Quantum evidential reasoning rule

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Abstract

In this paper, we propose a quantum evidential reasoning rule in the framework of generalized quantum evidence theory.

\textit{Keywords:} Generalized quantum evidence theory, Quantum evidential reasoning rule

1. Introduction

We develop a quantum evidential reasoning method in the framework of generalized quantum evidence theory\cite{1} inspired by \cite{2, 3}. A generalized quantum mass function $Q_{M_h}$ can be profiled by a quantum belief distribution (QBD), defined as follows

$$Q_{M_h} = \left\{ (\theta, P_{\theta,h}), \forall \theta \subseteq \Theta, \sum_{\theta \subseteq \Theta} |P_{\theta,h}|^2 = 1 \right\},$$

(1)

where $P_{\theta,h}$ is a complex number.

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Then, the generalized weighted quantum belief degree (WQBD) is defined as

\[
Q_{M,h}(\theta) = \begin{cases} 
0 & \theta = \emptyset \\
w_h P_{\theta,h} & \theta \subseteq \Theta, \theta \neq \emptyset \\
1 - w_h & \theta = P(\Theta)
\end{cases}
\]  

(2)

where \( w_h \) is the weight of generalized quantum mass function \( Q_{M,h} \).

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

\[
Q_{M,\theta,e}(h) = \bigoplus_{i=1}^{\hat{Q}_{M,\theta,e}(i)} Q_{M,\theta,e}(i) 
\]

(3)

\[
\hat{Q}_{M,\theta,e}(i) = \left[ Q_{M,\theta,e(i-1)} + Q_{M,\theta,e(i-1)} Q_{M,\theta,e(i)} \right] + \sum_{B \subseteq C = \emptyset} Q_{M,B,e(i-1)} Q_{M,C,i}, \quad \forall \theta \subseteq \Theta
\]

(4)

Finally, the generalized QER rule is represented as

\[
P_{\theta} = P_{\theta,e(L)} = \begin{cases} 
0 & \theta = \emptyset \\
\frac{|Q_{M,\theta,e(L)}|^2}{\sum_{B \subseteq \emptyset} |Q_{M,B,e(L)}|^2} & \theta \neq \emptyset
\end{cases}
\]  

(6)

where \( L \) is the length of quantum evidence set for combination.
References

