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Intervalized Similarity and Star Products

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Abstract

The author and his colleagues have previously defined the Similarity and Star fuzzy relational products. The products have been developed as a means to tackle certain real-world problems for which the semantics of the classical fuzzy relational products has proven somewhat insufficient. The author into a family of products has later extended the two products. This family of products is further extended in this paper to accommodate interval membership degrees. This consequently leads to the added ability of the products to process information whose uncertainty is more suitably expressed in terms of interval membership degrees instead of a single point/value membership degree.

Keywords: *Fuzzy relation, fuzzy relational product, similarity product, star product, interval computation, qualitative information processing.*

Introduction

Fuzzy relation, which is basically a fuzzy set with a multidimensional universe of discourse, has long been used to capture and represent qualitative relationships between sets of real-world objects. The so-called fuzzy relation is mostly employed in the form of fuzzy two-dimensional relations or alternatively called fuzzy binary relation. This fuzzy relation together with a group of fuzzy relational products has been shown to be applicable to a variety of application areas that require *qualitative* information processing. In such application areas, it is typically needed to deal with inherent uncertainty or imprecision. Fuzzy relation and its accompanying fuzzy relational products have become a means by which it can make machines, i.e. computers, possess a part of human intelligence in qualitative processing of imprecise, but meaningful information.

Exemplary application areas include information retrieval (Kohout *et al.* 1984; Kohout and Bandler 1985; Jiamthapthaksin and Santiprabhob 2000), medical diagnosis (Bandler and Kohout 1981; Kohout and Bandler 1990), information protection (Santiprabhob and Kohout 1992; Santiprabhob and Kohout 1993; Kohout and Santoprabhob 2000), and social network analysis (Dowpiset and Santiprabhob 1998). In such applications, the data from each respective application domains, which are to be processed, are represented in terms of fuzzy relations. Depending on the semantics of the eventual results, appropriate fuzzy relational products are applied to different combinations of the relations.

The classical fuzzy relational products include the *Circle product* (sometimes called the fuzzy compositional operator), and the family of BK products introduced by Kohout *et al.* (1984); Kohout and Bandler (1985); Bandler and Kohout (1980); Kohout and Bandler (1990); Bandler and Kohout (1981); Bandler and Kohout (1987). These products include *Triangle Subproduct*, *Triangle Superproduct* and *Square product*. In the course of our research into new application domains, we have found that the existing classical products mentioned do not always