

Guest Editorial: Smart Fuzzy Optimization in Operational Research and Renewable Energy: Modeling, Simulation, and Application

OVER THE last five decades, fuzzy optimization has found numerous successful applications in diverse fields, including operational research (OR), manufacturing, information technology, energy optimization, data science, smart cities, and big data analytics. Fuzzy optimization has strongly influenced research and development into other areas of intelligent computing leading to many hybrid and deep learning systems. It has opened new horizons in thinking, research and development and it will guide us into another half century of progress. In actuality, fuzzy optimization is an approximation of nonlinear optimization, which has formed a systematic but not yet unified theory of fuzzy systems and other fuzzy-set based methodologies. Fuzzy optimization along with decision making is an interdisciplinary area, which focuses on extracting useful knowledge with data technology and employing it. Specific topics include fuzzy sets, rough sets, statistical methods, parallel/distributed data mining, hybrid fuzzy optimization, hybrid evolutionary and swarm intelligence methods, big data optimization, IoTs, flexibility, reliability and robustness, smart systems, high-dimensional and big-data analytics, energy optimization, and software engineering.

This IEEE TFS Special Issue has succeeded to explore latest modeling, simulation, and fuzzy optimization, related with renewable energy, electronics and electricity, and various related topics. This offers a concentrative venue for researchers to make rapid exchange of ideas and innovative research findings in fuzzy and related stochastic optimization, optimal control, and OR. In particular, new interdisciplinary approaches in fuzzy optimization and control applications, computer science and engineering applications, as well as strong conceptual foundations were received and accepted after rigorous reviewing processes. Finally, the following ten articles became part of this exclusive IEEE TFS Special Issue.

Liu *et al.* in their article “A Fuzzy Interval Time Series Energy and Financial Forecasting Model Using Network-Based Multiple Time-Frequency Spaces and the Induced Ordered Weighted Averaging Aggregation Operation” propose a fuzzy interval time-series forecasting model in network-based multiple time-frequency spaces and an ordered weighted averaging aggregation operation to enhance overall prediction capabilities and

improve forecasting accuracy, giving better performance than earlier models.

In their article “Driver-Identified Supervisory Control System of Hybrid Electric Vehicles Based on Spectrum-Guided Fuzzy Feature Extraction,” Li *et al.* proposed that system can accurately identify the human driver from natural operating signals and provides driver-identified globally optimal control policies as opposed to mere control actions. To improve the identifiability and efficiency of this man-machine control system, the method of spectrum-guided fuzzy feature extraction is developed.

In the article “Hybrid Microgrid Many-Objective Sizing Optimization With Fuzzy Decision,” Cao *et al.* present an improved two-archive many-objective evolutionary algorithm based on fuzzy decisions to solve the optimal sizing problem for a hybrid system microgrid (HMS), since economics, reliability, and carbon efficiency of the HMS often conflict, so that reasonable design of the initial microgrid size is important.

The article by Kumar Das *et al.*, “Application of Type-2 Fuzzy Logic to a Multi-Objective Green Solid Transportation-Location Problem With Dwell Time Under Carbon Tax, Cap and Offset Policy: Fuzzy vs. Non-Fuzzy Techniques,” designs an effective and environmentally concerned logistics system. It introduces an unprecedented integrated mathematical model for a green solid transportation system with dwell time to execute the carbon tax, cap, and offset regulation.

In their article “Multi-Objective Fuzzy Portfolio Performance Evaluation Using Data Envelopment Analysis Under Credibilistic Framework,” Kumar Mehlaawat *et al.* present two different multiobjective fuzzy portfolio selection models. The significant criteria considered for portfolio selection are risk, return, liquidity, and entropy. Here, the return of the portfolio is considered to be satisfied by a minimum return threshold constraint.

In their article “Optimal Foraging Algorithm That Incorporates Fuzzy Relative Entropy for Solving Many-Objective Permutation Flow Shop Scheduling Problems” Zhu *et al.* solve permutation flow shop scheduling problems with many objectives. They use a membership function to connect the function values of many-objective optimization problems with a fuzzy membership degree. An approach for mapping function values to fuzzy sets is presented.

The article “A Fuzzy Mining Approach for Energy Efficiency in a Big Data framework,” by Fernandez-Basso *et al.* addresses discovery and exploitation of hidden information in collected

data. Fuzzy methods adequately transform the data can improve their interpretability. They present an automatic fuzzification method implemented using the Big Data paradigm, which in a later step enables the detection of interrelations and patterns among different sensors and weather data recovered from an office building.

In their article “*Multi-Task Scheduling in Consideration of Fuzzy Uncertainty of Multiple Criteria in Multi-Service-Oriented Manufacturing*,” Li *et al.* are concerned with tasks in the field of service-oriented manufacturing, such as cloud manufacturing, have the characteristics of complexity, heterogeneity, uncertainty, and geographically distribution. They propose four comprehensive models that are different in the uncertain degree of considered performance criteria and/or defuzzification time-points of fuzzy values.

In the article “*Fuzzy Mathematical Programming and Self-Adaptive Artificial Fish Swarm Algorithm for Just-in-Time Energy-Aware Flow Shop Scheduling Problem With Outsourcing Option*,” Tirkolae *et al.* determine the optimal sequence of processing jobs on available machines within a given customer order. A novel biobjective MILP model is offered for flow shop scheduling with an outsourcing option and just-in-time delivery to simultaneously minimize total cost of the production system and total energy consumption.

The article “*Adaptive Hierarchical Probabilistic Model Using Structured Variational Inference for Point Set Registration*” by He *et al.* proposes an adaptive hierarchical probabilistic model under a variational Bayesian framework for point set registration problem, which plays an important role in computer vision and pattern recognition. The authors construct a

robust adjustable transformation for effectively fitting target point set while resisting outliers. The performances against 11 state-of-the-art methods show that the new method gives the best performance in most scenarios.

We Guest Editors trust that this IEEE TFS Special Issue underlines and further strengthens the particular and unique position of IEEE TRANSACTIONS ON FUZZY SYSTEMS worldwide as a *Premium Journal* of academic excellence and scientific foresight, of rigor and vision. Now, we wish you all a great enrichment and joy when first browsing through and then reading in detail this exciting piece of work.

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