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FUZZY RISK ANALYSIS BASED ON LINGUISTIC AGGREGATION OPERATORS

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Abstract. *The aim of fuzzy risk analysis is to evaluate the probability of failure of every component consisting of many sub-components and the probability of failure is the combination of estimations of severity of loss and probability of failure of sub-components which are vaguely known. In this paper, we present a new method for fuzzy risk analysis with linguistic evaluating values. Firstly, we propose the unbalanced linguistic weighted geometric operator, which can be used to deal with aggregation of unbalanced linguistic values with numerical weights. Then, we generalize the operator to deal with aggregation of unbalanced linguistic values with linguistic weights, and discuss some properties of the operator. Finally, we apply the operator to aggregate linguistic evaluating values of fuzzy risk analysis. A comparison is given between the new method in this paper and the one based on interval-valued fuzzy numbers in the same linguistic evaluating values. The advantages of our method are that the evaluating result is linguistic value which is no need of approximation processing and easier to communicate to decision- and policy-makers, no loss of information and no complex computation due to the linguistic aggregation operator and the 2-tuple fuzzy linguistic representations.*
Keywords: Fuzzy risk analysis, Aggregation operator, Linguistic aggregation operator, 2-tuple fuzzy linguistic representation

1. **Introduction.** From the system point of view, risk analysis means to combine the individual responses to one statement on the system's performance for the purpose of decision-making. It deals with the occurrence of individual failure events (e.g., changes in components or in relations among components as distinct points in space and time) and their possible consequences on the system level [1]. In the procedure of risk analysis, the estimation of the likelihood (e.g., frequencies) and the consequences of hazard occurrence are included. The estimation of the likelihood of hazard occurrence depends greatly on the reliability of the system's components, the interaction of the components taking the system as a whole and human-system interactions. Risk evaluation needs a systematic research of accidental scenarios, including failure rates for the component (e.g., safety barriers) as well as for operator behavior (human factor) within an evolving environment [3]. In practice, information of risk analysis stems from historical data of complex systems