Lecture Notes in Networks and Systems

Volume 278

The series "Lecture Notes in Networks and Systems" publishes the latest developments in Networks and Systems—quickly, informally and with high quality. Original research reported in proceedings and post-proceedings represents the core of LNNS.

Volumes published in LNNS embrace all aspects and subfields of, as well as new challenges in, Networks and Systems.

The series contains proceedings and edited volumes in systems and networks, spanning the areas of Cyber-Physical Systems, Autonomous Systems, Sensor Networks, Control Systems, Energy Systems, Automotive Systems, Biological Systems, Vehicular Networking and Connected Vehicles, Aerospace Systems, Automation, Manufacturing, Smart Grids, Nonlinear Systems, Power Systems, Robotics, Social Systems, Economic Systems and other. Of particular value to both the contributors and the readership are the short publication timeframe and the world-wide distribution and exposure which enable both a wide and rapid dissemination of research output.

The series covers the theory, applications, and perspectives on the state of the art and future developments relevant to systems and networks, decision making, control, complex processes and related areas, as embedded in the fields of interdisciplinary and applied sciences, engineering, computer science, physics, economics, social, and life sciences, as well as the paradigms and methodologies behind them.

Indexed by SCOPUS, INSPEC, WTI Frankfurt eG, zbMATH, SCImago.

All books published in the series are submitted for consideration in Web of Science.

More information about this series at http://www.springer.com/series/15179

Leonard Barolli · Kangbin Yim ·
Tomoya Enokido
Editors

Complex, Intelligent and Software Intensive Systems

Proceedings of the 15th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2021)

Springer

Editors
Leonard Barolli
Department of Information
and Communication Engineering
Fukuoka Institute of Technology
Fukuoka, Japan

Kangbin Yim
Department of Information
Security Engineering
Soonchunhyang University
Asan, Korea (Republic of)

Tomoya Enokido
Faculty of Bussiness Administration
Rissho University
Tokyo, Japan

ISSN 2367-3370 ISSN 2367-3389 (electronic)
Lecture Notes in Networks and Systems
ISBN 978-3-030-79724-9 ISBN 978-3-030-79725-6 (eBook)
https://doi.org/10.1007/978-3-030-79725-6

Welcome Message of CISIS-2021 International Conference Organizers

Welcome to the 15th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2021), which will be held from July 1 to July 3, 2021, at Soon Chun Hyang (SCH) University, Asan, Korea, in conjunction with the 15th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2021).

The aim of the conference is to deliver a platform of scientific interaction between the three interwoven challenging areas of research and development of future ICT-enabled applications: software intensive systems, complex systems and intelligent systems.

Software intensive systems are systems, which heavily interact with other systems, sensors, actuators, devices, other software systems and users. More and more domains are involved with software intensive systems, e.g., automotive, telecommunication systems, embedded systems in general, industrial automation systems and business applications. Moreover, the outcome of web services delivers a new platform for enabling software intensive systems. The conference is thus focused on tools, practically relevant and theoretical foundations for engineering software intensive systems.

Complex systems research is focused on the overall understanding of systems rather than its components. Complex systems are very much characterized by the changing environments in which they act by their multiple internal and external interactions. They evolve and adapt through internal and external dynamic interactions.

The development of intelligent systems and agents, which is each time more characterized by the use of ontologies and their logical foundations, builds a fruitful impulse for both software intensive systems and complex systems. Recent research in the field of intelligent systems, robotics, neuroscience, artificial intelligence and cognitive sciences is a very important factor for the future development and innovation of software intensive and complex systems.

The CISIS-2021 is aiming at delivering a forum for in-depth scientific discussions among the three communities. The papers included in the proceedings cover all aspects of theory, design and application of complex systems, intelligent systems and software intensive systems.

We are very proud and honored to have two distinguished keynote talks by Dr. Jayh (Hyunhee) Park, Myongji University, Korea, and Dr. Antonio Esposito, University of Campania "Luigi Vanvitelli", Italy, who will present their recent work and will give new insights and ideas to the conference participants.

The organization of an international conference requires the support and help of many people. A lot of people have helped and worked hard to produce a successful CISIS-2021 technical program and conference proceedings. First, we would like to thank all the authors for submitting their papers, the program committee members and the reviewers who carried out the most difficult work by carefully evaluating the submitted papers. We are grateful to Honorary Co-Chairs Kyoil Suh, Soon Chun Hyang (SCH) University, Korea, and Prof. Makoto Takizawa, Hosei University, Japan, for their guidance and advices.

Finally, we would like to thank Web Administrator Co-Chairs for their excellent and timely work.

We hope you will enjoy the conference proceedings.

Organization

CISIS-2021 Organizing Committee

Honorary Co-chairs

Kyoil Suh	Soonchunhyang University, Korea
Makoto Takizawa	Hosei University, Japan

General Co-chairs

Kangbin Yim	Soonchunhyang University, Korea
Tomoya Enokido	Rissho University, Japan
Marek Ogiela	AGH University of Technology, Poland

Program Committee Co-chairs

Jonghyouk Lee	Sejong University, Korea
Antonio Esposito	University of Campania "Luigi Vanvitelli", Italy
Omar Hussain	University of New South Wales, Australia

International Advisory Board

David Taniar	Monash University, Australia
Minoru Uehara	Toyo University, Japan
Arjan Durresi	IUPUI, USA
Beniamino Di Martino	University of Campania "L. Vanvitelli", Italy

Award Co-chairs

Akio Koyama	Yamagata University, Japan
Kin Fun Li	University of Victoria, Canada
Kiwoong Park	Sejong University, Korea
Olivier Terzo	LINKS Foundation, Italy

International Liaison Co-chairs

Wenny Rahayu	La Trobe University, Australia
Fumiaki Sato	Toho University, Japan
Flora Amato	University of Naples Frederico II, Italy

Publicity Co-chairs

Nadeem Javaid	COMSATS University Islamabad, Pakistan
Takahiro Uchiya	Nagoya Institute of Technology, Japan
Markus Aleksy	ABB AG Corporate Research Center, Germany
Farookh Hussain	University of Technology Sydney, Australia

Finance Chair

Makoto Ikeda	Fukuoka Institute of Technology, Japan

Local Arrangement Co-chairs

Seongkeun Park	Soonchunhyang University, Korea
Kyuhaeng Lee	Soonchunhyang University, Korea
Taeyoon Kim	Soonchunhyang University, Korea

Web Administrator Chairs

Phudit Ampririt	Fukuoka Institute of Technology, Japan
Kevin Bylykbashi	Fukuoka Institute of Technology, Japan
Ermioni Qafzezi	Fukuoka Institute of Technology, Japan

Steering Committee Chair

Leonard Barolli	Fukuoka Institute of Technology, Japan

Track Areas and PC Members

1. Database and Data Mining Applications

Track Co-chairs

Kin Fun Li	University of Victoria, Canada
Pavel Krömer	Technical University of Ostrava, Czech Republic

PC Members

Antonio Attanasio	Links Foundation, Italy
Tibebe Beshah	Addis Ababa University, Etiopia

Jana Heckenbergerova	University of Pardubice, Czech Republic
Konrad Jackowski	Wroclaw University of Technology, Poland
Petr Musílek	University of Alberta, Canada
Aleš Zamuda	University of Maribor, Slovenia
Genoveva Vargas-Solar	French Council of Scientific Research, LIG-LAFMIA, France
Xiaolan Sha	Sky, UK
Kosuke Takano	Kanagawa Institute of Technology, Japan
Masahiro Ito	Toshiba Lab, Japan
Watheq ElKharashi	Ain Shams University, Egypt
Mohamed Elhaddad	University of Victoria, Canada
Wei Lu	Keene State College, USA

2. Artificial Intelligence and Bio-inspired Computing

Track Co-chairs

Hai Dong	Royal Melbourne Institute of Technology, Australia
Salvatore Vitabile	University of Palermo, Italy
Urszula Ogiela	Pedagogical University of Krakow, Poland

PC Members

Kit Yan Chan	Curtin University, Australia
Shang-Pin Ma	National Taiwan Ocean University, Taiwan
Pengcheng Zhang	Hohai University, China
Le Sun	Nanjing University of Information Science and Technology, China
Sajib Mistry	Curtin University, Australia
Klodiana Goga	Istituto Superiore Mario Boella, Italy
Vincenzo Conti	University of Enna Kore, Italy
Minoru Uehara	Toyo University, Japan
Philip Moore	Lanzhou University, China
Mauro Migliardi	University of Padua, Italy
Dario Bonino	CHILI, Italy
Andrea Tettamanzi	University of Nice, France
Cornelius Weber	Hamburg University, Germany
Tim Niesen	German Research Center for Artificial Intelligence (DFKI), Germany
Rocco Raso	German Research Center for Artificial Intelligence (DFKI), Germany
Fulvio Corno	Politecnico di Torino, Italy

3. Multimedia Systems and Virtual Reality

Track Co-chairs

Yoshinari Nomura	Okayama University, Japan
Santi Caballé	Open University of Catalonia, Spain
Shinji Sugawara	Chiba Institute of Technology, Japan

PC Members

Shunsuke Mihara	Lockon Inc., Japan
Shunsuke Oshima	Kumamoto National College of Technology, Japan
Yuuichi Teranishi	NICT, Japan
Kazunori Ueda	Kochi University of Technology, Japan
Hideaki Yanagisawa	National Institute of Technology, Tokuyama College, Japan
Kaoru Sugita	Fukuoka Institute of Technology, Japan
Keita Matsuo	Fukuoka Institute of Technology, Japan
Santi Caballé	Open University of Catalonia, Spain
Nobuo Funabiki	Okayama University, Japan
Yoshihiro Okada	Kyushu University, Japan
Tomoyuki Ishida	Fukuoka Institute of Technology, Japan
Nicola Capuano	University of Basilicata, Italy
Jordi Conesa	Universitat Oberta de Catalunya, Spain
Farzin Asadi	Kocaeli University, Kocaeli, Turkey
David Gañan	Universitat Oberta de Catalunya, Spain
Le Hoang Son	Vietnam National University, Vietnam
Jorge Miguel	Grupo San Valero, Spain
David Newell	Bournemouth University, UK

4. Next Generation Wireless Networks

Track Co-chairs

Marek Bolanowski	Rzeszow University of Technology, Poland
Andrzej Paszkowski	Rzeszow University of Technology, Poland
Sriram Chellappan	Missouri University of Science and Technology, USA

PC Members

Yunfei Chen	University of Warwick, UK
Elis Kulla	Okayama University of Science, Japan
Admir Barolli	Aleksander Moisiu University, Albania
Makoto Ikeda	Fukuoka Institute of Technology, Japan
Keita Matsuo	Fukuoka Institute of Technology, Japan
Shinji Sakamoto	Seikei University, Japan

Omer Wagar	University of Engineering & Technology, Poland
Zhibin Xie	Jiangsu University of Science and Technology, China
Jun Wang	Nanjing University of Post and Telecommunication, China
Vamsi Paruchuri	University of Central Arkansas, USA
Arjan Durresi	IUPUI, USA
Bhed Bista	Iwate Prefectural University, Japan
Tadeusz Czachórski	Polish Academy of Sciences, Poland

5. Semantic Web and Web Services

Track Co-chairs

Antonio Messina	Istituto di Calcolo e Reti ad Alte Prestazione CNR, Italy
Ilona Bluemke	Warsaw University of Technology, Poland
Natalia Kryvinska	Comenius University in Bratislava, Slovakia

PC Members

Alba Amato	Italian National Recserch Center (CNR), Italy
Nik Bessis	Edge Hill University, UK
Robert Bestak	Czech Technical University in Prague, Czech Republic
Ivan Demydov	Lviv Polytechnic National University, Ukraine
Marouane El Mabrouk	Abdelmalek Essaadi University, Morocco
Corinna Engelhardt-Nowitzki	University of Apllied Sciences, Austria
Michal Gregus	Comenius University in Bratislava, Slovakia
Jozef Juhar	Technical University of Košice, Slovakia
Nikolay Kazantsev	National Research University, Russia
Manuele Kirsch Pinheiro	Université Paris 1 Panthéon Sorbonne, France
Cristian Lai	CRS4 Center for Advanced Studies, Italy
Michele Melchiori	University of Brescia, Italy
Giovanni Merlino	Uniersity of Messina, Italy
Kamal Bashah Nor Shahniza	Universiti Teknologi MARA, Malaysia
Eric Pardede	La Trobe University, Australia
Aneta Poniszewska-Maranda	Lodz University of Technology, Poland
Pethuru Raj	IBM Global Cloud Center of Excellence, India
Jose Luis Vazquez Avila	University of Quintana Roo, México
Salvatore Venticinque	University of Campania “Luigi Vanvitelli”, Italy
Anna Derezinska	Warsaw University of Technology, Poland

6. Security and Trusted Computing

Track Co-chairs

Hiroaki Kikuchi	Meiji University, Japan
Omar Khadeer Hussain	University of New South Wales (UNSW) Canberra, Australia
Lidia Fotia	University of Calabria, Italy

PC Members

Saqib Ali	Sultan Qaboos University, Oman
Zia Rehman	COMSATS University Islamabad, Pakistan
Morteza Saberi	University of New South Wales (UNSW) Canberra, Australia
Sazia Parvin	University of New South Wales (UNSW) Canberra, Australia
Farookh Hussain	University of Technology Sydney, Australia
Walayat Hussain	University of Technology Sydney, Australia
Sabu Thampi	Indian Institute of Information Technology and Management - Kerala (IIITM-K) Technopark Campus, India
Sun Jingtao	National Institute of Informatics, Japan
Anitta Patience Namanya	University of Bradford, UK
Smita Rai	Uttarakhand Board of Technical Education Roorkee, India
Abhishek Saxena	American Tower Corporation Limited, India
Ilias K. Savvas	University of Thessaly, Greece
Fabrizio Messina	University of Catania, Italy
Domenico Rosaci	University Mediterranea of Reggio Calabria, Italy
Alessandra De Benedictis	University of Naples "Frederico II", Italy

7. HPC and Cloud Computing Services and Orchestration Tools

Track Co-chairs

Olivier Terzo	Links Foundation, Italy
Jan Martinovič	IT4Innovations National Supercomputing Center, VSB Technical University of Ostrava, Czech Republic
Jose Luis Vazquez-Poletti	Universidad Complutense de Madrid, Spain

PC Members

Alberto Scionti	Links Foundation, Italy
Antonio Attanasio	Links Foundation, Italy
Jan Platos	VŠB-Technical University of Ostrava, Czech Republic

Rustem Dautov	Kazan Federal University, Russia
Giovanni Merlino	University of Messina, Italy
Francesco Longo	University of Messina, Italy
Dario Bruneo	University of Messina, Italy
Nik Bessis	Edge Hill University, UK
MingXue Wang	Ericsson, Ireland
Luciano Gaido	Istituto Nazionale di Fisica Nucleare (INFN), Italy
Giacinto Donvito	Istituto Nazionale di Fisica Nucleare (INFN), Italy
Andrea Tosatto	Open-Xchange, Germany
Mario Cannataro	University "Magna Græcia" of Catanzaro, Italy
Agustin C. Caminero	Universidad Nacional de Educación a Distancia, Spain
Dana Petcu	West University of Timisoara, Romania
Marcin Paprzycki	Systems Research Institute, Polish Academy of Sciences, Poland
Rafael Tolosana	Universidad de Zaragoza, Spain

8. Parallel, Distributed and Multicore Computing

Track Co-chairs

Eduardo Alchieri	University of Brasilia, Brazil
Valentina Casola	University of Naples "Federico II", Italy
Lidia Ogiela	Pedagogical University of Krakow, Poland

PC Members

Aldelir Luiz	Catarinense Federal Institute, Brazil
Edson Tavares	Federal University of Technology—Parana, Brazil
Fernando Dotti	Pontificia Universidade Catolica do Rio Grande do Sul, Brazil
Hylson Neto	Catarinense Federal Institute, Brazil
Jacir Bordim	University of Brasilia, Brazil
Lasaro Camargos	Federal University of Uberlandia, Brazil
Luiz Rodrigues	Western Parana State University, Brazil
Marcos Caetano	University of Brasilia, Brazil
Flora Amato	University of Naples "Federico II", Italy
Urszula Ogiela	Pedagogical University of Krakow, Poland

9. Energy Aware Computing and Systems

Track Co-chairs

Muzammil Behzad	University of Oulu, Finland
Zahoor Ali Khan	Higher Colleges of Technology, United Arab Emirates

PC Members

Naveed Ilyas	Gwangju Institute of Science and Technology, South Korea
Muhammad Sharjeel Javaid	University of Hafr Al Batin, Saudi Arabia
Muhammad Talal Hassan	COMSATS University Islamabad, Pakistan
Waseem Raza	University of Lahore, Pakistan
Ayesha Hussain	COMSATS University Islamabad, Pakistan
Umar Qasim	University of Alberta, Canada
Nadeem Javaid	COMSATS University Islamabad, Pakistan
Yasir Javed	Higher Colleges of Technology, UAE
Kashif Saleem	King Saud University, Saudi Arabia
Hai Wang	Saint Mary's University, Canada

10. Complex Systems, Software Modeling and Analytics

Track Co-chairs

Lech Madeyski	Wroclaw University of Science and Technology, Poland
Bigumiła Hnatkowska	Wroclaw University of Science and Technology, Poland
Yogesh Beeharry	University of Mauritius, Mauritius

PC Members

Ilona Bluemke	Warsaw University of Technology, Poland
Anna Bobkowska	Gdańsk University of Technology, Poland
Anna Derezińska	Warsaw University of Technology, Poland
Olek Jarzębowicz	Gdańsk University of Technology, Poland
Miroslaw Ochodek	Poznań University of Technology, Poland
Michał Śmiałek	Warsaw University of Technology, Poland
Anita Walkowiak-Gall	Wroclaw University of Science and Technology, Poland
Zbigniew Huzar	Wroclaw University of Science and Technology, Poland
Robert T. F. Ah King	University of Mauritius, Mauritius

11. Multi-agent Systems, SLA Cloud and Social Computing

Track Co-chairs

Giuseppe Sarnè	Mediterranean University of Reggio Calabria, Italy
Douglas Macedo	Federal University of Santa Catarina, Brazil
Takahiro Uchiya	Nagoya Institute of Technology, Japan

PC Members

Mario Dantas	Federal University of Juiz de Fora, Brazil
Luiz Bona	Federal University of Parana, Brazil
Márcio Castro	Federal University of Santa Catarina, Brazil
Fabrizio Messina	University of Catania, Italy
Hideyuki Takahashi	Tohoku University, Japan
Kazuto Sasai	Ibaraki University, Japan
Satoru Izumi	Tohoku University, Japan
Domenico Rosaci	Mediterranean University of Reggio Calabria, Italy
Lidia Fotia	Mediterranean University of Reggio Calabria, Italy

12. Internet of Everything and Machine Learning

Track Co-chairs

Omid Ameri Sianaki	Victoria University, Sydney, Australia
Khandakar Ahmed	Victoria University, Australia
Inmaculada Medina Bulo	Universidad de Cádiz, Spain

PC Members

Farhad Daneshgar	Victoria University, Sydney, Australia
M. Reza Hoseiny F.	University of Sydney, Australia
Kamanashis Biswas (KB)	Australian Catholic University, Australia
Khaled Kourouche	Victoria University, Sydney, Australia
Huai Liu, Lecturer	Victoria University, Australia
Mark A. Gregory	RMIT University, Australia
Nazmus Nafi	Victoria Institute of Technology, Australia
Mashud Rana	CSIRO, Australia
Farshid Hajati	Victoria University, Sydney, Australia
Ashkan Yousefi	Victoria University, Sydney, Australia
Nedal Ababneh	Abu Dhabi Polytechnic, Abu Dhabi, UAE
Lorena Gutiérrez-Madroñal	University of Cádiz, Spain
Juan Boubeta-Puig	University of Cádiz, Spain

Guadalupe Ortiz	University of Cádiz, Spain
Alfonso García del Prado	University of Cádiz, Spain
Luis Llana	Complutense University of Madrid, Spain

CISIS-2021 Reviewers

Adhiatma Ardian
Ali Khan Zahoor
Amato Alba
Amato Flora
Barolli Admir
Barolli Leonard
Bista Bhed
Caballé Santi
Chellappan Sriram
Chen Hsing-Chung
Cui Baojiang
Dantas Mario
De Benedictis Alessandra
Di Martino Beniamino
Dong Hai
Durresi Arjan
Enokido Tomoya
Esposito Antonio
Fachrunnisa Olivia
Ficco Massimo
Fotia Lidia
Fun Li Kin
Funabiki Nobuo
Gotoh Yusuke
Hussain Farookh
Hussain Omar
Javaid Nadeem
Ikeda Makoto
Ishida Tomoyuki
Kikuchi Hiroaki
Koyama Akio
Kryvinska Natalia
Kulla Elis
Lee Kyungroul
Matsuo Keita
Mostarda Leonardo
Ogiela Lidia
Ogiela Marek
Okada Yoshihiro
Palmieri Francesco
Paruchuri Vamsi Krishna
Poniszewska-Maranda Aneta
Rahayu Wenny
Rawat Danda
Saito Takamichi
Sakamoto Shinji
Sato Fumiaki
Scionti Alberto
Sianaki Omid Ameri
Sugawara Shinji
Takizawa Makoto
Taniar David
Terzo Olivier
Uehara Minoru
Venticinque Salvatore
Vitabile Salvatore
Wang Xu An
Woungang Isaac
Xhafa Fatos
Yim Kangbin
Yoshihisa Tomoki

CISIS-2021 Keynote Talks

Asking AI Why: Explainable Artificial Intelligence

Jayh (Hyunhee) Park

Myongji University, Yongin, Korea

Abstract. In the early phases of AI adoption, it was okay to not understand what the model predicts in a certain way, as long as it gives the correct outputs. Explaining how they work was not the first priority. Now, the focus is turning to build human interpretable models. In the invited talk, I will explain why explainable AI is important. Then, I will explain an AI model. Through this invited talk, I will discuss models such as ensembles and neural networks called black-box models. I will deal with the following questions.

- Why should we trust your model?
- Why did the model take a certain decision?
- What drives model predictions?

Coevolution of Semantic and Blockchain Technologies

Antonio Esposito

University of Campania “Luigi Vanvitelli”, Aversa, Italy

Abstract. Semantic technologies have demonstrated to have the capability to ease interoperability and portability issues in several application fields such as cloud computing and the Internet of things (IoT). Indeed, the increase in resource representation and the inference capabilities enabled by semantic technologies represent important components of current distributed software systems, which can rely on better information interoperability and decision autonomy. However, semantics alone cannot solve trust and reliability issues that, in many situations, can still arise within software systems. Blockchain solutions have shown to be effective in this area, creating data sharing infrastructure where information validation can be done without the necessity of third-party services. A coevolution and integration of semantic and blockchain technologies would at the same time enhance data interoperability and ensure data trust and provenance, creating undeniable benefits for distributes software systems. This talk will focus on the current state of the art regarding the integration of semantic and blockchain technologies, looking at the state of their coevolution, at the available and still needed solutions.

Contents