

Replacing the Conjunctive Rule and Disjunctive Rule with T-norms and T-conorms respectively (Tchamova-Smarandache):

A **T-norm** is a function  $T_n: [0, 1]^2 \rightarrow [0, 1]$ , defined in fuzzy/neutrosophic set theory and fuzzy/neutrosophic logic to represent the “intersection” of two fuzzy/neutrosophic sets and the fuzzy/neutrosophic logical operator “and” respectively. Extended to the fusion theory the T-norm will be a substitute for the conjunctive rule.

The T-norm satisfies the conditions:

- a) Boundary Conditions:  $T_n(0, 0) = 0, T_n(x, 1) = x$ .
- b) Commutativity:  $T_n(x, y) = T_n(y, x)$ .
- c) Monotonicity: If  $x \leq u$  and  $y \leq v$ , then  $T_n(x, y) \leq T_n(u, v)$ .
- d) Associativity:  $T_n(T_n(x, y), z) = T_n(x, T_n(y, z))$ .

There are many functions which satisfy the T-norm conditions. We present below the most known ones:

The Algebraic Product T-norm:

$$T_{n\text{-algebraic}}(x, y) = x \cdot y$$

The Bounded T-norm:

$$T_{n\text{-bounded}}(x, y) = \max\{0, x+y-1\}$$

The Default (min) T-norm (introduced by Zadeh):

$$T_{n\text{-min}}(x, y) = \min\{x, y\}.$$

Min rule can be interpreted as an optimistic lower bound for combination of bba and the below Max rule as a prudent/pessimistic upper bound. (Jean Dezert)

A **T-conorm** is a function  $T_c: [0, 1]^2 \rightarrow [0, 1]$ , defined in fuzzy/neutrosophic set theory and fuzzy/neutrosophic logic to represent the “union” of two fuzzy/neutrosophic sets and the fuzzy/neutrosophic logical operator “or” respectively. Extended to the fusion theory the T-conorm will be a substitute for the disjunctive rule.

The T-conorm satisfies the conditions:

- a) Boundary Conditions:  $T_c(1, 1) = 1, T_c(x, 0) = x$ .
- b) Commutativity:  $T_c(x, y) = T_c(y, x)$ .
- c) Monotonicity: if  $x \leq u$  and  $y \leq v$ , then  $T_c(x, y) \leq T_c(u, v)$ .
- d) Associativity:  $T_c(T_c(x, y), z) = T_c(x, T_c(y, z))$ .

There are many functions which satisfy the T-conorm conditions. We present below the most known ones:

The Algebraic Product T-conorm:

$$T_{c\text{-algebraic}}(x, y) = x+y-x \cdot y$$

The Bounded T-conorm:

$$T_{c\text{-bounded}}(x, y) = \min\{1, x+y\}$$

The Default (max) T-conorm (introduced by Zadeh):

$$T_{c\text{-max}}(x, y) = \max\{x, y\}.$$

Then, the T-norm Fusion rule is defined as follows:

$$m_{\cap 12}(A) = \sum_{\substack{X, Y \in \Theta \\ X \cap Y = A}} T_n(m_1(X), m_2(Y))$$

and the T-conorm Fusion rule is defined as follows:

$$m_{\cup 12}(A) = \sum_{\substack{X, Y \in \Theta \\ X \cup Y = A}} Tc(m1(X), m2(Y))$$

The T-norms/conorms are commutative, associative, isotone, and have a neutral element.

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