

## Unification of Fusion Rules (UFR)

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In this short note we give a formula for the unification of a class of fusion rules based on the conjunctive and/or disjunctive rule at the first step, and afterwards the redistribution of the conflicting and/or non-conflicting mass to the non-empty sets at the second step.

Fusion of masses  $m_1(.)$  and  $m_2(.)$  is done directly proportional with some parameters and inversely proportional with other parameters (parameters that the hypotheses depend upon). The resulting mass is noted by  $m_{UFR}(.)$ .

- a) If variable  $y$  is directly proportional with variable  $p$ , then  $y=k_1 \cdot p$ , where  $k_1 \neq 0$  is a constant.
- b) If variable  $y$  is inversely proportional with variable  $q$ , then  $y=k_2 \cdot (1/q)$ , where  $k_2 \neq 0$  is a constant; we can also say herein that  $y$  is directly proportional with variable  $1/q$ .

In a general way, we say that if  $y$  is directly proportional with variables  $p_1, p_2, \dots, p_m$  and inversely proportionally with variables  $q_1, q_2, \dots, q_n$ , then:

$$y = k \cdot (p_1 \cdot p_2 \cdot \dots \cdot p_m) / (q_1 \cdot q_2 \cdot \dots \cdot q_n) = k \cdot P / Q, \text{ where } P = \prod_{i=1}^m p_i, Q = \prod_{j=1}^n q_j, \text{ and } k \neq 0 \text{ is a constant.}$$

With such notations we have a general formula for a **UFR rule**:

$$m_{UFR}(\phi) = 0, \text{ and } \forall A \in S^\Theta \setminus \phi \text{ one has:}$$

$$m_{UFR}(A) = \sum_{\substack{X_1, X_2 \in S^\Theta \\ X_1 * X_2 = A}} d(X_1 * X_2) T(X_1, X_2)$$

$$+ \frac{P(A)}{Q(A)} \sum_{\substack{X \in S^\Theta \setminus A \\ X * A \in Tr}} d(X * A) \frac{T(A, X)}{P(A) / Q(A) + P(X) / Q(X)}$$

where  $*$  can be an intersection or a union of sets,

$d(X*Y)$  is the degree of intersection or union,

$T(X, Y)$  is a  $T$ -norm fusion combination rule (extension of conjunctive or disjunctive rules),

$Tr$  is the ensemble of sets (in majority cases they are empty sets) whose masses must be transferred,

$P(A)$  is the product of all parameters directly proportional with  $A$ ,

while  $Q(A)$  the product of all parameters inversely proportional with  $A$ ,

$S^\Theta$  is the fusion space (i.e. the frame of discernment closed under union, intersection, and complement of the sets).

At the end we normalize the result.

### Reference:

F. Smarandache, *Unification of Fusion Theories (UFT)*, International Journal of Applied Mathematics & Statistics, Roorkee, India, Vol. 2, 1-14, 2004.