Editorial

Special Section on Z-Numbers and Applications

Real-world information is imperfect. On the one hand, such information is often characterized by fuzziness. This implies that we often impose soft constraints on values of variables of interest. On the other hand, real-world information is characterized by partial reliability. Indeed, any estimation of values of interest, be it precise or soft, is subject to the confidence in sources of information – knowledge, assumptions, intuition, envision, experience – which, in general, cannot completely cover the whole complexity of real-world phenomena. Thus, fuzziness and partial reliability are strongly associated to each other. In order to take into account this fact, L.A. Zadeh suggested the concept of a Z-number as a more adequate formal construct for description of real-world information.

Many numbers, especially, in fields such as economics and decision analysis, are in reality Z-numbers, but they are not treated as such, because it is much simpler to compute with numbers than with Z-numbers. Basically, the concept of a Z-number is a step toward formalization of the remarkable human capability to make rational decisions in an environment of imprecision and uncertainty.

The concept of a Z-number has a potential for many applications, especially in the realms of computation with probabilities and events described in NL. Of particular importance are applications in economics, decision analysis, risk assessment, prediction, anticipation, planning, biomedicine and rule-based manipulation of imprecise functions and relations.

This special issue is devoted to the most recent outstanding theoretical and practical contributions to the Z-number concept.

In the first paper "Numerical solution of fuzzy equations with Z-numbers using neural networks", Raheleh Jafari, Wen Yu, the authors consider fuzzy equation with Z-number valued coefficients for nonlinear system modeling under uncertainty. The conditions of controllability are proposed. Two types of neural networks are

implemented to approximate solutions of the fuzzy equations with Z-number coefficients.

In the second paper "Zet Theory", M.J. Wierman, a new concept of a zet set is proposed. The author uses the standard techniques of set theory for the development of a algebra of zets. It is shown that zets and fuzzy sets are essentially interchangeable. The fundamental manipulations, techniques, and definitions of zets are simpler and more amenable to analysis.

The third paper, "On an optimization method based on Z-numbers and the multi-objective evolutionary algorithm", Dong Qiu, Rongwen Dong, Shuqiao Chen, Andi Li, is devoted to the optimization problems with multiple Z-number valued objectives. The authors convert Z-numbers to classical fuzzy numbers to simplify calculation. A new dominance relationship of two fuzzy numbers based on the lower limit of the possibility degree is proposed. Then according to this dominance relationship, multi-objective evolutionary algorithm to solve the optimization problems is presented. Finally, a simple example is used to demonstrate the validity of the suggested algorithm.

The fourth paper, "Failure mode and effects analysis based on Z-numbers" Wen Jiang, Chunhe Xie, Boya Wei, Yongchuan Tang, is devoted to a new method for failure mode and effects analysis based on Z-numbers. In the proposed method, Z-numbers are used to perform the valuations of the risk factors like occurrence, severity, and detection. These Z-valuations of the risk factors are integrated by fuzzy weighted mean method. A new risk priority number named as ZRPN is calculated to prioritize failure modes based on a modified method of ranking fuzzy numbers. A case study for the rotor blades of an aircraft turbine is performed to demonstrate the feasibility of the proposed method.

In the fifth paper, "The Identification of Job Satisfaction under Z-Information", S. Z. Eyupoglu, K.I. Jabbarova, K.R. Aliyeva, authors consider a job satisfaction evaluation problem which is naturally chracterized by imprecision and partially reliable information. In view of this authors apply a Z-number valued If-Then rules based model to desribe the relationship between job satisfaction and the influential

factors. A real-world job satisfaction index evaluation problem is used to illustrate the suggested approach.

The sixth paper "Numerical solution of linear regression based on Z-numbers by improved neural network" Somayeh Ezadi, Tofigh Allahviranloo, is devoted to a linear regression based on Z-number. In this regression, observations are real-valued but the coefficients and results of observations are Z-valued. Therefore, to estimate this type of regression, the authors use three distinct ways depending on different conditions dominating the problem. Moreover, the method of calculating the weights of Z-number neural network has been mentioned and the stability of neural Network weights is considered. In some examples, the answer is estimated compared with the original answer.

In the seventh paper, "Z-Numbers and Type-2 Fuzzy Sets: A Representation Result", Vladik Kreinovich and Rafik Aliev, the authors study the relation between type-2 fuzzy sets and Z-numbers. The authors prove that type-2 fuzzy set can be represented as a result of applying an appropriate data processing algorithm to some Z-numbers.

In the eighth paper, "Modelling of Consumer Buying Behaviour Using Z-Number Concept", Gunay Sadikoglu, consumer behaviour modeling by using the Z-number concept for handling real-world uncertainties is considered. The proposed approach is applied to a real-world problem with linguistic information obtained through a survey that includes questions related to marketing, socio-cultural, psychological and personal factors of consumer behavior.

In the ninth paper, "A Z-Number Valued Regression Model and Its Application", L.M. Zeinalova, O.H. Huseynov, P. Sharghi, the authors consider a problem of Z-number valued multiple regression analysis where both variables and coefficients are Z-valued. Authors provide an application of the proposed study to a real-world decision making problem. The obtained results show applicability of the proposed approach.

The tenth paper "Introduction to U-number calculus", R.A. Aliev, is devoted to a new approach to commonsense reasoning. In this paper, an approach to modeling

of usuality on the basis of calculus of usual numbers (U-numbers) is proposed. A U-number is considered as a Z-number where the second component is "usually". Validity of the suggested approach is verified by examples.

In the eleventh paper, "New multi-layer method for Z-number ranking using Hyperbolic Tangent function and convex combination", Somayeh Ezadi, Tofigh Allahviranloo, a new method for ranking Z-numbers is proposed. The method is based on ranking of fuzzy numbers, hyperbolic tangent function and convex combination. Several examples are used to illustrate the proposed method.

Guest Editors

Prof. Rafik Aliev
Prof. Vladik Kreinovich
Prof. Burhan Turksen
Prof. K.-W. Bonfig