Complex evidential reasoning rule in complex evidence theory

Junjie Huang[a], Fuyuan Xiao[a,*]

[a]School of Big Data and Software Engineering, Chongqing University, Chongqing, China

ARTICLE INFO

Keywords:
Uncertainty
Evidential reasoning
Complex evidence theory

ABSTRACT

In this paper, to extend the triditional evidential reasoning (ER) method to complex plane, a novel complex evidential reasoning (CER) method is defined in the framework of complex evidence theory (CET).

Novel complex evidential reasoning method

Inspired by Yang and Singh (1994); Yang and Xu (2013), we develop a complex evidential reasoning method in complex evidence theory (CET). In general, a piece of complex evidence $\mathbb{E}_i$ can be profiled by a complex belief distribution (CBD), defined as follows

$$\mathbb{E}_i = \left\{ (\theta, \mathbb{P}_{\theta,i}), \forall \theta \subseteq \Theta, \sum_{\theta \subseteq \Theta} \mathbb{P}_{\theta,i} = 1 \right\}, \tag{1}$$

where $\mathbb{P}_{\theta,i}$ is a complex number.

Then, the weighted complex belief degree (WCBD) is defined as

$$\mathbb{M}_{\theta,i} = \mathbb{M}_i(\theta) = \begin{cases} 0 & \theta = \emptyset \\ w_i \mathbb{P}_{\theta,i} & \theta \subseteq \Theta, \theta \neq \emptyset \\ 1 - w_i & \theta = P(\Theta) \end{cases} \tag{2}$$

where w_i is the weight of complex evidence $\mathbb{E}_i$.

After the WCBDs are calculated, the recursive combination rule of WCBDs is defined as follows

$$\mathbb{M}_{\theta,e(i)} = [\mathbb{M}_1 \oplus \cdots \oplus \mathbb{M}_i](\theta) = \begin{cases} 0 & \theta = \emptyset \\ \frac{\hat{\mathbb{M}}_{\theta,e(i)}}{\sum_{D \subseteq \Theta} \hat{\mathbb{M}}_{D,e(i)} + \hat{\mathbb{M}}_{P(\Theta),e(i)}} & \theta \neq \emptyset \end{cases} \tag{3}$$

$$\hat{\mathbb{M}}_{\theta,e(i)} = \left[\mathbb{M}_{P(\theta),i} \mathbb{M}_{\theta,e(i-1)} + \mathbb{M}_{P(\theta),e(i-1)} \mathbb{M}_{\theta,i} \right] + \sum_{B \cap C = \theta} \mathbb{M}_{B,e(i-1)} \mathbb{M}_{C,i}, \quad \forall \theta \subseteq \Theta \tag{4}$$

$$\hat{\mathbb{M}}_{P(\Theta),e(i)} = \mathbb{M}_{P(\theta),i} \mathbb{M}_{P(\Theta),e(i-1)}. \tag{5}$$

Finally, the CER rule is represented as

$$\mathbb{P}_{\theta} = \mathbb{P}_{\theta,e(L)} = \begin{cases} 0 & \theta = \emptyset \\ \frac{\hat{\mathbb{M}}_{\theta,e(L)}}{\sum_{B \subseteq \Theta} \hat{\mathbb{M}}_{B,e(L)}} & \theta \neq \emptyset \end{cases} \tag{6}$$

where L is the length of complex evidence set for combination.

References

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

Yang, J.B., Xu, D.L., 2013. Evidential reasoning rule for evidence combination. Artificial Intelligence 205, 1–29.

*Corresponding author
xiaofuyuan@cqu.edu.cn (F. Xiao)
ORCID(s):