A Fuzzy logic based Implementation of Intelligent Network Selection of Wireless 4G Network

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ABSTRACT

Next generation wireless network are expected to improve multiple radio access technologies in terms of service and application requirements. In a 4g system, performance of soft conventional handoff can be improved by adopting soft handoff thresholds using fuzzy inference systems. To maintain continuous services, a fuzzy multi attribute decision making access network selection is used to select suitable network. The algorithm considers the factors like no of base stations, no of channel remaining and Eb/Io (signal to interference ratio) compared to 3G and IS-95 soft handoff algorithms to show that the proposed fuzzy inference system gives lower blocking probability, outage probability and better Eb/Io.

Keyword: - Network selection, *4G, Fuzzy Logic etc*

1. INTRODUCTION

Handoff is an essential feature for maintaining quality-of service (QoS) for mobile communication system systems. It guarantees the continuity of services when a mobile station (MS) moves across the cellular boundaries. Third generation of mobile cellular networks, which are predominantly based on CDMA technology, used soft handoff (SHO). With soft handoff a conditional decision is made on whether to handoff or not compared to hard handoff (HHO) where a definite decision is made. In soft handoff users have simultaneous traffic channel communication with all candidate base stations in the interim period.[1]

2. METHODOLOGY OF INTELLIGENT NETWORK SELECTION

Intelligent network selection for soft handoff with adaptive threshold is done with the help of fuzzy inference system which gives lower blocking probability, outage probability and better Eb/Io compared to other algorithms. Fuzzy logic is basically many valued logic in which the truth values of variables may be any real number between 0 and 1 which are considered to be fuzzy, where 0 and 1 are the crisp values. In this, fuzzification, fuzzy inference and defuzzyfication are the three sub procedures in fuzzy logic based soft handoff algorithm. Proposed fuzzy logic based soft handoff algorithm has three inputs and one output. Three inputs are the expectation of number of based stations in the active set (noBS), number of remaining channels in the base station (CHrm and Etfl. T_Down is the output of the algorithm.

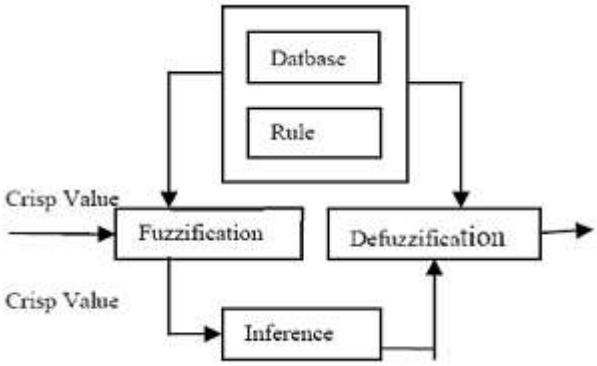
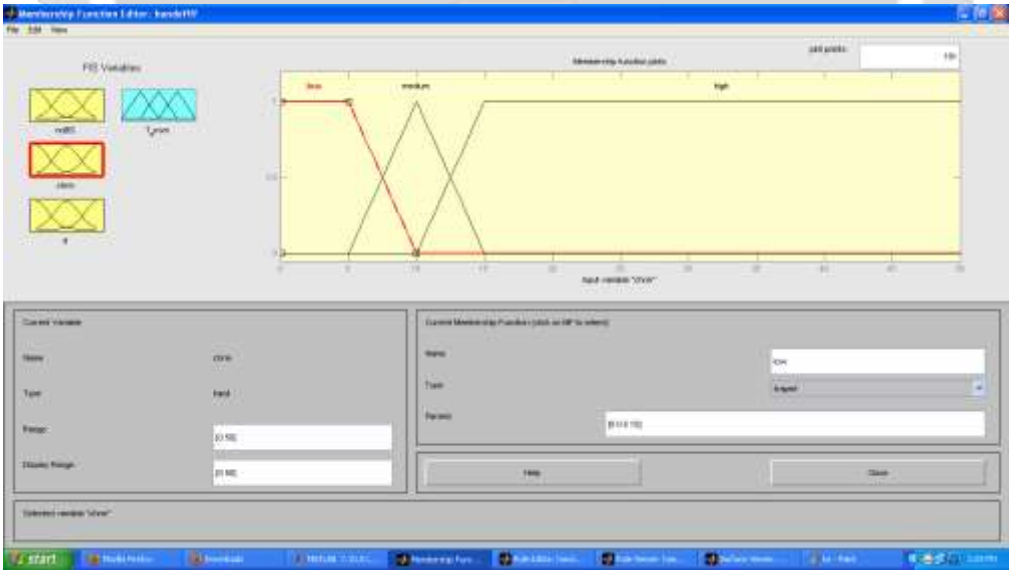


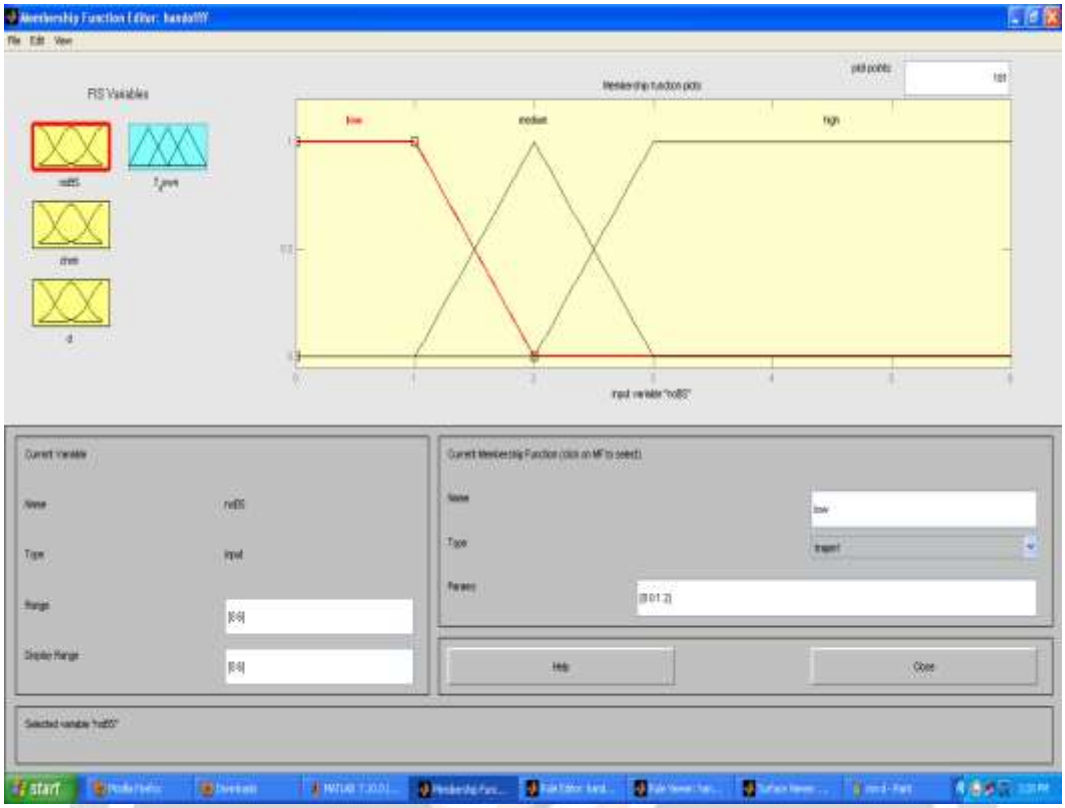
Fig-1: Control plant of each mobile station of fuzzy logic based three inputs soft handoff algorithm [1]

In this method, the crisp inputs are converted into fuzzy inputs with the help of fuzzification process. These are then stored as database in the form of parameters like no of base station, no of channel remaining and signal to noise ratio. In order to process them in the context of fuzzy inference, where these three parameters are considered to be the inputs and are given to the rule base in which 27 different sets of rules are present which are applied in order to achieve the desired output. This output is based on all the three inputs which represents the parameters that can be decreased in order to increase the quality of traffic channel at low traffic load while it is increased for releasing the traffic channel so as new calls or handoff calls can be served at high traffic load.

2.1Fuzzification

During this procedure all the crisp inputs are changed into fuzzy inputs with the use of membership functions. Membership functions of each crisp input is shown below

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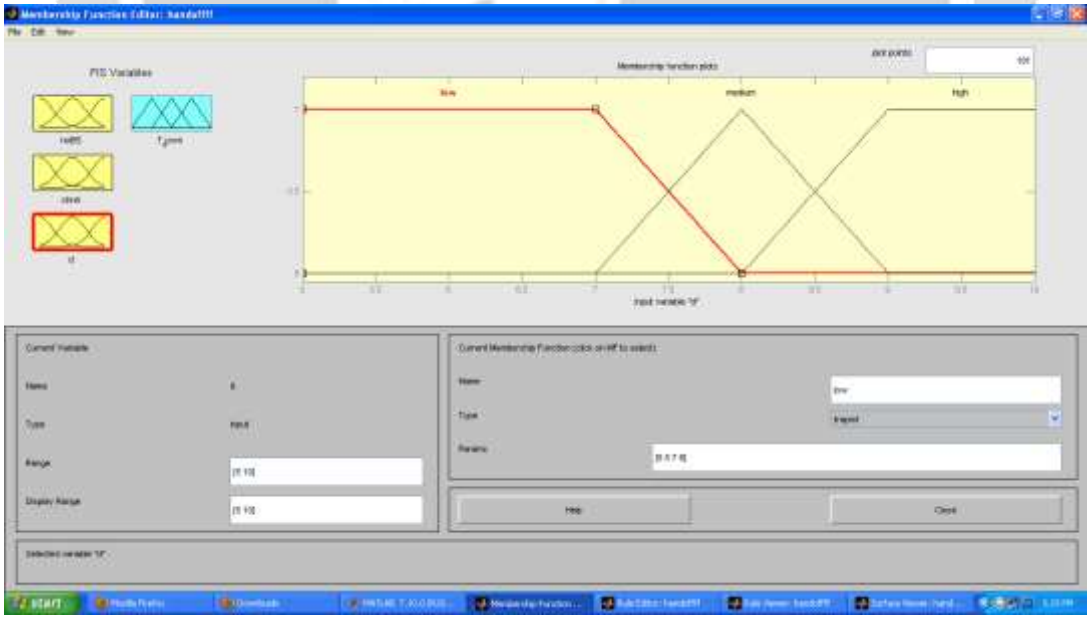
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2.2FuzzyInference:

For calculating the output, Tdown, fuzzy inference system uses if- then rules. Here all the crisp inputs i.e Base stations, Channel remaining and Eb/I0 are allotted A,B and C, and Tdown is D . Here A, B, C, D belongs to Low, medium and high. Based on this rules required output is calculated.

2.3 Rule Base:

There are twenty seven rules and this rules determine the required output Tdown from the three crisp inputs. Value of output parameters can be decreased for increasing the quality of traffic channel at low traffic load while it is increased for releasing the traffic channel so as new calls can be served.

Rule No.	Input Parameter			Output Parameter
	$n_{0_{BS}}$	CH_{rm}	E_b/I_0	T_Down
1	Low	Low	Low	Medium
2	Low	Medium	Low	Medium
3	Low	High	Low	Medium
4	Medium	Low	Low	High
5	Medium	Medium	Low	High
6	Medium	High	Low	High
7	High	Low	Low	High
8	High	Medium	Low	High
9	High	High	Low	High
10	Low	Low	Medium	Low
11	Low	Medium	Medium	Low
12	Low	High	Medium	Low
13	Medium	Low	Medium	Medium
14	Medium	Medium	Medium	Medium
15	Medium	High	Medium	Medium
16	High	Low	Medium	High
17	High	Medium	Medium	High
18	High	High	Medium	High
19	Low	Low	High	Low
20	Low	Medium	High	Low
21	Low	High	High	Low
22	Medium	Low	High	Low
23	Medium	Medium	High	Low
24	Medium	High	High	Low
25	High	Low	High	Medium
26	High	Medium	High	Medium
27	High	High	High	Medium

Chart -2: Rule Base [1]

2.4 Aggregation and Composition

Here minimum of membership function of all the crisp inputs is determined for each rules. A membership function for each region is calculated using the rule base and the values are determined in the aggregation step. Minimum and maximum is used for composition.

2.5 Defuzzification:
During this sub procedure, the fuzzy output is converted into real numbers. The below figures shows the surface viewer of Base station, channel remaining and Eb/Io

3. ADVANTAGES

- An intelligent approach with simplicity and flexibility.
- It can be blended with conventional methods.
- Easy to understand and implement.
- It gives precise data.
- Provide more user friendly and efficient performance.

3.1 APPLICATIONS

- Camcorders
- Washing machines
- Microwave ovens
- Medical instruments
- Decision support system

3.2 PERFORMANCE PARAMETERS

1. **No of base stations** – It shows the distance between mobile station and base station and the signal strength mobile station receives for inputs while output is a defined value for the decision.
2. **No of channel remaining** – It specifies the no of traffic channels used during the high carried traffic load and it can be decreased for increasing quality of traffic channel at low traffic load while it is increased for releasing the traffic channel so handoff calls can be served.
3. **Signal to interference ratio** – It measures the interference in the signal when the process of handoff is carried on.

4. CONCLUSIONS

In the proposed algorithm, the network related attributes are included to minimize the number of vertical handoff and Eb/Io. Thus, the best suitable network is selected for ongoing traffic by providing optimization between the complexity and improved signal to noise ratio. The proposed schemes can benefit both users and networks by handling the uncertainty and time varying information using fuzzy logic rules

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