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Editorial

In recent years fuzzy sets theory and related to it possibility theory, both originated by Professor Lotfi A. Zadeh from the University of California at Berkeley in 1965 and 1978, respectively, are experiencing a rapid growth of interest and finding applications in a large spectrum of different fields.

Basically, a fuzzy set is a class to which an element is allowed not only to belong or not, as in a conventional set, but to belong to a partial extent: from the full belongingness to the full nonbelongingness, through all intermediate values. A fuzzy set may be therefore used to represent imprecise, ambigous or vague — to be called fuzzy, for brevity — concepts and relationships. And this is what has been needed for a long time in diverse domains: economy, medicine, social sciences, linquistics, biology, knowledge engineering, etc. in which many issues and problems involve entities and relationships that are inherently fuzzy, hence falling outside of the scope of the conventional "precise" mathematics.

Optimization, or more generally decision making, is one of the fields where applications of fuzzy sets have been particularly strongly advocated. One of main reasons is a principal discrepancy between the tools and techniques, and the real problems they are intended to solve. Namely, the existing rich apparatus of well developed optimization tools and techniques is rigid in the sense that they require precise specifications and data of the problems to be dealt with as, e.g., constraints and objective functions, or even the essence of optimum (for instance, corresponding to the maximization of a utility type function). In practice, however, we rarely have precise constraints and objective functions, and our perception of the very goal of optimization may not coincide with a simple utility maximization. Some "softer", less rigid optimization models may be therefore needed to be consistent with that human perception, which is a prerequisite for an easier implementation. Fuzzy sets and possibility theory may provide here appropriate, and simple and intuitively appealing means.

And, indeed, much research has been recently done in fuzzy decision making and optimization, and many interesting theoretical and applicational results have been obtained. In recognizing importance and growing interest in this topic, the editorial board of "Control and Cybernetics" has decided to publish a special issue of the journal on fuzzy sets and possibility theory in optimization models, with myself as the quest editor. The papers have been solicited from leading specialists in the field. Their very positive response has resulted in 13 papers dealing with different problems of theory and applications, and representing a diversity of approaches and views. Needless to say that the opinions expressed by the authors are not always those of the guest editor. An important feature of the issue is that the contributions come from all over the world, both East and West, representing Austria, Canada, France, Hong Kong, Japan, People's Republic of China, Poland, Spain, the USA, and the USSR.

The papers are ordered from those dealing with more general, theoretical problems to those devoted to more specific issues and applications.

C. V. Negoita ("Structure and logic in optimization") discusses in a category — — theoretic language the very essence of optimization, in particular of multicriteria type, showing how a need for a fuzzy framework arises.

D. Dubois and H. Prade ("Fuzzy-set-theoretic differences and inclusions and their use in the analysis of fuzzy equations") consider a new "optimistic" fuzzy arithmetics, allowing for compensation of errors (imprecision), relevant for the analysis of equations involving fuzzy numbers which may be in turn a prerequisite for optimization.

N. Slyadz and A. Borisov ("Decision-making based on fuzzy stochastic dominance") consider decision making without an exact knowledge of a utility function, based on stochastic dominance tests involving a fuzzy initial information.

J. Kacprzyk and R. R. Yager ("Linguistic quantifiers and belief qualification in fuzzy multicriteria and multistage decision making") discuss some "softening" of fuzzy multicriteria and multistage decision making by involving a linguistic quantifier (e.g., most) to specify the number of fuzzy objectives to be satisfied, with possibly varying importances and belief as to a particular fuzzy objective.

S. A. Orlovski ("Multiobjective programming problems with fuzzy parameters") proposes to solve a fuzzy multiobjective programming problem by seeking a best compromise between the degrees of nondominance and feasibility.

H. Tanaka, H. Ichihashi and K. Asai ("A formulation of fuzzy linear programming problem based on comparison of fuzzy numbers") discuss some fuzzy linear programming problems with fuzzy coefficients, and — using an inequality relation between fuzzy numbers — transform them into some equivalent conventional linear programs.

S. Chanas and M. Kulej ("A fuzzy linear programming problem with equality constraints") show how to obtain an optimal solution, and some solutions close to it, of a fuzzy linear program with fuzzy equality constraints by using parametric linear programming.

Y. Leung ("Compromise programming under fuzziness") discusses the derivation of a solution in fuzzy multiobjective programming by deriving a (fuzzy) compromise solution which is the closest one from a (fuzzy) ideal solution.

M. Sakawa ("Interactive fuzzy goal programming for multiobjective nonlinear problems and its application to water quality management") presents an interactive computerized model for finding a satisficing solution to a multiobjective nonlinear program in which a decision maker has for each objective some fuzzy goal which may be interactively updated.

J. L. Verdegay ("Application of fuzzy optimization to operational research") considers solution concepts and duality in fuzzy linear programming, and applications in transportation and vector optimization problems.

M. Togai and P. P. Wang ("Analysis of a fuzzy dynamic system and synthesis of its optimal controller") discuss a mathematical description of a fuzzy dynamic system by means of a fuzzy relation, and develop a fuzzy controller providing a suboptimal control of that fuzzy system.

J. Kiszka, M. M. Gupta and P. N. Nikiforuk ("The influence of some fuzzy implication operators on the steady-state and dynamical properties of a fuzzy logic controller") consider the influence of fuzzy implication operators on the performance of a fuzzy controller with respect to the settling time, overshoot and steady-state value.

Feng De-yi, Lou Shi-bo, Chen Hua-cheng, Gu Jin-ping and Lin Ming-zhou ("Applications of fuzzy mathematics in seismological and meteorological research") present an overview of interesting works done in the People's Republic of China on using fuzzy sets for earthquake classification and prediction, and weather forecasting.

We hope that this Special Issue will be valuable for all those interested in solving "soft" optimization problems arising in a variety of fields.

We wish to thank all the contributors for their kind cooperation in the project. Moreover, we are indebted to the editor in chief of "Control and Cybernetics", Professor Kazimierz Malanowski, for his encouragement and support.

Janusz Kacprzyk
Guest editor

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