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AGGREGATION OPERATORS AND T-NORM BASED OPERATIONS WITH L-FUZZY REAL NUMBERS

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Our work deals with a fuzzy analogue of a real number. In the literature on fuzzy mathematics one can find several different schemes for defining fuzzy numbers. We consider the notion originating from B.Hutton paper [1] and later developed by several authors.

Let $L = (L, \wedge, \vee)$ be a completely distributive lattice with lower and upper bounds $0_L, 1_L \in L$. An L-fuzzy real number is a function $z\colon \mathbb{R} \to L$ such that

(i) z is non-increasing;

(ii) $\bigwedge_x z(x) = 0_L, \bigvee_x z(x) = 1_L$;

(iii) z is left semi-continuous, i.e. $\bigwedge_{t<x} z(t) = z(x)$.

The set of all fuzzy real numbers is called the fuzzy real line and is denoted by $\mathbb{R}(L)$. The operations of L-fuzzy addition and L-fuzzy multiplication as they are defined in [2] are jointly continuous extensions of addition and multiplication from the real line $\mathbb{R}$ to the L-fuzzy real line $\mathbb{R}(L)$.

The aim of this talk is to present alternative definitions for arithmetic operations with L-fuzzy numbers which are based on a triangular norm (recall that a triangular norm, or a t-norm for short, is an associative, commutative binary operation on a lattice L which is non-decreasing in each argument and has the neutral element 1_L [3]). For this aim we use the t-norm extension $\tilde{A}$ of an aggregation operator A which is defined by the following formula [4]:

$$\tilde{A}(z_1, \ldots, z_n)(x) = \bigvee_{x=A(x_1,\ldots,x_n)} T(z_1(x_1), \ldots, z_n(x_n)),$$

where $z_1, \ldots, z_n \in \mathbb{R}(L)$, $x_1, \ldots, x_n \in \mathbb{R}$ and T is a t-norm. Basic algebraic properties of these arithmetic operations are discussed. Examples illustrating the role of a t-norm in the definition of operations are given. In particular we consider the cases of minimum, product and Lukasiewicz t-norms.

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