IUKM2022

The Ninth International Symposium on Integrated Uncertainty in Knowledge Modelling and Decision Making

18 - 19 March 2022, Ishikawa, Japan

Program and Digest

IUKM2022 Program

18 March, 2022 (Friday)

Japan (GMT+9)	Thailand (GMT+7)	Central European (GMT+1)		
12:40 - 13:05	10:40 - 11:05	4:40 - 5:05	Opening	
13:05 - 14:20	11:05 - 12:20	5:05 - 6:20	Uncertainty Management and Decision Making I (3 papers)	Pattern Classification and Data Analysis I (3 papers)
14:20 - 14:35	12:20 - 12:35	6:20 - 6:35	Break (15 min.)	
14:35 - 15:50	12:35 - 13:50	6:35 - 7:50	Machine Learning I (3 papers)	Pattern Classification and Data Analysis II (3 papers)
15:50 - 16:05	13:50 - 14:05	7:50 - 8:05	Break (15 min.)	
16:05 - 17:45	14:05 - 15:45	8:05 - 9:45	Machine Learning II (4 papers)	Economic Applications I (4 papers)
17:45 - 18:00	15:45 - 16:00	9:45 - 10:00	Break (15 min.)	
18:00 - 19:00	16:00 - 17:00	10:00 - 11:00	Keynote Lecture 1 (Dr. Rudolf Felix)	

19 March, 2022 (Saturday)

Japan (GMT+9)	Thailand (GMT+7)	Central European (GMT+1)		
13:00 - 14:00	11:00 - 12:00	5:00 - 6:00	Keynote Lecture 2 (Prof. Motohide Umano)	
14:00 - 14:15	12:00 - 12:15	6:00 - 6:15	Break (15 min.)	
14:15 - 15:55	12:15 - 13:55	6:15 - 7:55	Economic Applications II (4 papers)	Optimization and Statistical Methods I (4 papers)
15:55 - 16:10	13:55 - 14:10	7:55 - 8:10	Break (15 min.)	
16:10 - 17:50	14:10 - 15:50	8:10 - 9:50	Uncertainty Management and Decision Making II (4 papers)	Optimization and Statistical Methods II (4 papers)
17:50 - 18:05	15:50 - 16:05	9:50 - 10:05	Break (15 min.)	
18:05 - 19:05	16:05 - 17:05	10:05 - 11:05	Keynote Lecture 3 (Prof. Salvatore Greco)	
19:05 - 19:20	17:05 17:20	11:05 11:20	Closing	

Regular presentation: 20 min. talk + 5 min. discussion

Short presentation: 15 min. talk + 5 min. discussion

Keynote Lectures

March 18, 2022
18:00 - 19:00

Rudolf Felix (PSI FLS Fuzzy Logik & Neuro Systeme GmbH, Germany)

Decision Making and Optimization in Context of Inconsistently Interacting Goals and its Relation to Machine Learning

Many traditional optimization models are limited with respect to the management of inconsistency that frequently appear between decision and optimization goals. As consequence, such models in many cases achieve results that may be optimal for the model but are not for the use case to be managed. In real world use cases both decision and optimization goals are usually partly conflicting and therefore partly inconsistent. Assumptions like independence of goals, additivity or monotonicity as preconditions usually do not hold. Due to this, traditional concepts like integration based on weighted sums, for instance, in many cases do not really help. In this talk we describe some applications of a decision and optimization model based on (extended fuzzy) interactions between goals (DMIG) to some relevant real-world decision and optimization use cases. After a brief discussion of the basics of the concept of the model, example use cases are presented and advantages of their solutions are shown. The use cases are related to real-world decision and optimization problems in business processes such as management and scheduling of field forces that maintain complex industrial infrastructure, management of resources based on sequencing of production orders in car producing factories and automated management of bus and tram depots. Some additional examples are named. It is also shown how the so-called key performance indicators (KPIs) of such real-world use cases are understood as decision and optimization goals and how interactions between decision and optimization goals build a bridge to the optimization of real-world KPIs. Finally, it is discussed why DMIG may be used for learning of consistent preferences between the KPIs and how the concept is connected to the field of machine learning.

Bio

After studying computer science and business administration at the University of Dortmund, Dr. Rudolf Felix did his doctorate in the field of decision support systems and fuzzy logic. In 1992 he founded PSI FLS Fuzzy LogiK & Neuro Systeme GmbH and continuously developed PSI FLS' own Deep Qualicision KI technology, which is based on machine learning and neural networks as well as on qualitative labeling using optimization algorithms.
The solutions are successful in sectors such as the automotive industry, the automotive supplier industry, the energy industry, transport logistics, local public transport or retail as a cross-sectional technology in productive use. Qualicision technology has been complementing the software tools and applications of the Berlin PSI Group since 2008. Dr. Rudolf Felix published more than 60 scientific and numerous user-oriented articles in various specialist journals. In addition to his managerial activities in the integration of Qualicision into complex business processes in a multi-criteria environment, he is a member of the European Society of Fuzzy Logic and Technology, EUSFLAT.

March 19, 2022
13:00 - 14:00

Motohide Umano
(Osaka Prefecture University, Hitachi Zosen Corporation, Japan)

Partition of Time Series Using Hierarchical Clustering

We understand a long time-series through features and trends and their transitions, for example, “Globally it increases a little, but it starts with a medium value, decreases a little in the beginning and has big oscillations at end.” It is often the case where the periods of features and trends are determined by the data themselves. We must, therefore, partition time-series into several periods of different features and trends.
We propose a method to partition time-series data by clustering adjacent data with the total similarity of their values, changes of values and degrees of oscillations of adjacent periods. First we have the initial clusters of line segments of adjacent data in time. Next we get the adjacent clusters that have the maximum total similarity and merge them into one. We repeat this process until the condition of termination. We formulate the total similarity as the weighted average of three similarities of the value, change of values and degree of oscillations. The weights are very important. The fixed weights cannot have the clustering results that fit our sense. We, therefore, propose variable weights with three similarities and sizes of adjacent clusters with the operation of ordered weighted average. Furthermore, in order to exclude small clusters of outliers, we define similarities of two clusters adjacent to the small cluster. We apply this method to actual time-series data and show results. The method can improve linguistic expressions of time-series data and retrieval of similar time-series with linguistic similarity.

Bio

Motohide Umano received the B.S. degree in 1974, the M.S. degree in 1976 and the Dr. of Engineering degree in 1979 in Information and Computer Sciences from Osaka University, Japan. He was an Assistant Professor of Department of Applied Mathematics, Faculty of Science, Okayama University of Science in 1979-1985. Then he moved to Osaka University, where he was a Research Associate, an Assistant Professor and an Associate Professor of Computation Center in 1985-1990, an Associate Professor of Department of Precision Engineering, Faculty of Engineering in 1991-1993 and Department of Systems Engineering, Faculty of Engineering Science in 1993–1996. He then moved as a Professor to Osaka Prefecture University, where he was a member of Department of Mathematics and Information Sciences, College of Integrated Arts and Sciences in 1996-2005 and Department of Mathematics and Information Sciences, Graduate School of Science in 2005-2016 and Department of Computer Science and Intelligent Systems, Graduate School of Engineering in 2016-2017 and he took Professor Emeritus of Osaka Prefecture University. He is a Technical Adviser of Intelligent Machinery Research Center, Technical Research Institute, Hitachi Zosen Corporation.
His current research interests are fuzzy data/knowledge information processing including fuzzy-set manipulation systems, fuzzy database systems, fuzzy intelligent systems and learning of fuzzy knowledge from data.

March 19, 2022
18:05 - 19:05

Salvatore Greco (University of Catania, Italy)

The Robust Ordinal Regression: Basic Ideas, Principal Models, Recent Developments

Multiple Criteria Decision Aiding (MCDA) is constituted by a set of concepts, techniques and procedure aiming to provide a recommendation in complex decision contexts. MCDA is based on a constructive approach that aims to build a preference model in cooperation between the analyst and the Decision Maker. A typical MCDA methodology is the ordinal regression aiming to define a decision model in a given class (an additive value function, a Choquet integral, an outranking model such as ELECTRE or PROMETHEE and so on) representing the preference information provided by the DM. Recently ordinal regression has been extended and generalized through Robust Ordinal Regression taking into account the idea that there is a plurality of decision models in a given class compatible with the preferences expressed by the decision maker. Originally, the set of compatible decision models was used to define the necessary and possible preference relations holding when the preference holds for all value functions or for at least one value function, respectively. After, a probability distribution on the set of compatible decision model was introduced to define probabilistic preferences. ROR has been also fruitfully applied to interactive optimization procedures. In this talk I shall present the basic concepts, the principal models, the main applications and the recent developments of Robust Ordinal Regression taking into consideration its advantages in the context of an MCDA constructive approach.

Bio
Salvatore Greco is full professor at the Department of Economics and Business at the University of Catania where has been teaching Decision Theory, General Mathematics, Financial Mathematics and Actuarial Mathematics. Since 2013 Salvatore Greco has also a part time position at the Business School of Portsmouth University (UK). His research regards preference modeling and multiple criteria decision analysis (MCDA) with a specific attention to application of rough set theory, non-additive integrals, evolutionary multiobjective optimization methodologies, composite indices for sustainable development, wellbeing and innovation, MCDA models for territorial and urban planning. At the 22nd International conference on MCDM held in Malaga June 17-22 2013, he received the MCDM Gold Medal being “the highest honor that the International Society on Multiple Criteria Decision Making bestows upon a scholar who, over a distinguished career, has devoted much of his/her talent, time, and energy to advancing the field of MCDM, and who has markedly contributed to the theory, methodology, and practice of MCDM”. Since 2010, Salvatore Greco is one of the three coordinators of the EURO Working Group in Multiple Criteria Decision Aiding. He has been member of the executive committee of International Society on Multiple Criteria Decision Making (http://www.mcdmsociety.org/) for the years 2006-2009, 2011-2013, 2016-2019. In the years 2014-2019 Salvatore Greco was member of the scientific committee of AMASES (Italian Society for mathematics applied to economics and social sciences and in the years 2017-2019 he served as vicepresident. He is currently the president elect of the MCDM section of INFORMS. Scopus reports 248 publications of Salvatore Greco cited all together 9734 times and an h-index of 51. Google Scholar reports a total of 2223 citations with an h-index of 68.

The Detailed Program of IUKM2022

Friday 18 March 2022

12:40 - 13:05 Opening

13:05 - 14:20 **General Session Room A: Uncertainty Management and Decision Making I**
(Chair: Prof. Van-Nam Huynh)

1. The Lattice Structure of Coverings in an Incomplete Information Table with Value Similarity
   (Michinori Nakata, Norio Saito, Hiroshi Sakai, and Takeshi Fujiwara)
2. Group Formation Models Based on Inner Evaluations of Members
   (Tomoe Entani)
3. A Data-driven Weighting Method Based on DEA Model for Evaluating Innovation
   (Nu Dieu Khue Ngo and Van Nam Huynh)

General Session Room B: Pattern Classification and Data Analysis I
(Chair: Dr. Seiki Ubukata)

1. On Some Fuzzy Clustering Algorithms for Time-Series Data
   (Mizuki Fujita and Yuchi Kanzawa)
2. On an Multi-directional Searching Algorithm for Two Fuzzy Clustering Methods for Categorical Multivariate Data
   (Kazune Suzuki and Yuchi Kanzawa)
3. Hybrid Rule-Based Classification by Integrating Expert Knowledge and Data
   (Lianmeng Jiao, Haonan Ma, and Quan Pan)

14:20 - 14:35 Break

14:35 - 15:50 **General Session Room A: Machine Learning I**
(Chair: Dr. Warut Pannakkong)

1. Toward Latent Cognizance on Open-set Recognition
   (Pisit Nakjai and Tatpong Katanyukul)
2. A Genetic Algorithm Based Artificial Neural Network for Production Rescheduling Problem
   (Pakkaporn Saophan and Warut Pannakkong)
3. Backtracking Approaches to k-anonymous Rule Induction Method for Binary Classified Data Tables **(Short Presentation)**
   (Taichi Chujo and Masahiro Inuiguchi)

General Session Room B: Pattern Classification and Data Analysis II
(Chair: Dr. Yoshifumi Kusunoki)

1. A Comparative Study on Utilization of Semantic Information in Fuzzy Co-clustering
   (Yusuke Takahata, Katsuhiro Honda, and Seiki Ubukata)
2. On Some Fuzzy Clustering Algorithms with Cluster-wise Covariance
   (Toshiki Ishii and Yuchi Kanzawa)
3. On Fuzzy Clustering Algorithms for Categorical Data Based on k-Partitions **(Short Presentation)**
   (Yunkai Yan and Yuchi Kanzawa)

15:50 - 16:05 Break

16:05 - 17:45 **General Session Room A: Machine Learning II**

(Chair: Prof. Katsuhiro Honda)

1. Noise Fuzzy Clustering-based Robust Non-negative Matrix Factorization with I-divergence Criterion
   (Akira Okabe, Katsuhiro Honda, and Seiki Ubukata)
2. Topic Modeling of Political Dynamics with Shifted Cosine Similarity
   (Yifan Luo, Tao Wan, and Zengchang Qin)
3. Transductive Learning Based on Low-Rank Representation with Convex Constraints
   (Yoshifumi Kusunoki, Katsuhiko Kojima, and Keiji Tatsumi)
4. A Robustification Improvement of ANFIS Classifier **(Short Presentation)**
   (Koki Kitamori, Katsuhiro Honda, and Seiki Ubukata)

General Session Room B: Economic Applications I

(Chair: Dr. Woraphon Yamaka)

1. Hedging Agriculture Commodities Futures with Histogram data Based on Conditional Copula-GJR-GARCH
   (Roengchai Tansuchat and Pichayakone Rakpho)
2. Predicting Energy Price Volatility using Hybrid Artificial Neural Networks with GARCH-type Models
   (Pichayakone Rakpho, Woraphon Yamaka, and Rungrapee Phadkantha)
3. Estimating Wind Speed by using Confidence Intervals for the Median in a Three-Parameter Lognormal Model
   (Patcharee Maneerat, Sa-Aat Niwitpong, and Pisit Nakjai)
4. A Manual Assembly Process Virtual Training System with Automatically Generated Augmented Feedback **(Short Presentation)**
   (Raveekiat Singhaphandu, Van-Nam Huynh, and Warut Pannakkong)

17:45 - 18:00 Break

18:00 - 19:00 **Keynote 1 (Room A): Decision Making and Optimization in Context of Inconsistently Interacting Goals and its Relation to Machine Learning**

Dr. Rudolf Felix (Chair: Prof. Van-Nam Huynh)

Saturday 19 March 2022

13:00 - 14:00 **Keynote 2 (Room A): Partition of Time Series Using Hierarchical Clustering**
Prof. Motohide Umano (Chair: Prof. Katsuhiro Honda)

14:00 - 14:15 Break

14:15 - 15:55 **General Session Room A: Economic Applications II**
(Chair: Prof. Roengchai Tansuchat)

1. Trust Uncertainty Modeling in Agri-food Logistic Decision Making
   (Rindra Yusianto, Suprihatin Suprihatin, Hartrisari Hardjomidjojo, and Marimin Marimin)
2. Investigating the Predictive Power of Google Trend and Real Price Indexes in Forecasting the Inflation Volatility
   (Kittawit Autchariyapanitkul, Terdthiti Chitkasame, Namchok Chimprang, and Chaiwat Klinlampu)
3. Price Volatility Dependence Structure Change among Agricultural Commodity Futures due to Extreme Event: an Analysis with the Vine Copula
   (Konnika Palason, Tanapol Rattanasamakarn, and Roengchai Tansuchat)
4. Daily Electricity Peak Demand Forecasting using Hybrid Model based on Similar Day Selection Technique **(Short Presentation)**
   (Lalitpat Aswanuwath, Van-Nam Huynh, and Warut Pannakkong)

General Session Room B: Optimization and Statistical Methods I
(Chair: Prof. Masahiro Inuiguchi)

1. Coyote Optimization Algorithm with Linear Convergence for Global Numerical Optimization
   (Hsin-Jui Lin and Sheng-Ta Hsieh)
2. Additional Out-group Search for JADE
   (Yuichi Miyahira and Akira Notsu)
3. Confidence Intervals for Mean of Delta Two-parameter Exponential Distribution
   (Wansiri Khooriphan, Sa-Aat Niwitpong, and Suparat Niwitpong)
4. An Analysis to Treat the Degeneracy of a Basic Feasible Solution in Interval Linear Programming
   (Zhenzhong Gao and Masahiro Inuiguchi)

15:55 - 16:10 Break

16:10 - 17:50 **General Session Room A: Uncertainty Management and Decision Making II**
(Chair: Prof. Tomoe Entani)

1. Measuring Quality of Belief Function Approximations
   (Radim Jiroušek and Václav Kratochvíl)
2. Preference-based Assessment of Organizational Risk in Complex Environments
   (Silvia Carpitella and Joaquín Izquierdo)
3. Decision Analysis with the Set of Normalized Triangular Fuzzy Weight Vectors in Fuzzy AHP
   (Shigeaki Innan and Masahiro Inuiguchi)
4. Three-point Accuracy Comparison of Various Interval Weight Estimation Methods under a Given Pairwise Comparison Matrix **(Short Presentation)**
   (Akiko Hayashi, Shigeaki Innan, and Masahiro Inuiguchi)

General Session Room B: Optimization and Statistical Methods II
(Chair: Prof. Katsushige Fujimoto)

1. Accounting for Gaussian Process Imprecision in Bayesian Optimization
   (Julian Rodemann and Thomas Augustin)
2. Job-satisfaction Enhancement in Nurse Scheduling: A Case of Hospital Emergency Department in Thailand
   (Pavinee Rerkjirattikal, Raveekiat Singhaphandu, Van-Nam Huynh, and Sun Olapiriyakul)
3. Analysis of Medical Data Using Interval Estimators for Common Meanof Gaussian Distributions with Unknown Coefficients of Variation
   (Warisa Thangjai, Sa-Aat Niwitpong and Suparat Niwitpong)
4. On the Effects of Data Protection on Multi-database Data-driven Models
   (Lili Jiang and Vicenç Torra)

17:50 - 18:05 Break

18:05 - 19:05 **Keynote 3 (Room A): The Robust Ordinal Regression: Basic Ideas, Principal Models, Recent Developments**
Prof. Salvatore Greco (Chair: Prof. Masahiro Inuiguchi)

19:05 - 19:20 Closing

Proceedings

The proceedings for regular presentation of IUKM 2022 are published by Springer-Verlag in the Lecture Notes in Artificial Intelligence series, and are available for temporary (about three weeks) free access at the following conference web page:

https://www.jaist.ac.jp/IUKM/IUKM2022/Program.php

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The abstracts for short presentation of IUKM 2022 are available in the Abstract Book, which starts from the next page of this Program and Digest.

IUKM2022

The Ninth International Symposium on Integrated Uncertainty in Knowledge Modelling and Decision Making

18 - 19 March 2022, Ishikawa, Japan

Abstract Book

(Short Presentation Papers)

Contents

Backtracking approaches to k-anonymous rule induction method for binary classified data tables

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Abstract

In recent years, as big data is widely utilized, the importance of privacy protection in personal data is increasing. The rough set theory [1] provides an induction method of a minimal set of minimal length decision rules from data tables showing values of multiple conditional attributes and a decision attribute. Privacy protection has not yet been studied considerably in the rough set theory. Utilizing the fact that an imprecise decision rule having multiple decision classes in its conclusion is supported by more objects than a precise decision rule having a single decision class in its conclusion, a k-anonymous rule induction method through imprecise decision rule induction has been proposed in the framework of rough set-based methods [2]. On the other hand, personal data often contains binary attributes such as "gender", "pass/fail" and so on, and thus we come across binary classification problems. The k-anonymous rule induction method using imprecise decision rules cannot work well for binary classified data tables because the conclusions of any imprecise rules are no longer significant. To solve this difficulty, decision classes are subdivided and the k-anonymous rule induction method is applied to binary classified data tables. However, this method requires a very large amount of computational effort as the number of subclasses after the subdivision becomes large. In this study, two k-anonymous rule induction methods for binary classified data tables are proposed by a different approach from the subdivision. In the proposed approach, k-anonymous rules are explored by modifying non-k-anonymous decision rules induced by the conventional rule induction method. For the exploration, only objects satisfying relaxed conditions of non-k-anonymous decision rules are used, the reduction of computational effort can be expected. Based on this approach, a method for inducing k-anonymous precise rules and that for inducing k-anonymous imprecise rules are proposed. By numerical experiments using real-world data, the performance of the proposed approach is examined in terms of classification accuracy and computation time.

Acknowledgement
This work is supported by JSPS KAKENHI Grant Number JP18H01658.

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On Fuzzy Clustering Algorithms for Categorical Data Based on k-Partitions

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Abstract.

Hard c-means (HCM) is the most representative clustering algorithm [1]. Fuzzy c-means (FCM) [2] is an extension of HCM, which allows each object to belong to all or some clusters to varying degrees. To distinguish FCM from other proposed alternatives, such as entropy-regularized FCM (EFCM) [3], it is referred to as the standard FCM (SFCM) in this presentation. The above-mentioned algorithms may misclassify some objects that should be assigned to a large cluster as belonging to a smaller cluster if the cluster sizes are not balanced. To overcome this problem, some approaches introduce variables to control the cluster sizes [4], [5]. Such variables have been added to the SFCM and EFCM algorithms to derive the revised SFCM (RSFCM) and revised EFCM (REFCM) [6] algorithms, respectively.

In the aforementioned clustering algorithms, the dissimilarity between an object and a cluster center is measured by the inner-product-induced squared distance. Such a measure cannot be used for categorical data, that is, the type of data used to label variables without providing any quantitative value. The fuzzy k-partitions algorithm (FKPn) [7] is a representative clustering algorithm for categorical data, which is referred to as the standard fuzzy k-partitions (SFKPn) in this presentation.

SFKPn does not introduce variables to control the cluster sizes, whereas SFCM was developed into RSFCM by introducing variables to control the cluster sizes. The drawback of SFKPn is that some objects that should be assigned to a large cluster may be misclassified as belonging to a smaller cluster if the cluster sizes are not balanced. The accuracy of the clustering results can be improved by introducing variables to control the cluster sizes; this is the first motivation for this study. Furthermore, no algorithm corresponding to REFCM has been proposed for categorical data. The accuracy of the clustering results for categorical data can be improved by adopting the fuzzification techniques used for REFCM; this is the second motivation for this study.

In this presentation, we propose three fuzzy clustering algorithms for categorical data. The first algorithm is obtained by revising the SFKPn objective function for introducing variables to control the cluster sizes; we term this as revised SFKPn (RSFKPn). The second algorithm is obtained by replacing the object-cluster dissimilarity in the REFCM objective function with that in RSFKPn; we term this as EFKPn. The third algorithm is developed by regularizing the RSFKPn objective function with q-divergence between the memberships and variables to control the cluster sizes; we term this as QFKPn. The theoretical results indicate that QFKPn reduces to EFKPn under a certain condition, and to RSFKPn under another condition. Numerical experiments on two real datasets show that QFKPn outperforms RSFKPn and EFKPn in terms of accuracy.

Keywords: Fuzzy Clustering · Categorical Data · Fuzzy k-partitions.

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A Robustification Improvement of ANFIS Classifier

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Abstract. Adaptive Network-based Fuzzy Inference System (ANFIS) [1] is a neural network-based model for fuzzy inference system (FIS) [2] and can be a promising approach for explainable neural networks. In real world classification tasks, we often suffer from unreliable class labels, where some objects have incorrect class labels and should be rejected from classifier construction.

In this paper, robustification of ANFIS is considered from the classification application viewpoint, where the noise rejection mechanism is introduced induced by noise fuzzy clustering. Noise fuzzy clustering proposed by Davé [3, 4] is an extension of fuzzy c-means (FCM) [5, 6] to robust clustering, where an additional noise cluster works for absorbing noise objects. Because the noise clustering scheme with single cluster cases can be identified with robust least square estimation [7], the robustifying mechanism has been applied to several least square-type data analysis [8]. The noise clustering scheme is introduced into the ANFIS classification model, where non-noise fuzzy memberships are utilized such that the additional noise cluster absorbs noise objects and the ANFIS classifier is robustly constructed by rejecting noise objects. The minimization of the membership-weighted least square objective function and the estimation of non-noise fuzzy memberships are iteratively implemented until convergence.

The characteristics of the proposed method are demonstrated through a numerical experiment using the Iris dataset, which is composed of 4 dimensional features of 150 instances drawn from 3 classes with 50 instances each. The dataset was partitioned into the training and test subsets and the ANFIS classifier was applied after randomly changing a part of class labels of the training subset. The classification ability of the ANFIS classifier was evaluated by predicting the intrinsic class of the test subset with/without the proposed robustification mechanism. Then, the proposed method was demonstrated to improve the generalization capability for the test dataset rather than the conventional one. The proposed method can properly identify noise objects having incorrect labels and reject their influences in classifier construction while the conventional model was degraded by their influences.

Possible future works include further investigation of noise sensitivity with other types of data such as imbalanced class ratios and class overlappings.

Keywords: ANFIS · Fuzzy clustering · Noise rejection.

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A Manual Assembly Process Virtual Training System with Automatically Generated Augmented Feedback

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Abstract. A face-to-face manual assembly training in manufacturing requires an experienced operator or an expert to deliver the training content. The experts' availability to provide the training is limited and must be re-assigned from an assembly line to offer training. The training consists of multiple iterations of an expert demonstration on the task, followed by a trainee trail session, and lastly, one-on-one evaluation and discussion about improving training outcomes. It repeatedly occurs until a trainee can perform a task under expected quality at a consistently desirable time. The research community and state-of-the-art commercial system currently offer a system primarily focusing on delivering rich multi-media immersive content as a task demonstration. In addition, some systems also digitally capture an expert's task knowledge or evaluate the trainee's motor performance against the expert by using motion capture technology. However, no system provides extensively automatically generated augmented feedback for the training outcomes. A trainee later requires the evaluation and feedback externally, which hindered the overall usefulness and adoption of the system. This research introduces an ability of a virtual training system to objectively evaluate the trainee's cognitive and motor skills for the manual assembly task together with automatically providing augmented feedback. A trainee will have more access to the training, which used to be limited by the expert's availability. In addition, this research employs the available underlying concepts finding a possible combination for realizing such a training system, including digitizing human cognitive and motor skills and objectively measuring those skills. Lastly, the implemented system was objectively evaluated by its ability to train participants and measure system usability.

Keywords: Virtual training · Skill training · Augmented feedback · Industrial manual assembly

Daily Electricity Peak Demand Forecasting using Hybrid Model based on Similar Day Selection Technique

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Abstract. Electricity demand forecasting is an important research area, it is the critical process for planning the electric utilities to avoid a blackout in peak time and reduce the operation cost of the exceeded generating capacity. Most of the research focuses on forecasting electricity consumption by using all historical data and forecasted weather factors as machine learning inputs. However, weather can change rapidly on the day of forecasting which reduces the model accuracy and increase forecasting error. Moreover, learning of all historical data increase model complexity that requires a long learning time and high computational cost. This research focuses on forecasting electricity peak demand (highest amount of electricity used each day) to avoid electricity blackout in peak time. The purpose of this research is to propose a hybrid model that can capture different characteristics of each day while reducing the complexity of the model. The proposed hybrid model consists of a similar day selection method based on Stepwise regression forecasted by ANN and Stepwise regression selection forecasted by ANN. The proposed model provides a separate model for catching the different characteristics of weekdays and special days. It reduces complexity by containing only historical data and controlled parameters (seasonal index, moving average), and using Stepwise regression to eliminate insignificant input parameters. To make sure that the test set is unknown data, the model is validated for hyperparameter tuning by a validation set before testing with the target day and optimized hyperparameter to prevent bias from the hyperparameter. The proposed model is tested by electricity peak demand in Thailand. The proposed model shows a promising potential to improvement in accuracy of electricity demand forecasting over a single model and satisfy reducing the complexity of the model.

Keywords: Daily electricity demand forecasting · Artificial neural network · Similar day selection · Stepwise regression.

Three-point accuracy comparison of various interval weight estimation methods under a given pairwise comparison matrix

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Abstract

The Analytic Hierarchy Process (AHP) is well known as a decision tool under multiple criteria. It provides a method for estimating criteria weights from a pairwise comparison matrix. However, the pairwise comparison matrix given by a decision-maker is often inconsistent. In the conventional AHP approach, inconsistencies are regarded as errors. On the other hand, in the interval AHP, it is assumed that the evaluation value of the decision-maker is not clear enough to be expressed by one real value, and thus inconsistencies are supposed to come from the human vague evaluation so that the interval weights are estimated from a pairwise comparison matrix. Various interval weight estimation methods have been proposed for the interval AHP. A suitable method has been investigated by comparing the estimation accuracy under the condition that the sum of the centers of the interval weights is 1. However, it is known that the most appropriate interval weights cannot be always determined uniquely, considering this estimation problem as the problem of finding the interval weights that minimize the deviation from the given pairwise comparison matrix [1].

In this study, reflecting the non-uniqueness of interval weights obtained by any estimation methods, the accuracy of the estimated interval weights is not evaluated only by the standard solution such that the sum of centers of interval weights is one but also by minimum and maximum solutions such that the sum of centers of interval weights are minimum and maximum under the normality condition, respectively. In the numerical experiments, such three-point accuracy scores are compared between interval weights obtained by estimation problems and interval weights having the same interval pairwise comparison matrix as true interval weights. The accuracy scores in the numerical experiments are based on the coincidence of ranking alternatives between true and estimated interval weights. For both true and estimated interval weights, we consider the three-point solutions described above. For ranking alternatives, we use maximin and maximax decision principles to treat the uncertainty of the interval evaluations.

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