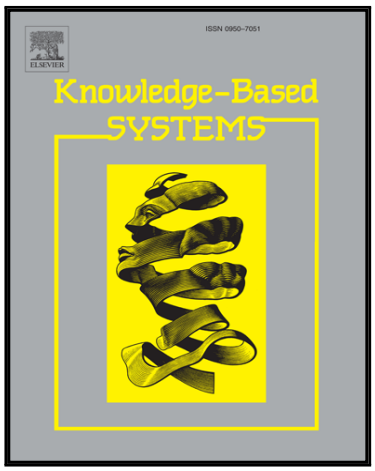

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A new emergency decision support methodology based on multi-source knowledge in 2-tuple linguistic model

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Abstract

Knowledge is the foundation of emergency decision-making (EDM), in which the experts from multi-fields express their knowledge with multi-granularity linguistic model to assistant decision-making. Thus, the paper proposed a new decision support methodology to generate decision-making knowledge. In this paper, the framework of decision knowledge generation in the EDM was introduced firstly. To generate decision-making knowledge accurately and objectively, two objective models, which can effectively determine the weights of criteria and experts respectively, were built based on the tacit knowledge hidden in the original information. Then, the personal knowledge, generated by combining the normalized decision knowledge and the weight vector of criteria, is further aggregated into the collective knowledge by means of aggregation operator. Finally, an illustrative example is presented to verify the application of the proposed methods, and relevant discussions prove the results obtained from the proposed decision support methodology can improve the scientificity and accuracy of the EDM.

Keywords: Multi-source knowledge aggregation, Multi-granularity linguistic model, 2-tuple linguistic model, Expert weight, Attribute weight, Emergency decision-making
2017 MSC: 00-01, 99-00

1. Introduction

Unconventional emergency events impact millions of people all over the world. For example, the Wenchuan earthquake in 2008 results in over 69,000 deaths, 374,176 injuries, 18,222 missing persons [1]. Generally, there are many emergency decision-making problems that need to be solved in emergency management to reduce the damage and loss of life [2]. Emergency decision-making (EDM) is typically characterized by time limitations, partial or incomplete information, limited expertise and decision pressure resulting from potentially serious outcomes [2, 3, 4]. Therefore, an emergency decision usually requires many experts(or decision makers) to provide their knowledge about a set of different alternatives. Due to the complexity, uncertainty and time limitations of EDM, experts feel more comfortable providing their knowledge by using linguistic terms close to human beings cognitive model [5, 6]. Therefore, aggregating the linguistic knowledge provided by multi-source (one expert can be regarded as a source of knowledge [7]) into collective knowledge in a timely and accurate manner is required in a reasonable EDM.

Due to the differences in culture, education, experience and cognition of all experts, the unique linguistic term set (LTS) is not enough to fulfill the needs of knowledge descriptions, which implies the necessity of using linguistic terms from different LTS, i.e. multi-granularity linguistic term sets (M-LTS), to represent decision knowledge. M-LTS has been applied successfully to decision-making and many methods have been proposed to manage the multi-granularity linguistic information. For example, Herrera et al[8] proposed the first method to manage M-LTS information in decision-making problem, in which all linguistic terms from different LTS are transformed to fuzzy sets defined in the basic linguistic term set by using transformation function. Chen et al [9] propose a new fusion approach to break the limitation that the method proposed in [8] cann't transfer a large LTS into a smaller one, but the computational process is too complicated. Massanet et al [10] presented a linguistic computational model based on discrete fuzzy numbers, and proposed some aggregation operators defined on a finite chain in accordance with the granularity of the LTS. Morente-Molinera et al[11] proposed a different novel approach to manage the multi-criteria group decision-making problems with a high number of alternatives using multi-granularity linguistic modeling methods. Jiang et al [12] proposed the approach for managing M-LTS information by transforming the linguistic term from M-LTS into the form of fuzzy numbers. Furthermore, a method for transforming multi-granularity uncertain linguistic variables into trapezoidal fuzzy numbers was proposed to solve decision-making problems with

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