in Location Based Service by Secure Computation . . . . .                                     | 493 |
| <i>Masato Ishikawa and Noriaki Yoshiura</i>  |     |

## Interactive Analysis of Image, Video and Motion Data in Life Sciences

|  |     |
|--|-----|
| Exploration of Explainable AI in Context of Human-Machine Interface for the Assistive Driving System. . . . .                        | 507 |
| <i>Zenon Chaczko, Marek Kulbacki, Grzegorz Gudzbeler, Mohammad Alsawwaf, Ilya Thai-Chyzykau, and Peter Wajs-Chaczko</i>              |     |
| Combining Results of Different Oculometric Tests Improved Prediction of Parkinson's Disease Development . . . . .                    | 517 |
| <i>Albert Śledzianowski, Artur Szymanski, Aldona Drabik, Stanisław Szłufik, Dariusz M. Koziorowski, and Andrzej W. Przybyszewski</i> |     |
| In Your Face: Person Identification Through Ratios of Distances Between Facial Features. . . . .                                     | 527 |
| <i>Mohammad Alsawwaf, Zenon Chaczko, and Marek Kulbacki</i>  |     |
| Eye-Tracking and Machine Learning Significance in Parkinson's Disease Symptoms Prediction . . . . .                                  | 537 |
| <i>Artur Chudzik, Artur Szymański, Jerzy Paweł Nowacki, and Andrzej W. Przybyszewski</i>   |     |
| IGrC: Cognitive and Motor Changes During Symptoms Development in Parkinson's Disease Patients . . . . .                              | 548 |
| <i>Andrzej W. Przybyszewski, Jerzy Paweł Nowacki, Aldona Drabik, Stanisław Szłufik, and Dariusz M. Koziorowski</i>                   |     |
| A New Facial Expression Recognition Scheme Based on Parallel Double Channel Convolutional Neural Network . . . . .                   | 560 |
| <i>D. T. Li, F. Jiang, and Y. B. Qin</i>   |     |
| Reversible Data Hiding Based on Prediction Error Histogram Shifting and Pixel-Based PVO . . . . .                                    | 570 |
| <i>Nguyen Kim Sao, Cao Thi Luyen, Le Kinh Tai, and Pham Van At</i>   |     |

|  |     |
|--|-----|
| An Improved Reversible Watermarking Based on Pixel Value Ordering<br>and Prediction Error Expansion. . . . . | 582 |
| <i>Le Quang Hoa, Cao Thi Luyen, Nguyen Kim Sao, and Pham Van At</i>  |     |
| Early Detection of Coronary Artery Diseases Using Endocrine Markers. . . . .                                 | 593 |
| <i>Felician Jonathan More, Zenon Chaczko, and Julita Kulbacka</i>  |     |
| <b>Author Index</b> . . . . .  | 603 |

# Contents – Part I

## Knowledge Engineering and Semantic Web

|  |    |
|--|----|
| Toward Blockchain-Assisted Gamified Crowdsourcing<br>for Knowledge Refinement. . . . .                                       | 3  |
| <i>Helun Bu and Kazuhiro Kuwabara</i>  |    |
| Predicting Research Collaboration Trends Based on the Similarity<br>of Publications and Relationship of Scientists . . . . . | 15 |
| <i>Tuong Tri Nguyen, Ngoc Thanh Nguyen, Dinh Tuyen Hoang,<br/>and Van Cuong Tran</i>   |    |
| Assessing the Influence of Conflict Profile Properties on the Quality<br>of Consensus . . . . .                              | 25 |
| <i>Adrianna Kozierkiewicz, Marcin Pietranik, and Mateusz Sitarczyk</i>   |    |
| OWL RL to Framework for Ontological Knowledge Integration<br>Preliminary Transformation . . . . .                            | 37 |
| <i>Bogumiła Hnatkowska, Adrianna Kozierkiewicz, and Marcin Pietranik</i>   |    |

## Natural Language Processing

|  |    |
|--|----|
| Cached Embedding with Random Selection: Optimization Technique<br>to Improve Training Speed of Character-Aware Embedding . . . . . | 51 |
| <i>Yaofei Yang, Hua-Ping Zhang, Linfang Wu, Xin Liu, and Yangsen Zhang</i>   |    |
| A Comparative Study of Pretrained Language Models on Thai Social<br>Text Categorization . . . . .                                  | 63 |
| <i>Thanapapas Horsuwan, Kasidis Kanwatchara, Peerapon Vateekul,<br/>and Boonserm Kijsirikul</i>                                    |    |
| Comparative Analysis of Deep Learning Models for Myanmar<br>Text Classification. . . . .   | 76 |
| <i>Myat Sapal Phyu and Khin Thandar Nwet</i>   |    |
| Open Information Extraction as Additional Source for Kazakh<br>Ontology Generation . . . . .                                       | 86 |
| <i>Nina Khairova, Svitlana Petrasova, Orken Mamyrbayev,<br/>and Kuralay Mukhsina</i>   |    |
| Comparing High Dimensional Word Embeddings Trained on Medical Text<br>to Bag-of-Words for Predicting Medical Codes. . . . .        | 97 |
| <i>Vithya Yogarajan, Henry Gouk, Tony Smith, Michael Mayo,<br/>and Bernhard Pfahringer</i>   |    |

|  |     |
|--|-----|
| Dyslexic Frequency Signatures in Relaxation and Letter Writing . . . . .   | 109 |
| <i>N. B. Mohamad, Khuan Y. Lee, W. Mansor, Z. Mahmoodin,<br/>C. W. N. F. Che Wan Fadzal, and S. Amirin</i>                                       |     |
| <b>Decision Support and Control Systems</b>  |     |
| A Trading Framework Based on Fuzzy Moore Machines . . . . .  | 123 |
| <i>Iván Calvo, Mercedes G. Merayo, and Manuel Núñez</i>  |     |
| Fuzzyfication of Repeatable Trust Game . . . . .   | 135 |
| <i>Anna Motylska-Kuźma and Jacek Mercik</i>  |     |
| Online Auction and Optimal Stopping Game with Imperfect Observation . . .  | 145 |
| <i>Vladimir Mazalov and Anna Ivashko</i>   |     |
| Metaheuristics for Discovering Favourable Continuous Intravenous<br>Insulin Rate Protocols from Historical Patient Data . . . . .                | 157 |
| <i>Hongyu Wang, Lynne Chepulis, Ryan G. Paul, and Michael Mayo</i>   |     |
| Continuous-Time Approach to Discrete-Time PID Control for UPS<br>Inverters - A Case Study . . . . .  | 170 |
| <i>Marian Błachuta, Zbigniew Rymarski, Robert Bieda, Krzysztof Bernacki,<br/>and Rafał Grygiel</i>   |     |
| On Stabilizability of Discrete Time Systems with Delay in Control . . . . .  | 182 |
| <i>Artur Babiarz, Adam Czornik, and Jerzy Klamka</i>   |     |
| A Simple yet Efficient MCSes Enumeration with SAT Oracles . . . . .  | 191 |
| <i>Miyuki Koshimura and Ken Satoh</i>  |     |
| <i>Alpha-N</i> : Shortest Path Finder Automated Delivery Robot with Obstacle<br>Detection and Avoiding System . . . . .                          | 202 |
| <i>Asif Ahmed Neloy, Rafia Alif Bindu, Sazid Alam, Ridwanul Haque,<br/>Md. Saif Ahammod Khan, Nasim Mahmud Mishu,<br/>and Shahnewaz Siddique</i> |     |
| Image Representation for Cognitive Systems Using SOEKS and DDNA:<br>A Case Study for PPE Compliance . . . . .                                    | 214 |
| <i>Caterine Silva de Oliveira, Cesar Sanin, and Edward Szczerbicki</i>   |     |
| Harmony Search Algorithm with Dynamic Adjustment of <i>PAR</i> Values<br>for Asymmetric Traveling Salesman Problem . . . . .                     | 226 |
| <i>Krzysztof Szwarec and Urszula Boryczka</i>  |     |
| Graph-Based Optimization of Public Lighting Retrofit . . . . .   | 239 |
| <i>Adam Sędziwy and Leszek Kotulski</i>  |     |

|  |     |
|--|-----|
| Solving the Unrelated Parallel Machine Scheduling Problem with Setups<br>Using Late Acceptance Hill Climbing . . . . . | 249 |
| <i>Mourad Terzi, Taha Arbaoui, Farouk Yalaoui, and Karima Benatchba</i>  |     |

## Computer Vision Techniques

|   |     |
|---|-----|
| Study on Digital Image Evolution of Artwork by Using<br>Bio-Inspired Approaches . . . . .                             | 261 |
| <i>Julia Garbaruk, Doina Logofătu, Costin Bădică, and Florin Leon</i>   |     |
| 3D Model-Based 6D Object Pose Tracking on RGB Images. . . . .   | 271 |
| <i>Mateusz Majcher and Bogdan Kwolek</i>  |     |
| Angiodysplasia Segmentation on Capsule Endoscopy Images Using<br>AlbuNet with Squeeze-and-Excitation Blocks . . . . . | 283 |
| <i>Sirichart Gobpradit and Peerapon Vateekul</i>  |     |
| GOHAG: GANs Orchestration for Human Actions Generation . . . . .  | 294 |
| <i>Aziz Siyaev and Geun-Sik Jo</i>  |     |

## Machine Learning and Data Mining

|  |     |
|--|-----|
| Finger-Vein Classification Using Granular Support Vector Machine . . . . .                                       | 309 |
| <i>Ali Selamat, Roliana Ibrahim, Sani Suleiman Isah, and Ondrej Krejcar</i>                                      |     |
| Mining Non-redundant Periodic Frequent Patterns . . . . .  | 321 |
| <i>Michael Kofi Afriyie, Vincent Mwintieru Nofong, John Wondoh,<br/>and Hamidu Abdel-Fatao</i>                   |     |
| On Robustness of Adaptive Random Forest Classifier on Biomedical<br>Data Stream . . . . .                        | 332 |
| <i>Hayder K. Fatlawi and Attila Kiss</i>   |     |
| Sentence Writing Test for Parkinson Disease Modeling: Comparing<br>Predictive Ability of Classifiers. . . . .    | 345 |
| <i>Aleksei Netšunajev, Sven Nõmm, Aaro Toomela, Kadri Medijainen,<br/>and Pille Taba</i>                         |     |
| Confidence in Prediction: An Approach for Dynamic Weighted Ensemble . . .  | 358 |
| <i>Duc Thuan Do, Tien Thanh Nguyen, The Trung Nguyen, Anh Vu Luong,<br/>Alan Wee-Chung Liew, and John McCall</i> |     |
| Towards Personalized Radio-Chemotherapy – Learning from Clinical Data<br>vs. Model Optimization . . . . .        | 371 |
| <i>Andrzej Świerniak, Jarosław Śmieja, Krzysztof Fajarewicz,<br/>and Rafał Suwiński</i>                          |     |

|   |     |
|---|-----|
| Inference Ability Assessment of Modified Differential Neural Computer . . . .   | 380 |
| <i>Urszula Markowska-Kaczmar and Grzegorz Kulakowski</i>  |     |
| Simple Quantum Circuits for Data Classification. . . . .  | 392 |
| <i>Joanna Wiśniewska and Marek Sawerwain</i>  |     |
| A DCA Based Algorithm for Feature Selection<br>in Model-Based Clustering. . . . .   | 404 |
| <i>Viet Anh Nguyen, Hoai An Le Thi, and Hoai Minh Le</i>  |     |
| PRTNets: Cold-Start Recommendations Using Pairwise Ranking<br>and Transfer Networks. . . . .                                  | 416 |
| <i>Dylan M. Valerio and Prospero C. Naval Jr.</i>   |     |
| <b>Deep Learning Models</b>   |     |
| Dynamic Prototype Selection by Fusing Attention Mechanism<br>for Few-Shot Relation Classification . . . . .                   | 431 |
| <i>Linfang Wu, Hua-Ping Zhang, Yaofei Yang, Xin Liu, and Kai Gao</i>  |     |
| An Enhanced CNN Model on Temporal Educational Data<br>for Program-Level Student Classification . . . . .                      | 442 |
| <i>Chau Vo and Hua Phung Nguyen</i>   |     |
| Ensemble of Multi-channel CNNs for Multi-class Time-Series<br>Classification. Depth-Based Human Activity Recognition. . . . . | 455 |
| <i>Jacek Trelński and Bogdan Kwolek</i>   |     |
| Post-training Quantization Methods for Deep Learning Models. . . . .  | 467 |
| <i>Piotr Kluska and Maciej Zięba</i>  |     |
| Semi-supervised Representation Learning for 3D Point Clouds . . . . .   | 480 |
| <i>Adrian Zdobyłak and Maciej Zieba</i>   |     |
| Stock Return Prediction Using Dual-Stage Attention Model with Stock<br>Relation Inference. . . . .                            | 492 |
| <i>Tanawat Chiewhawan and Peerapon Vateekul</i>   |     |
| Comparison of Aggregation Functions for 3D Point Clouds Classification . . .  | 504 |
| <i>Maciej Zamorski, Maciej Zięba, and Jerzy Świątek</i>   |     |
| Benign and Malignant Skin Lesion Classification Comparison for Three<br>Deep-Learning Architectures. . . . .                  | 514 |
| <i>Ercument Yilmaz and Maria Trocan</i>   |     |



## Advanced Data Mining Techniques and Applications

|  |     |
|--|-----|
| Automatic Parameter Setting in Hough Circle Transform . . . . .  | 527 |
| <i>Pei-Yu Huang, Chih-Sheng Hsu, Tzung-Pei Hong, Yan-Zhih Wang,<br/>Shin-Feng Huang, and Shu-Min Li</i>  |     |
| Construction of an Intelligent Tennis Coach Based on Kinect<br>and a Sensor-Based Tennis Racket . . . . .  | 536 |
| <i>Chun-Hao Chen, Che-Kai Fan, and Tzung-Pei Hong</i>  |     |
| Data Pre-processing Based on Convolutional Neural Network<br>for Improving Precision of Indoor Positioning . . . . .   | 545 |
| <i>Eric Hsueh-Chan Lu, Kuei-Hua Chang, and Jing-Mei Ciou</i>   |     |
| Efficient Approaches for Updating Sequential Patterns. . . . .   | 553 |
| <i>Show-Jane Yen and Yue-Shi Lee</i>   |     |
| Improving Accuracy of Peacock Identification in Deep Learning Model<br>Using Gaussian Mixture Model and Speeded Up Robust Features. . . . .  | 565 |
| <i>Tzu-Ting Chen, Ding-Chau Wang, Min-Xiung Liu, Chi-Luen Fu,<br/>Lin-Yi Jiang, Gwo-Jiun Horng, Kawuu W. Lin, Mao-Yuan Pai,<br/>Tz-Heng Hsu, Yu-Chuan Lin, Min-Hsiung Hung, and C.-C. Chen</i> |     |
| A Lifelong Sentiment Classification Framework Based on a Close<br>Domain Lifelong Topic Modeling Method . . . . .  | 575 |
| <i>Thi-Cham Nguyen, Thi-Ngan Pham, Minh-Chau Nguyen,<br/>Tri-Thanh Nguyen, and Quang-Thuy Ha</i>   |     |

## Multiple Model Approach to Machine Learning

|  |     |
|--|-----|
| Data Preprocessing for DES-KNN and Its Application to Imbalanced<br>Medical Data Classification . . . . .    | 589 |
| <i>Maciej Kinal and Michał Woźniak</i>   |     |
| Novel Approach to Gentle AdaBoost Algorithm with Linear<br>Weak Classifiers . . . . .                        | 600 |
| <i>Robert Burduk, Wojciech Bożejko, and Szymon Zacher</i>  |     |
| Automatic Natural Image Colorization . . . . .   | 612 |
| <i>Tan-Bao Tran and Thai-Son Tran</i>  |     |
| Remote Usability Testing of Data Input Methods for Web Applications. . . . .                                 | 622 |
| <i>Krzysztof Osada, Patient Zihisire Muke, Mateusz Piwowarczyk,<br/>Zbigniew Telec, and Bogdan Trawiński</i> |     |

|   |            |
|---|------------|
| <b>Machine Learning Models for Real Estate Appraisal Constructed Using<br/>Spline Trend Functions . . . . .</b>         | <b>636</b> |
| <i>Mateusz Jarosz, Marcin Kutrzyński, Tadeusz Lasota,<br/>Mateusz Piwowarczyk, Zbigniew Telec, and Bogdan Trawiński</i> |            |
| <b>Author Index . . . . .</b>   | <b>649</b> |