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Fuzzy Conditional Inference and Application to Wireless Sensor Network

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Abstract

Zadeh, Mamdani, and TSK were proposed different fuzzy conditional inference for ?if ? then ? ?to approximate incomplete information. The Zadeh and Mamdani fuzzy conditional inferences require prior information for the consequent part. The TSK fuzzy conditional inference need not to know prior information for the consequent part, but it is difficult to compute. In this paper, new method is proposed for the position containing ?if ? then ?? when prior information is not know the consequent part. Fuzzy Wireless Sensor Networks are discussed an application for proposed fuzzy conditional inference. Fuzzy inference system (FIS) is also discussed for WSN to detect Coastal erosion and Turbo Charger fuzzy controls System an examples.

Index terms— fuzzy logic; fuzzy conditional inference; fuzzy control systems; wireless sensorn networks; costal erosions.

1 Fuzzy Conditional Inference and Application to Wireless Sensor Network

Poli Venkata Subba Reddy Abstract-Zadeh, Mamdani, and TSK were proposed different fuzzy conditional inference for "if ? then ? "to approximate incomplete information. The Zadeh and Mamdani fuzzy conditional inferences require prior information for the consequent part. The TSK fuzzy conditional inference need not to know prior information for the consequent part, but it is difficult to compute. In this paper, new method is proposed for the position containing "if ? then ?" when prior information is not know the consequent part. Fuzzy Wireless Sensor Networks are discussed an application for proposed fuzzy conditional inference. Fuzzy inference system (FIS) is also discussed for WSN to detect Coastal erosion and Turbo Charger fuzzy controls System an examples.

2 II.

3 Fuzzy Logic

Zadeh [11] introduced the concept of a fuzzy set as a model of a vague fact. Fuzzy set theory for control systems is accepted because it is very convenient and believable. The fuzzy set may be defined with membership function or commonsense. Definition: Given some universe of discourse X, a fuzzy set A of X is defined by its membership function µA taking values on the unit interval[0,1] i.e µ A :X?[0,1] Suppose X is a finite set. The fuzzy set A of X may be represented asA= µ A (x 1)/x 1 + µ A (x 2)/x 2 + ??????+ µ A (x n)/x n

Where "+" is union For instance, fuzzy set may be defined with commonsense TALL =0.00/5'0" + 0.08/5'4" + 0.32/5'8"+ 0.50/6'0" + 0.82/6'4"

There is an alternative way to defined fuzzy subset with function and is given by [7] For instance, fuzzy set may be defined with m**embership functionYOUNG = { µ YOUNG (x)/x=1 if xÑ?"[0,25] =[1+((x-25)2)]-1 if xÑ?"[25,100]

Let A and B be the fuzzy sets, and the operations on fuzzy sets are given belowAVB=max(μ A (x) , μ B (y)} Disjunction A?B=min(μ A (x) , μ B (y)} Conjunction A?=1-μ A (x) Negation A?B=min {1, (1-μ A (x) +μ B (y)} Implication AXB=min { μ A (x) , μ B (y)}/(x,y) Relation AoR=min x { μ A (x) , μ R (x,y)}/

4 y Composition

5 Implication

The Zadeh fuzzy condition inference s given by if x 1 is A 1 and x 2 is A 2 and ? and x n is A n then y is B = min {1, (1-min(μ A1 (x), μ A2 (x), ?, μ An (x)) +μ B (y)} For Example A 1 = 0.2/x 1 + 0.6/x 2 + 0.9/x 3 + 0.6/x 4 +0.2/x 5

6 Introduction

here are many theories to approximate incomplete information. Until recently, probability theory was the only existing theory to the approximate incomplete formation. Zadeh [11] proposed to deal with incomplete information. n Fuzzy set allows us to represent membership function aspossibility distribution. Fuzzy theory is the most effective than the other theory because fuzzy theory depends on the degree of belief rather than likelihood (Probability). Fuzzy conditional propositions are of the type if (precedent part) then (consequent part). There are different methods of fuzzy conditional inference to approximate uncertain information [2,3,4,6,7]. The Zadeh and Mamdani inferences are needed prior information for both precedent and consequent part. There are some applications like fuzzy control systems that do not have prior information to the consequent part. The TSK fuzzy conditional inference need not know prior information to the consequent part, but it is difficult to compute.

The Sensors are able to sense and process the data. The Sensors are used to collect the data or information for many application like Wireless Sensor Networks and Contro Systems. The Wireless Sensor Network (WSN) and fuzzy control systems are give an an examples for proposed fuzzy conditional inference. It is necessary to give a brief description of fuzzy logic and WSN.

T A 2 = 0.5/x 1 + 0.7/x 2 + 0.9/x 3 + 0.7/x 4 +0. = 0.9/x 1 + 0.8/x 2 + 0.7/x 3 + 0.8/x 4 +0.9/x 5 Mamdani fuzzy inference is given asmin(A 1 , A 2 ,? ,A n , B) = 0.1/x 1 + 0.4/x 2 + 0.6/x 3 + 0.4/x 4 +0.1/x 5

Mamdani inference is given as if x 1 is A 1 and x 2 is A 2 and ? and x n is A n then y is B = min(A 1 , A 2 ,? ,A n , B) Reddy [7] fuzzy inference is given asif x 1 is A 1 and x 2 is A 2 and ? and x n is A n then y is B =min(A 1 , A 2 ,? ,A n)

The "consequent" part is derived from "president" part of fuzzy conditions.min(A 1 , A 2 ,? ,A n) = 0.2/x 1 + 0.6/x 2 + 0.9/x 3 + 0.7/x 4 +0.3/x 5

The Graphical representation of fuzzy inference is shown in Fig. **??**.

7 Fig. 2: Composition

8 Composition

If some relation R between A and B is known and some value A1 then B1 is to infer from R B1=A1 o R= min x {μ A1 (x), μ R (x,y)}/(x,y), where R=A?BIf x = y B1=A o R=min{μ A1 (x), μ R (x)}/x According to Zadeh fuzzy conditional inference B1=A1 o R=min{μ A (x), μ R (x)} = min{μ A (x), min(1,1-μ A1 (x)+ μ B (x))} According to Mamdani fuzzy inference = min{μ A1 (x),μ A (x),μ B (x)}

If some relation R between A and B is not known According to The proposed fuzzy inference= min{μ A1 (x), μ R (x)} III.

9 Wireless Sensor Technology

Natural calamities are unpredictable and happen within short periods. Therefore WSN technology [1] used to capture signals and transmitted by monitoring. Wireless sensor technology that can send the sensed data to a data analysis center.

Fuzzy Inference System may be used an alternative procedure. The capture data may be analyzed using fuzzy parameters, and these parameters are used in fuzzy inference system. Fuzzy inference system is applied to WSN to detect Coastal erosion.

WSN technology has the capability of capturing and transmission of critical data in real-time. The most common forms are minimum spanning trees for wireless networking sensors. Shortest paths: Minimal spanning tree is the shortest path connecting all the nodes with minimum distance. The Prim's algorithm may be used to construct minimum spanning tree. The minimum spanning tree has the base node and destination node. The data is transmitted from destination node to the base server.

The Prim's algorithm is to find a minimum spanning tree with nodes and edges. The nodes (V) are Sensors, and edges (E) are distances in WSN. Algorithm Prim(G) G(V,E) is a weighted connected Graph E T is a set of edges of a minimum spanning tree V T ? is the initial node with any vertex Mamdani [2], and TSK [3,4] proposed fuzzy conditional inference for incomplete information. Zadeh and Mamdani's inferences need prior information

for the consequent part in "if ? then ?" if x 1 is A 1 and x 2 is A 2 and ? and x n is A n then y is B Zadeh fuzzy inference is given by = min(1, 1min(A 1 , A 2 ,? ,A n)+ B)

The proposed fuzzy conditional inference for Zadeh fuzzy inference as when consequent part is not known = min(1, 1-min(A 1 , A 2 ,? ,A n +1)), where B=1 because B is not known.

For instance A 1 = 0.2/x 1 + 0.6/x 2 + 0.9/x 3 + 0.6/x 4 +0.2/x 5 A 2 = 0.5/x 1 + 0.7/x 2 + 0.9/x 3 + 0.7/x 4 +0.3/x 5 if x is A1 and x is A2 then x is B= B = 1/x 1 + 1/x 2 + 1/x 3 + 1x 4 +1/x 5 and is not known Zadeh conditional inference is not suitable The fuzziness may be given for rule as If Depression is High and Temperature is High and Wave velocity is High Then Coastal Erosion is Savior . = min(1, (1-min{.6,0.7,0.8) +0.9) = 1 and is unknown Zadeh fuzzy conditional inference is not suitable when consequent part is unknown Mamdani inference is given by if x 1 is A 1 and x 2 is A 2 and ? and x n is A n then y is B = min(A 1 , A 2 , ?, A n , B) The proposed fuzzy conditional inference for Mamdani fuzzy inference is given as when the consequent part is unknown =min(A 1 , A 2 ,? ,A n ,1), where B=1 because B is not known. =min(A 1 , A 2 ,? ,A n ,1) = min(A 1 , A 2 ,? ,A n) if x?.. An) then y=f(x 1 , x 2 ,?, x n) is B

A method is possible to define with memberships of x 1 , x 2 ,?, x n when consequent part is not known

The proposed method for TSK fuzzy conditional inference may be defined as using t-norm [5] If x is A 1 and A 2 and ,?,and A n-1 or A n then y isB=f(A 1 ,A 2 ,?, A n) If x is A 1 and A 2 or A 3 then y is B = A 1 ? A 2 VA 3 min(max(µ A1 (x), µ A2 (x)), µ A3 (x)) Where t-norm is t(aVb)=max(a,b) t(a ? b)=min(a,b)

if x is A1 and x is A2 then x is B= B = 0.2/x 1 + 10.6x 2 + 0.9/x 3 + 0.6x 4 +0.2/x 5 The fuzziness may be given for rule as If Depression is High and Temperature is High and Wave velocity is High Then Coastal Erosion is Savior = min(.6,0.0.7, 0.8) =0.6 It may be observed that the proposed methods of Mamdani and TK conditional inferences are equal.

V.

10 Presentation of Fuzzy Set Type-2

The fuzzy set type-2 is a type of fuzzy set in which some additional degree of information is provided [6] Definition: Given some universe of discourse X, a fuzzy set type-2 A of X is defined by its membership function

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Volume XX Issue IV Version I 15 Year 2020 ( )µ A (x) taking values on the unit interval[0,1] i.e. µ Ã (x)?[0,1] [0.1]

Suppose X is a finite set. The fuzzy set A of X may be represented as A= µ Ã1 (x 1)/Ã1+ µ Ã2 (x 2)/Ã2+ ??????+ µ Ãn (x n)/Ãn Headache= { 0.4/mild , 0.6/moderate, 0.9/severe} John has "mild headache" with fuzziness 0.4 The fuzzy set type-2 may be defined as Definition: The fuzzy set type-2 Ã is characterized by membership function µ Ã :XxY? [0,1], x?X and y?A Suppose X is a finite set. The fuzzy set A of X may be new represented by Ã=??µ Ã (x,y)/x/y= ?? µ Ã (x,y) = (µ Ã (x 1 ,y 1)/x 1 + µ Ã (x 2 ,y 1)/x 2 +?+ µ Ã (x n ,y 1)/x n)/y 1 + (µ Ã (x 1 ,y 2)/x 1 + µ Ã (x 2 ,y 2)/x 2 +?+ µ Ã (x n ,y 2)/x n)/y 2 +?+ (µ Ã (x 1 ,y m)/x 1 + µ Ã (x 2 ,y m)/x 2 +?+ µ Ã (x n ,y 1)/x n)/y m Ã ?=1-µ Ã (x,y) Ã = { (0.1/x 1 +0.2/x 2 +0.3/x 3 +0.35/x 4 +0.4/x 5)/high +(0.4/x 1 +0.45/x 2 +0.5/x 3 +0.55/x 4 +0.6/x 5)/normal +(0.7/x 1 +0.75/x 2 +0.8/x 3 +0.85/x 4 +0.9/x 5)/low } Let ? and ? be the fuzzy sets. The operations on fuzzy sets type-2are given as

12 Fuzzy Inference System

Fuzzy Inference System is Fuzzy Control System, which contains fuzzification ad defuzzification. The Fuzzification will be defined using the fuzzy rule. The fuzzy algorithm is a set of statements with a single fuzzy value. The fuzzy conditional statement is defined as fuzzy algorithm if x i is A1 i and x i is A2 i and ? and x i is An i then y i is B i The precedence part may contain and/or/not.

The Fuzzy Control System consists of a set of fuzzy rules If (set of conditions are satisfied then (set of consequences inferred).

13 Conclusion

Some methods are studied for fuzzy conditional inference when prior information is unknown to consequent part. Zadeh and Mamdani methods are not suitable when prior information is unknown. A new method is proposed for "if ? then ?" when prior information is unknown to the consequent part with single fuzzy member function, and two fuzzy membership functions. Fuzzy Certainty Factor is defined with two membership functions to made a single fuzzy membership function. WSN are send data to the base station. The Fuzzy inference system (FIS) is Studied for WSN to detect Coastal erosions. The Prim's algorithm is used to construct a spanning tree for collection of Data from WSN to base station. Sensors are discussed an application for proposed fuzzy conditional inference. The Fuzzy Control System is given an example for FCF. [1] [2]

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[2] ( ) E © 2020 Global JournalsFuzzy Conditional Inference and Application to Wireless Sensor Network

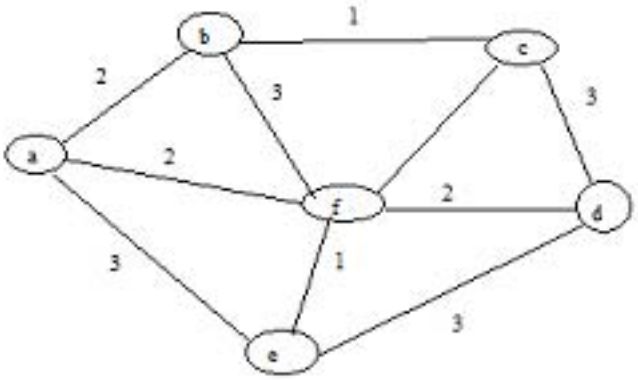

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Figure 1: 3 /x 5 B 1 Fig. 1 :

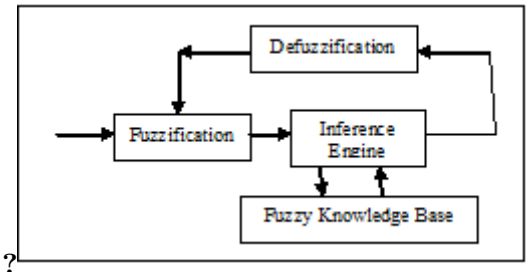

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Figure 2: E T ? ?

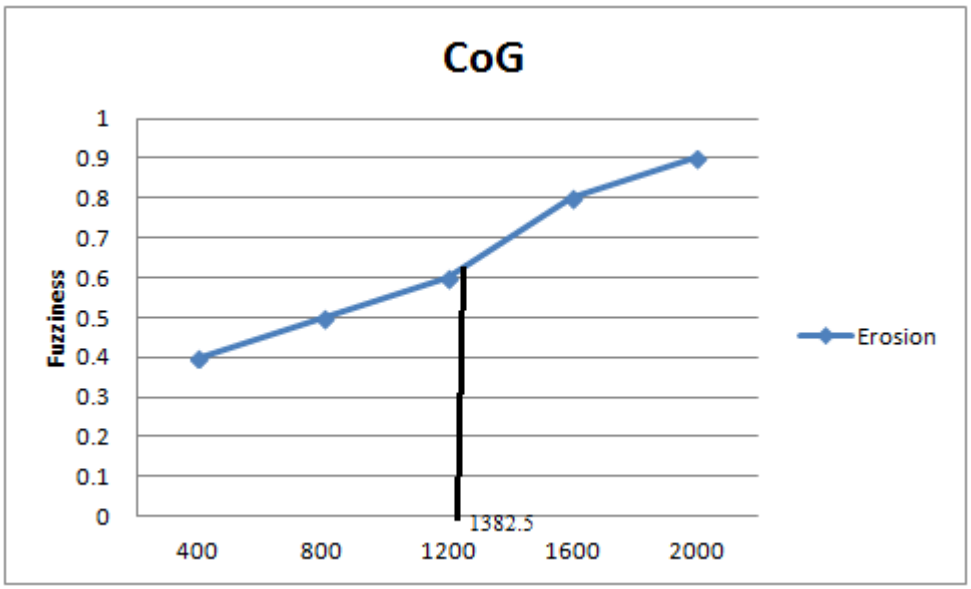

Figure 3:

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