

# **Studies in Computational Intelligence**

Volume 949

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Editors


# Intelligent Systems in Industrial Applications

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ISSN 1860-949X

ISSN 1860-9503 (electronic)

Studies in Computational Intelligence

ISBN 978-3-030-67147-1

ISBN 978-3-030-67148-8 (eBook)

<https://doi.org/10.1007/978-3-030-67148-8>

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# Preface

This book represents a collection of papers selected for the Industrial Part of ISMIS 2020 (25th International Symposium on Methodologies for Intelligent Systems) which has virtually taken place in Graz, Austria, in 2020. ISMIS was organized by the Institute of Software Technology of the Technical University of Graz, Austria, in cooperation with the Institute of Informatics Systems of the University of Klagenfurt, Austria.

ISMIS is a conference series that started in 1986. Held twice every three years, it provides an international forum for exchanging scientific, research, and technological achievements in building intelligent systems. In particular, major areas selected for ISMIS 2020 include explainable AI (XAI), machine learning, deep learning, data mining, recommender systems, constraint-based systems, autonomous systems, applications (configuration, Internet of things, financial services, e-Health, ...), intelligent user interfaces, user modeling, human computation, socially aware systems, autonomous systems, digital libraries intelligent agents, information retrieval, natural language processing, knowledge integration and visualization, knowledge representation, soft computing, and web and text mining.

Besides the scientifically oriented part of ISMIS, the organizers were happy to be able to establish a separate track of papers with a focus on application of research outcome, represented in this book. A broad range of application possibilities is characterizing the presented papers, which were carefully selected in a single-blind review process, where at least three anonymous reviewers evaluated the submissions. We as the organizers appreciate the broad range of applicability, because this is an indicator for the relevance of the work of our community.

The selection of papers starts with an example showing an application in the automotive sector. The paper of Elzbieta Kubera, Alicja Wieczorkowska, and Andrzej Kuranc deals with the possibilities of applying AI methods for the automation of economic driving. Apart from environmental benefits, road safety is also increased when drivers avoid speeding and sudden changes of speeds, but speed measurements usually do not include such information. The authors therefore focus their work on automatic detection of speed, whereas three classes are of relevance: accelerating, decelerating, and maintaining stable speed. Theoretical

discussions of the thresholds for these classes are followed by experiments with an automatic search for these thresholds. The obtained results are emphasized in the paper.

A sector related to automotive, concretely transportation, and logistics is the topic of the paper presented by Marie Le Guilly, Claudia Capo, Jean-Marc Petit, Marian Scuturici, Rémi Revellin, Jocelyn Bonjour, and Gérald Cavalier. The authors apply machine learning methods to predict aging and durability of vehicles transporting refrigerated goods. They focus their work on the company CEMAFROID, a french delegated public service, delivering conformity attestations of refrigerated transport vehicles. The DATAFRIG database opens the opportunity to predict the aging, however with some limitations the authors emphasize in their paper. They propose to use the notion of functional dependencies to address these limitations. The approach has been evaluated with domain experts from CEMAFROID, with many positive feedbacks.

The next selection of papers addresses—in a broader sense—aspects of learning. Stefano Ferilli, Giovanni Luca Izzi, and Tiziano Franza focus their work on natural language processing and present an attempt to automatically derive tools to support natural language processing. Such tools are useful linguistic resources, but not available for many languages. Since manually building them would be complex, the authors emphasize ways to generate such tools automatically, for example from sample texts. In their paper, the authors focus on stopwords, i.e., terms which are not relevant to understand the topic and content of a document and investigate other techniques proposed in the literature. The basic language investigated is Italian, and the presented approach is generic and applicable to other languages, too.

Azim Roussanaly, Marharyta Aleksandrova, and Anne Boyer focus their work on students who failed the final examination in the secondary school in France (known as baccalauréat or baccalaureate). In this case, students can improve their scores by passing a remedial test. This test consists of two oral examinations in two subjects of the student's choice. Students announce their choice on the day of the remedial test. However, the secondary education system in France is quite complex. There exist several types of baccalaureate consisting of various streams. Depending upon the stream students belong to, they have different subjects allowed to be taken during the remedial test and different coefficients associated with each of them. The authors present BacAnalytics—a tool that was developed to assist the rectorate of secondary schools with the organization of remedial tests for the baccalaureate.

Anna Saranti, Simon Streit, Heimo Müller, Deepika Singh, and Andreas Holzinger investigate visual concept learning methodologies which have become the state-of-the-art research that challenges the reasoning capabilities of deep learning methods. In their paper, the authors discuss the evolution of those methods, starting from the captioning approaches that prepared the transition to current cutting-edge visual question answering systems. Recent developments in the field encourage the development of AI systems that will support them by design. Explainability of the decision-making process of AI systems, either built-in or as a by-product of the acquired reasoning capabilities, underpins the understanding of those systems robustness, their underlying logic, and their improvement potential.

Piotr Borkowski, Krzysztof Ciesielski, and Mieczysław A. Kłopotek base their work on the known phenomenon that text document classifiers may benefit from the inclusion of hypernyms of the terms in the document. The authors have elaborated a new type of document classifiers, so-called semantic classifiers, trained not on the original data but rather on the categories assigned to the document by our semantic categorization that requires significantly smaller corpus of training data and outperforms traditional classifiers used in the domain. With this research, the authors want to clarify what is the advantage/disadvantage of using supercategories of the assigned categories (an analogon of hypernyms) on the quality of classification.

Damian Węgrzyn, Piotr Wrzeciono, and Alicja Wieczorkowska present the usage of deep learning in flue pipe-type recognition. Organbuilders claim that they can distinguish the pipe mouth type only by hearing it, and the authors used artificial neural networks (ANN) to verify if it is possible to train ANN to recognize the details of the organ pipe, as this confirms a possibility that a human sense of hearing may be trained as well. In the future, usage of deep learning in the recognition of pipe sound parameters may be used in the voicing of the pipe organ and the selection of appropriate parameters of pipes to obtain the desired timbre.

In the following group of papers, different perspectives on applicability of scientific work in industrial settings are presented. Lothar Hotz, Rainer Herzog, and Stephanie von Riegen address challenges in mechanical and plant engineering, specifically those related to the adaption to changing requirements or operating conditions at the plant operator's premises. Such changes require a well-coordinated cooperation with the machine manufacturer and his suppliers and involve high efforts due to the communication and delivery channels. An autonomous acting machine would facilitate this process. In the paper, subtasks for the design of autonomous adaptive machines are identified and discussed.

Cristian Vidal-Silva, José Ángel Galindo, Jesús Giráldez-Cru, and David Benavides have identified the problem that the completion of partial configurations represents an expensive computational task. Existing solutions, such as those which use modern constraint satisfaction solvers, perform a complete search, making them unsuitable on large-scale configurations. In their work, the authors propose an approach based on diagnosis tasks based on an algorithm named FastDiag, an efficient solution for preferred minimal diagnosis (updates) in the context of partial configuration.

Chiara Grosso and Cipriano Forza emphasize the increasing demand for online transactions. This is propelled by both the digital transformation paradigm and the COVID-19 pandemic. The research on web infrastructure design recognizes the impact that social, behavioral, and human aspects have on online transactions in e-commerce, e-health, e-education, and e-work. The authors present a study focusing on the social dimension of the e-commerce of customizable products. This domain was selected because of the specificity of its product self-design process in terms of customers' decision-making and their involvement in product value creation. The results should provide companies and software designers with insights about customers' need for social presence during their product self-design experience.

In their paper, Ignacio Romero, Jorge Estrada, Angel L. Garrido, and Eduardo Mena point out that traditional media are experiencing a strong change. The collapse of advertising-based revenues on paper newspapers has forced publishers to concentrate efforts on optimizing the results of online newspapers published on the web by improving content management systems. The authors present an approach for performing automatic recommendation from news in this hard context combining matrix factoring and semantic techniques. The authors have implemented their solution in a modular architecture design to give flexibility to the creation of elements that take advantage of these recommendations and also with great monitoring possibilities. Experimental results in real environments are promising, improving outcomes regarding traffic redirection and clicks on ads.

The work of Viet-Man Le, Thi Ngoc Trang Tran, and Alexander Felfernig investigates feature model-based configuration which involves selecting desired features from a collection of features (called a feature model) that satisfy pre-defined constraints. Configurator development can be performed by different stakeholders with distinct skills and interests, who could also be non-IT domain experts with limited technical understanding and programming experience. In this context, a simple configuration framework is required to facilitate non-IT stakeholders' participation in configurator development processes. In their paper, the authors present a tool named FM2EXCONF that enables stakeholders to represent configuration knowledge as an executable representation in Microsoft Excel. The tool supports the conversion of a feature model into an Excel-based configurator, which is performed in two steps. In the first step, the tool checks the consistency and anomalies of a feature model. As a second feature, explanations (which are included in the Excel-based configurator) are provided to help non-IT stakeholders to fix inconsistencies in the configuration phase.

The last two papers in the track are emphasizing different aspects of basic research and algorithmic problems in the field. The paper of Antoni Ligęza, Paweł Jemioło, Weronika T. Adrian, Mateusz Ślaziński, Marek Adrian, Krystian Jobczyk, Krzysztof Kluza, Bernadetta Stachura-Terlecka, and Piotr Wiśniewski explores a "yet another approach" to explainable artificial intelligence. The proposal consists in the application of constraint programming to discover internal structure and parameters of a given black-box system. Apart from specification of a sample of the input and output values, some presupposed knowledge about the possible internal structure and functional components is required. This knowledge can be parameterized with respect to the functional specification of internal components, connections among them, and internal parameters. Models of constraints are put forward, and example case studies illustrate the proposed ideas.

Frej Berglind, Jianhua Chen, and Alexandros Sopasakis compare classic scalar temporal difference learning with three new distributional algorithms for playing the game of five-in-a-row using deep neural networks based on the application of different algorithms. The algorithms are applicable to any two-player deterministic zero sum game. Though all the algorithms utilized performed reasonably well, some advantages and disadvantages were identified which are emphasized in the paper.



Despite the difficulties related to COVID-19 which hindered us (the organizers) to carry out the ISMIS conference and the industrial track physically in the area of Graz, the papers presented were of very high quality, presented in the form pre-recorded videos and complemented with live discussion sections. It is a great pleasure to thank all the people who helped this book come into being and made ISMIS 2020 in general and the industrial track in particular a successful and exciting event. We would like to express our appreciation for the work of the ISMIS 2020 program committee members and external reviewers who helped assure the high standard of accepted papers. We would like to thank all authors, without whose high-quality contributions, it would not have been possible to organize the conference. We are grateful to all the organizers and contributors to the successful preparation and implementation of ISMIS 2020. We are thankful to the people at Springer for supporting the ISMIS 2020 and the possibility to publish this extra volume for the industrial section. We believe that this book will become a valuable source of reference for your ongoing and future research activities.

Martin Stettinger  
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# Contents

## Applications in the Automotive and Transport Sector

<b>Parameter Tuning for Speed Changes Detection in On-Road Audio Recordings of Single Drives</b> . . . . .	3
Elżbieta Kubera, Alicja Wieczorkowska, and Andrzej Kuranc	

<b>Attempt to Better Trust Classification Models: Application to the Ageing of Refrigerated Transport Vehicles</b> . . . . .	15
Marie Le Guilly, Claudia Capo, Jean-Marc Petit, Vasile-Marian Scuturici, Rémi Revellin, Jocelyn Bonjour, and Gérald Cavalier	

## Perspectives on Artificial Learning

<b>Automatic Stopwords Identification from Very Small Corpora</b> . . . . .	31
Stefano Ferilli, Giovanni Luca Izzi, and Tiziano Franza	

<b>BacAnalytics: A Tool to Support Secondary School Examination in France</b> . . . . .	47
Azim Roussanaly, Marharyta Aleksandrova, and Anne Boyer	

<b>Towards Visual Concept Learning and Reasoning: On Insights into Representative Approaches</b> . . . . .	59
Anna Saranti, Simon Streit, Heimo Müller, Deepika Singh, and Andreas Holzinger	

<b>The Impact of Supercategory Inclusion on Semantic Classifier Performance</b> . . . . .	69
Piotr Borkowski, Krzysztof Ciesielski, and Mieczysław A. Kłopotek	

<b>Recognition of the Flue Pipe Type Using Deep Learning</b> . . . . .	80
Damian Węgrzyn, Piotr Wrzeciono, and Alicja Wieczorkowska	

**Industrial Applications**

**Adaptive Autonomous Machines - Modeling and Architecture. . . . .** 97  
Lothar Hotz, Rainer Herzog, and Stephanie von Riegen

**Automated Completion of Partial Configurations as a Diagnosis  
Task Using FastDiag to Improve Performance. . . . .** 107  
Cristian Vidal-Silva, José A. Galindo, Jesús Giráldez-Cru,  
and David Benavides

**Exploring Configurator Users’ Motivational Drivers for Digital  
Social Interaction . . . . .** 118  
Chiara Grosso and Cipriano Forza

**Impact of the Application of Artificial Intelligence Technologies  
in a Content Management System of a Media . . . . .** 139  
Ignacio Romero, Jorge Estrada, Angel L. Garrido, and Eduardo Mena

**A Conversion of Feature Models into an Executable Representation  
in Microsoft Excel . . . . .** 153  
Viet-Man Le, Thi Ngoc Trang Tran, and Alexander Felfernig

**Basic Research and Algorithmic Problems**

**Explainable Artificial Intelligence. Model Discovery  
with Constraint Programming . . . . .** 171  
Antoni Ligęza, Paweł Jemioło, Weronika T. Adrian, Mateusz Ślażyński,  
Marek Adrian, Krystian Jobczyk, Krzysztof Kluza,  
Bernadetta Stachura-Terlecka, and Piotr Wiśniewski

**Deep Distributional Temporal Difference Learning  
for Game Playing . . . . .** 192  
Frej Berglind, Jianhua Chen, and Alexandros Sopasakis

**Author Index. . . . .** 207