mathematics

Editorial

Fuzzy Logic and Soft Computing—Dedicated to the Centenary of the Birth of Lotfi A. Zadeh (1921–2017)

Sorin Nădăban

Department of Mathematics and Computer Science, Aurel Vlaicu University of Arad, Elena Drăgoi 2, RO-310330 Arad, Romania; snadaban@gmail.com

1. Introduction

In 1965, Lotfi A. Zadeh published "Fuzzy Sets", his pioneering and controversial paper, which has now reached over 115,000 citations. Zadeh's papers have altogether been cited over 248,000. Starting from the ideas presented in that paper, Zadeh later founded the Fuzzy Logic Theory, which proved to have useful applications from consumer to industrial intelligent products.

In accordance with Zadeh's definition, soft computing (SC) consists of computational techniques in computer science, machine learning, and some engineering disciplines to study, model, and analyze very complex realities, for which more traditional methods have been either unusable or inefficient. SC uses soft techniques, contrasting it with classical artificial intelligence hard computing (HC) techniques, and includes fuzzy logic, neural computing, evolutionary computation, machine learning, and probabilistic reasoning. HC is bound by a computer science (CS) concept called NP-complete, which means that there is a direct connection between the size of a problem and the amount of resources needed to solve it called the "grand challenge problem". SC helps to surmount NP-complete problems by using inexact methods to give useful but inexact answers to intractable problems. SC became a formal CS area of study in the early 1990s. Earlier computational approaches could model and precisely analyze only relatively simple systems. More complex systems arising in biology, medicine, the humanities, management sciences, and similar fields often remained intractable to HC. It should be pointed out that the simplicity and complexity of systems are relative, and many conventional mathematical models have been both challenging and very productive. SC techniques resemble biological processes more closely than traditional techniques, which are largely based on formal logical systems, such as Boolean logic, or rely heavily on computer-aided numerical analysis (such as finite element analysis). SC techniques are intended to complement HC techniques. Unlike HC schemes, which strive for exactness and full truth, SC techniques exploit the given tolerance of imprecision, partial truth, and uncertainty for a particular problem. Inductive reasoning plays a larger role in SC than in HC. SC and HC can be used together in certain fusion techniques. SC can deal with ambiguous or noisy data and it is tolerant of imprecision, uncertainty, partial truth, and approximation. In effect, the role model for SC is the human mind. Artificial intelligence and computational intelligence based on SC provide the background for the development of smart management systems and decisions in the case of ill-posed problems.

2. Contributions

In the following, a brief overview of the published papers is presented.

Finding a suitable definition of fuzzy inner product space have concerned many mathematicians. In [1], first, various approaches are presented for the concept of fuzzy inner product space existing in the specialized literature, and then a new definition is introduced. In fact, the authors modified P. Majumdar and S.K. Samanta's definition of inner product space and proved some new properties of the fuzzy inner product function.

Citation: Nădăban, S. Fuzzy Logic and Soft Computing—Dedicated to the Centenary of the Birth of Lotfi A. Zadeh (1921–2017). *Mathematics* **2022**, *10*, 3216. https://doi.org/10.3390/math10173216

Received: 22 August 2022
Accepted: 2 September 2022
Published: 5 September 2022

Finally, in this paper, it is also proved that this fuzzy inner product generates a fuzzy norm of the type Nădăban-Dzitac.

The paper [2] proposes a new generalization of vector spaces over field, which is called M-hazy vector spaces over M-hazy field. Some fundamental properties of M-hazy field, M-hazy vector spaces, and M-hazy subspaces are studied, and some important results are also proved. Furthermore, the linear transformation of M-hazy vector spaces is studied, and their important results are also proved.

Optimization problems in the fuzzy environment are widely studied in the literature. In paper [3] the authors restrict their attention to mathematical programming problems with coefficients and/or decision variables expressed by fuzzy numbers. This paper identifies the current position and role of the extension principle in solving mathematical programming problems that involve fuzzy numbers in their models, highlighting the indispensability of the extension principle in approaching this class of problems. Finally, some research directions focusing on using the extension principle in all stages of the optimization process are proposed.

The interval range is an important characterization of a fuzzy set. The interval range is also useful for analyses and applications of arithmetic. In paper [4], the authors presented general conclusions on crucial problems related to interval ranges of fuzzy sets.

In paper [5], the authors present a group decision-making solution based on a preference relationship of interval-valued fuzzy soft information. Further, two crisp topological spaces, namely, lower topology and upper topology, are introduced based on the interval-valued fuzzy soft topology. Then, a score function-based ranking system is also defined to design an adjustable multi-steps algorithm. Finally, some illustrative examples are given to compare the effectiveness of the present approach with some existing methods.

In paper [6], the notions of L-fuzzy subalgebra degree and L-subalgebras on an effect algebra are introduced and some characterizations are given. The authors use four kinds of cut sets of L-subsets to characterize the L-fuzzy subalgebra degree. Finally, it is proved that the set of all L-subalgebras on an effect algebra can form an L-convexity, and its L-convex hull formula is given.

The paper [7] is dedicated to Professor Ioan Dzitac (1953–2021). Therefore, his life is briefly presented, as well as a comprehensive overview of his major contributions in the domain of soft computing methods in a fuzzy environment. Finally, some future trends are discussed.

In paper [8], a certain fuzzy class of analytic functions is defined in the open unit disc and some interesting results related to this class are obtained using the concept of fuzzy differential subordination.

In paper [9], the authors introduce the concept of an m-polar fuzzy set (m-PFS) in semigroups. This paper provides some important results related to m-polar fuzzy subsemigroups (m-PFSSs), m-polar fuzzy ideals (m-PFIs), m-polar fuzzy generalized bi-ideals (m-PFGBIs), m-polar fuzzy bi-ideals (m-PFBIs), m-polar fuzzy quasi-ideals (m-PFQIs) and m-polar fuzzy interior ideals (m-PFIIs) in semigroups.

In paper [10], a new implementation of the marks library is presented. Examples in dynamical systems simulation, fault detection and control are also included to exemplify the practical use of the marks.

In paper [11], a fuzzy logic approach is proposed for the decision-making system in management control in small and medium enterprises. The C. Mamdani fuzzy inference system (MFIS) was applied as a decision-making technique to explore the influence of the use of management control tools on the organizational performance of SMEs.

In paper [12], fuzzy differential subordination results are obtained using a new integral operator introduced by the author, using the well-known confluent hypergeometric function, also known as the Kummer hypergeometric function. The new hypergeometric integral operator is defined by choosing particular parameters, having as inspiration the operator studied by Miller, Mocanu and Reade in 1978.

The paper [13] presents the multigranulation roughness of an intuitionistic fuzzy set based on two soft relations over two universes with respect to the aftersets and foresets. Finally, a decision-making algorithm is presented with a suitable example.

The aim of the paper [14] is to present new fuzzy differential subordinations and superordinations for which the fuzzy best dominant and, respectively, fuzzy best subordinant are given. The original theorems proved in the paper generate interesting corollaries for particular choices of functions acting as fuzzy best dominant and fuzzy best subordinant.

Funding: This research received no external funding.

Acknowledgments: As the Guest Editor of this Special Issue, I am grateful to the authors of the papers for their quality contributions, to the reviewers for their valuable comments towards the improvement of the submitted works and to the administrative staff of the MDPI publications for the support to complete this project.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Popa, L.; Sida, L. Fuzzy Inner Product Space: Literature Review and a New Approach. *Mathematics* **2021**, *9*, 765. [CrossRef]
2. Mehmood, F.; Shi, F.-G. M-Hazy Vector Spaces over M-Hazy Field. *Mathematics* **2021**, *9*, 1118. [CrossRef]
3. Stanojević, B.; Stanojević, M.; Nădăban, S. Reinstatement of the Extension Principle in Approaching Mathematical Programming with Fuzzy Numbers. *Mathematics* **2021**, *9*, 1272. [CrossRef]
4. Mao, Q.; Huang, H. Interval Ranges of Fuzzy Sets Induced by Arithmetic Operations Using Gradual Numbers. *Mathematics* **2021**, *9*, 1351. [CrossRef]
5. Ali, M.; Kiliçman, A.; Zahedi Khameneh, A. Application of Induced Preorderings in Score Function-Based Method for Solving Decision-Making with Interval-Valued Fuzzy Soft Information. *Mathematics* **2021**, *9*, 1575. [CrossRef]
6. Dong, Y.-Y.; Shi, F.-G. L-Fuzzy Sub-Effect Algebras. *Mathematics* **2021**, *9*, 1596. [CrossRef]
7. Dzitac, S.; Nădăban, S. Soft Computing for Decision-Making in Fuzzy Environments: A Tribute to Professor Ioan Dzitac. *Mathematics* **2021**, *9*, 1701. [CrossRef]
8. Lupaş, A.A.; Oros, G.I. New Applications of Sălăgean and Ruscheweyh Operators for Obtaining Fuzzy Differential Subordinations. *Mathematics* **2021**, *9*, 2000. [CrossRef]
9. Bashir, S.; Shahzadi, S.; Al-Kenani, A.N.; Shabir, M. Regular and Intra-Regular Semigroups in Terms of m-Polar Fuzzy Environment. *Mathematics* **2021**, *9*, 2031. [CrossRef]
10. Sainz, M.A.; Calm, R.; Jorba, L.; Contreras, I.; Vehi, J. Marks: A New Interval Tool for Uncertainty, Vagueness and Indiscernibility. *Mathematics* **2021**, *9*, 2116. [CrossRef]
11. Nicolas, C.; Müller, J.; Arroyo-Cañada, F.-J. A Fuzzy Inference System for Management Control Tools. *Mathematics* **2021**, *9*, 2145. [CrossRef]
12. Oros, G.I. Fuzzy Differential Subordinations Obtained Using a Hypergeometric Integral Operator. *Mathematics* **2021**, *9*, 2539. [CrossRef]
13. Anwar, M.Z.; Bashir, S.; Shabir, M.; Alharbi, M.G. Multigranulation Roughness of Intuitionistic Fuzzy Sets by Soft Relations and Their Applications in Decision Making. *Mathematics* **2021**, *9*, 2587. [CrossRef]
14. Lupaş, A.A. Applications of the Fractional Calculus in Fuzzy Differential Subordinations and Superordinations. *Mathematics* **2021**, *9*, 2601. [CrossRef]