Int. J. Fuzzy Syst. (2021) 23(4):1055–1056
https://doi.org/10.1007/s40815-021-01124-8

Editorial on Special Issue: "Trends and Developments on Type-2 Fuzzy Sets and Systems"

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Published online: 9 June 2021

Initially proposed by Zadeh in 1975, higher order fuzzy sets (or type-m fuzzy sets) actually gained interest of research community in last 20 years. It has evolved from an emerging field to full-fledged research area, where researchers have proved its significance in various real-world applications such as: time series, real-time systems, aeronautics, gene expression analysis etc. Mostly, type-2 fuzzy sets (T2 FSs) or interval T2 FSs (IT2 FSs) have been used in these applications only because they potentially hold more implication than the traditional FSs (or type-1 FSs). The membership function modelling in these T2 FSs and IT2 FSs offers more degrees of freedom as compared to the type-1 FSs. Technically, the membership function uncertainty is uniformly weighted in the IT2 FSs, while it is non-uniform in T2 FSs. According to the widely used indexing platform, Scopus, there are more than 4500 publications on T2 FSs till the mid of 2019 and the number of publications is increasing exponentially. One of the pioneers in this field, Prof. J. M. Mendel, recently established that a general T2 fuzzy logic systems (GT2 FLS) has the capability to give better (or at least equal) performance than a IT2 FLS which on the other hand have the potential to produce better (or at least equal) performance than a T1 FLS. This has led a number of researchers (but very few) to focus on this GT2 FSs. The modelling and representation have now been well established in the literature for the researchers so that it can be explored for various applications. This warrants more and more research attention from the scientific community on this important topic, especially since everyday newer and newer systems are emerging across all the domains of science and engineering, e.g. social networks, big data analytics, cyber security, cyber-physical systems, cloud computing etc. Moreover, uncertainty modelling using T2 FSs has a lot of potential within the framework of machine learning and deep learning. Therefore, this special issue aims to introduce cutting edge research concepts on T2 FSs and Systems and their applications in a number of emerging systems. There are 10 papers in this special issue that can be considered a representative sample to cutting edge research that is currently being done in the area of type-2 fuzzy logic around the world. We briefly mention below each of the 10 papers, to offer the readers a better idea of the kind of works that form this special issue.

In Xing Xu et al. a Coordinated Control of Dual-Motor using Interval Type-2 Fuzzy Logic in Autonomous Steering System of AGV is presented. In Eduardo Aguiar et al. a new Model to Distinguish Railhead Defects Based on Set-Membership Type-2 Fuzzy Logic System is described. In Xiaohong Pan et al. an Enhanced Technique for Order Preference by Similarity to Ideal Solutions and its Application to Renewable Energy Resources Selection Problem is outlined. In Emanuel Ontiveros et al. an Efficient High-Order α-Plane Aggregation in General Type-2 Fuzzy Systems using Newton–Cotes Rules is presented. In Junqing Li et al. an approach for Solving Type-2 Fuzzy Distributed Hybrid Flowshop Scheduling using an Improved Brain Storm Optimization Algorithm is described. In

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Hashem Namvar and Shahrooz Bamdad a Resilience-Based Efficiency Measurement of Process Industries with Type-2 Fuzzy Sets is presented. In Hongde Qin et al. an Adaptive Interval Type-2 Fuzzy Fixed-time Control for Underwater Walking Robot with Error Constraints and Actuator Faults Using Prescribed Performance Terminal Sliding-mode Surfaces is outlined. In Tiechao Wang et al. a Type-2 Fuzzy Adaptive Event-Triggered Saturation Control for Photovoltaic Grid-Connected Power Systems is presented. In Xiaofeng Liu et al. an approach for Measures of Uncertainty Based on Gaussian Kernel for Type-2 Fuzzy Information Systems is presented. In Chen Liu et al. an Analysis and Control of Blood Glucose Situation for Diabetic Patients Based on Interval Type-2 Fuzzy Sets is described.

We believe that these papers will be an important contribution to the state of the art of type-2 fuzzy sets and systems for solving real-world problems. In addition, there are also contributions on the theoretical side with new concepts and models of type-2 fuzzy theory. We envision that the papers of the special issue will be of great interest to researchers and students of the type-2 fuzzy systems and computational intelligence areas, as well as in different application areas.

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