

corresponding sparse fuzzy rule-based knowledge representation could be a reasonably efficient structure for handling the building evaluation procedure. In this paper the fuzzy rule interpolation as a novel aggregation method in

fuzzy signature structures is proposed. Its application is presented with a case study of roof structure evaluation of a classic urban-type residential house located in a historic district of Budapest, Hungary.

FrF2-4 Fuzzy Decision Making and Decision Support Systems II

Friday, July 11, 10:30AM-12:30PM, Room: 201D, Chair: Vladik Kreinovich and Toshihiko Watanabe

10:30AM *Multiple Attribute Group Decision Making Using Interval-Valued Intuitionistic Fuzzy Soft Matrix* [#F-14240]

Sujit Das, Mohuya B. Kar, Tandra Pal and Samarjit Kar, National Institute of Technology, India; Heritage Institute of Technology, India

A noticeable progress has been found in decision making problems since the introduction of soft set theory by Molodtsov in 1999. It is found that classical soft sets are not suitable to deal with imprecise parameters whereas fuzzy soft sets (FSS) are proved to be useful. Use of intuitionistic fuzzy soft sets (IFSS) is more effective in environment, where arguments are presented using membership and nonmembership values. In this paper we propose an algorithmic approach for multiple attribute group decision making problems using interval-valued intuitionistic fuzzy soft matrix (IVIFSM). IVIFSM is the matrix representation of intervalvalued intuitionistic fuzzy soft set (IVIFSS), where IVIFSS is a natural combination of interval-valued intuitionistic fuzzy set and soft set theory. Firstly, we propose the concept of IVIFSM. Then an algorithm is developed to find out the desired alternative(s) based on product interval-valued intuitionistic fuzzy soft matrix, combined choice matrix, and score values of the set of alternatives. Finally, a practical example has been demonstrated to show the effectiveness of the proposed algorithm.

10:50AM *Towards Data-Driven Environmental Planning and Policy Design -Leveraging Fuzzy Logic to Operationalize a Planning Framework* [#F-14385]

Amir Pourabdollah, Christian Wagner, Simon Miller, Michael Smith and Ken Wallace, The University of Nottingham, United Kingdom; Department of Parks and Wildlife, Australia

Environmental planning is complex, and requires careful consideration of a large number of factors, including quantitative ones (e.g., water balance) and qualitative ones (e.g., heterogeneous stakeholder input). To better integrate these factors, value-driven frameworks have been designed in the environmental conservation community. These frameworks are currently largely utilized manually by conservation and policy experts in order to inform policy design. In this paper, we present a fuzzy logic based system, which has been developed to operationalize the existing manual framework while preserving essential qualities, including the capture of uncertainty in the data sources and a consistent interpretability of the underlying automatic reasoning mechanisms. We provide a detailed description of the current implementation which can be applied in the operationalization of policy design and planning tasks in a range of natural resources management cases, followed by a set of concrete, practical outputs for a studied use case in Western Australia. Finally, we highlight remaining limitations and future work.

11:10AM *A New Fuzzy Approach for Multi-Source Decision Fusion* [#F-14436]

Farnoosh Fatemipour, Mohammad-R Akbarzadeh-T and Rouhollah Ghasempour, Ferdowsi University of Mashhad, Iran

Nowadays, we are facing the rapidly growing amount of data being produced in many organizations, social networks and internet. These data are generated in disparate locations and their aggregation into one location is exceedingly time and space consuming. Traditional statistical methods are not sufficient for processing of this massive multi-source data. In this paper, we propose a new fuzzy-based decision fusion approach for classification

problems of this kind. The necessity of fuzzy information arises in distributed classification because imprecision, uncertainty and ambiguity can be found at all information sources, from the data itself to the results of the classifiers. In the proposed approach, multiple classifiers are constructed based on different information sources which have different degrees of reliability. Then a fuzzy rule based system is designed for approximating distribution of reliabilities of sources over the input space. The decision fusion of multiple classifiers takes place using the estimated degrees of sources' reliabilities. Comparison results are made between both centralized classification and two other distributed classification methods. One is averaging and the other is discounting each classifier's decision based on its accuracy. Results show the high accuracy of the proposed method in making decisions in distributed environments, without the overhead of aggregating the entire data in one location.

11:30AM *Towards Decision Making under Interval, Set-Valued, Fuzzy, and Z-Number Uncertainty: A Fair Price Approach* [#F-14454]

Joe Lorkowski, Rafik Aliev and Vladik Kreinovich, University of Texas at El Paso, United States; Azerbaijan State Oil Academy, Azerbaijan

In this paper, we explore one of the possible ways to make decisions under uncertainty: namely, we explain how to define a fair price for a participation in such a decision, and then select an alternative for which the corresponding fair price is the largest. This idea is explained on the examples of interval uncertainty, set-valued, fuzzy, and Z-number uncertainty.

11:50AM *A Fuzzy-Logic-Based Approach for Soft Data Constrained Multiple-Model PHD Filter* [#F-14476]

Sepideh Seifzadeh, Bahador Khaleghi and Fakhri Karray, University of Waterloo, Canada

Tracking multiple targets with non-linear dynamics is a challenging problem. One of the popular solutions, Sequential Monte Carlo-Probability Hypothesis Density (SMC-PHD) filter, deploys a Random Set (RS) theoretic formulation along with the Sequential Monte Carlo approximation, which is a variant of Bayes filtering. The performance of Bayesian filtering-based methods can be enhanced by using extra information incorporated as specific constraints into the filtering process. Following the same principle, this paper proposes a constrained variant of the SMC-PHD filter, in which the inherently vague human-generated data are transformed into a set of constraints using a fuzzy logic approach. These constraints are enforced to the filtering process by applying coefficients to the particles' weights. The Soft Data (SD) reports on target agility level; wherein, the agility refers to the case in which the observed dynamics of the targets deviates from its given probabilistic characterization. Consequently, the proposed constrained filtering approach enables dealing with multitarget tracking scenarios in presence of target agility, as demonstrated by the experimental results presented in this paper.

12:10PM *Handling Preferences Under Uncertainty in Recommender Systems* [#F-14450]

Samia Boulkrinat, Allel Hadjali and Aicha Aissani-Mokhtari, RIIMA/USTHB University, Algeria; LIAS/ENSMA, France

While uncertainty can't be ignored in real-world problems, there is almost no research work addressing this issue in the recommender systems framework, especially all that relates to user ratings preferences. Indeed, the subjectivity of user's rating and his/her changing preferences over time, make them



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