Fuzzy Optimization and Decision Making, 1, 11–12, 2002

Preface

The debut of "Fuzzy Optimization and Decision Making," is an important milestone in the evolution of decision analysis and optimization theory. To appreciate the importance of this milestone, a bit of history is in order.

Decision analysis as we know it today is rooted in the pioneering work of von Neumann, Morgenstern and other great intellects who followed them. The work of these pioneers was driven by a quest for a mathematical theory which is rigorous, precise and prescriptive. What can be said today is that important progress has been made but achievement of the ultimate goal is not in sight. With the passage of time, it has become increasingly clear that the real world is much too complex, uncertain and imprecise to admit of analysis with von Neumann-Morgenstern spirit.

My l970 paper with R.E. Bellman, "Decision-Making in a Fuzzy Environment," was intended to suggest a framework based on the theory of fuzzy sets for dealing with imprecision and partial truth in optimization and decision analysis. In the intervening years, a voluminous literature on applications of fuzzy logic to decision analysis has come into existence. It is this reality that motivated Professor Shu-Cherng Fang to propose to Kluwer Academic Publishers to launch the Journal of Fuzzy Optimization and Decision Making. Professor Fang's vision and initiative deserve our applause and congratulations.

In what follows, I should like to articulate a perception—that fuzzy-logic-based decision analysis may be entering a new and important phase.

More specifically, what I have in mind is the impact on decision analysis of the recently developed fuzzy-logic-based computational theory of perceptions (CTP) and precisiated natural language (PNL).

Decisions are based on information. In most real world settings, decision-relevant information is a mixture of measurements and perceptions. What existing theories lack is the capability to operate on perception-based information. It is this capability that underlies the remarkable human ability to perform a wide variety of physical and mental tasks without any measurements and any computations. Everyday examples of such tasks are parking a car, driving in city traffic, playing golf and summarizing a story. In performing these tasks, humans employ perceptions of time, size, shape, direction, likelihood, intent, gain, similarity and other attributes of physical and mental objects.

The point of departure in the computational theory of perceptions is the assumption that perceptions are described by propositions drawn from a natural language, NL. In perception-based decision analysis, descriptions of perceptions are precisiated through translation into what is called the Generalized Constraint Language, GCL. Thus, PNL is the subset of NL which is precisiable through translation into GCL. These are the core ideas underlying the methodology of computing with words (CW)– a methodology which subsumes the computational theory of perceptions and precisiated natural language.

Computing with words adds a powerful tool to the armamentarium of optimization theories and decision analysis. The need for this tool is underscored by what may be called the Intractability Principle, described in the following.

As the complexity of a problem increases, a critical threshold is reached beyond which solution cannot be achieved through the use of techniques based on two-valved logic and probability theory. Beyond the critical threshold, achievement of solution necessitates the use of fuzzy-logic-based methodology of computing with words and perception-based theory of probabilistic reasoning.

Acceptance of this principle may have a far reaching impact on the course of development of scientific theories, especially those which relate to optimization and decision analysis. In this development, the journal of "Fuzzy Optimization and Decision Making" is likely to play an influential role as a forum for presentation of new ideas and new theories.

Lotfi A. Zadeh
June, 2001