Inclusion Measures in Intuitionistic Fuzzy Set Theory

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Abstract. Twenty years after their inception, intuitionistic fuzzy sets are on the rise towards making their "claim to fame". Competing alongside various other, often closely related, formalisms, they are catering to the needs of a more demanding and rapidly expanding knowledge–based systems industry. In this paper, we develop the notion of a graded inclusion indicator within this setting, drawing inspiration from related concepts in fuzzy set theory, yet keeping a keen eye on those particular challenges raised specifically by intuitionistic fuzzy set theory. The use of our work is demonstrated by its applications in approximate reasoning and non–probabilistic entropy calculation.

1 Introduction and Problem Definition

1.1 Putting Intuitionistic Fuzzy Set Theory on the Map

IFS theory basically enriches Zadeh's fuzzy set theory with a notion of indeterminacy expressing hesitation or abstention. While in the latter, membership degrees, identifying the degree to which an object satisfies a given property (generally speaking), are taken to be exact, in the former extra information in the guise of a non–membership degree is permitted to address a commonplace feature of uncertainty. Imagine, for instance, a voting procedure in which delegates have to express their feelings w.r.t. a number of proposals. It is obvious that while one can be in favour or in disfavour of a proposal to a certain extent, one can also abstain from the vote; an attitude inspired by, e.g., a lack of background or interest, or simply because no obvious arguments for or against the cause at stake have been raised. In such a situation, using only a $[0, 1]$–valued degree α expressing support for the proposal is arguably too committing. A similar argument can be set up when the opinion of a given voter is not (fully) known, and we should be duly hesitant to classify him as a supporter or an opponent of the proposal.

IFS theory allows for an easy, yet elegant, way out of such problems by not insisting that membership and non–membership to a set be strictly complementary properties. In an IFS A defined in a universe[1] X, alongside a **membership**

[1] For simplicity, throughout this paper X is assumed to be finite.