Analysis and Extension of the Evidential Reasoning Algorithm for Multiple Attribute Decision Analysis with Uncertainty

Lianmeng Jiao JIAOLIANMENG@NWPU.EDU.CN

Xiaojiao Geng XIAOJIAOGENG@MAIL.NWPU.EDU.CN

School of Automation
Northwestern Polytechnical University, Xi'an, P.R. China

Poster Abstract

In multiple attribute decision analysis (MADA) problems, one often needs to deal with assessment information with uncertainty. The evidential reasoning approach is one of the most effective methods to deal with such MADA problems. As a kernel of the evidential reasoning approach, an original evidential reasoning (ER) algorithm was firstly proposed by Yang and Singh (1994), and later Yang and Xu (2002) modified the ER algorithm in order to satisfy the proposed four synthesis axioms which a rational aggregation process needs to satisfy. However, the problem is whether the original ER algorithm is wrong, or more generally, whether only the algorithms satisfying the four axioms are rational. It is important to discover the essential difference between the two ER algorithms and the rationality of the synthesis axioms so that we can take a right choice when using these algorithms for resolving MADA problems.

Motivated by the above considerations, we analyzed the ER algorithms in the Dempster-Shafer theory framework and proved that the original ER algorithm follows the traditional reliability discounting and combination scheme, while the modified one follows the importance discounting and combination scheme recently developed by Jiao et al. (2016). We also revealed that the four synthesis axioms are not valid criteria to check the rationality of an attribute aggregation algorithm. Based on these new findings, an extended ER (E^2R) algorithm was proposed to take into account both the reliability and importance of different attributes, which provides a more general attribute aggregation scheme for MADA with uncertainty. The capability of the proposed E^2R algorithm was evaluated through a real-world motorcycle performance assessment problem.

References

L. Jiao, Q. Pan, Y. Liang, X. Feng, and F. Yang. Combining sources of evidence with reliability and importance for decision making. *Central European Journal of Operations Research*, 24:87–106, 2016.

J. B. Yang and M. G. Singh. An evidential reasoning approach for multiple attribute decision making with uncertainty. *IEEE Transactions on Systems, Man, and Cybernetics*, 24:1–18, 1994.

J. B. Yang and D. L. Xu. On the evidential reasoning algorithm for multiple attribute decision analysis under uncertainty. *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans*, 32:289–304, 2002.