Generalized Fuzzy System: A Toolbox

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Abstract

The Fuzzy Logic Toolbox (FLT) from MATLAB is essentially meant for designing Fuzzy Logic Systems (FLSs) based only upon ordinary fuzzy sets now termed as Type-1 Fuzzy Sets (T1 FSs). However, designing FLSs using Type-2 Fuzzy Sets (T2 FSs) that are capable of handling uncertainties involved in T1 FSs, or for that matter, in T1 FLSs, is out of its scope. This paper reports the development of a versatile toolbox, named as Generalized Fuzzy System (GFS) Toolbox, aimed at facilitating the design processes of FLSs that may involve use of either T1 FSs or T2 FSs or both. Various possible approaches to specify T2 FSs and visualize design steps involved in the development of FLSs have been considered. The FLSs have been popularized by the MATLAB FLT due to its user-friendly design approach, so with a view to lend ease of usage, certain similarities of MATLAB FLT have been borrowed and carried over to GFS Toolbox also. More specifically, it subsumes sub modules like GFS Set Editor, GFS Rule Editor, GFS Rule Analyzer and GFS Surface Analyzer, among other features, for better design flow and understanding of GFSs. A fairly typical application, involving classification of noisy and, therefore, uncertain iris data, has been tested in the GFS Toolbox and found as sufficiently amenable to handle uncertainties with the help of Interval Type-2 (IT2) FSs.

Keywords: Fuzzy Logic System (FLS), Generalized Fuzzy System (GFS) Toolbox, MATLAB, Type-2 Fuzzy Sets (T2 FSs), GFS Set Editor, GFS Rule Editor, GFS Rule Analyzer, GFS Surface Analyzer.

1. Introduction

In the physical world, any quantity exhibiting variation in time or variation in space (such as an image) is potentially a signal that might provide information on the status of a physical system, or convey a message between observers, among other possibilities [1, 2]. In the physical world, any quantity exhibiting variation in time or variation in space (such as an image) is potentially a signal that might provide information on the status of a physical system, or convey a message between observers, among other possibilities. In the physical world, any quantity exhibiting variation in time or variation in space (such as an image) is potentially a signal that might provide information on the status of a physical system, or convey a message between observers, among other possibilities. In the physical world, any quantity exhibiting variation in time or variation in space (such as an image) is potentially a signal that might provide information on the status of a physical system, or convey a message between observers, among other possibilities (Refer Fig. 1).

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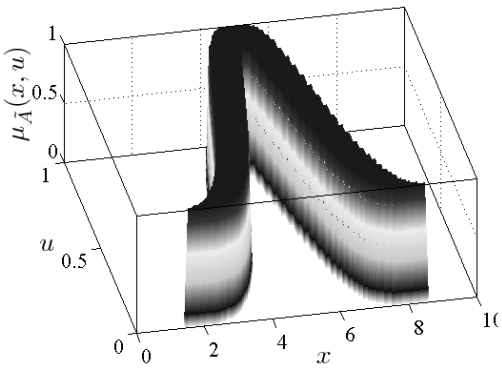

Figure 1: Interval Type-2 in 3-dimensional space

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2. Dummy Text

In the physical world, any quantity exhibiting variation in time or variation in space (such as an image) is potentially a signal that might provide information on the status of a physical system, or convey a message between observers, among other possibilities [3].

$$E = \sum_{i=1}^{N} R_i I_i \tag{1}$$

Refer (1) for KVL.

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