FUZZY LOGIC BASED MODEL FOR QUALITY OF SERVICE IN COGNITIVE RADIO

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Abstract

A cognitive radio is an intelligent radio system that automatically changes its parameters like transmission and reception. Cognitive radios decide the best available spectrum band to meet the quality of service requirements. FLS (Fuzzy Logic System) can maintain the quality of service (QoS) of each network while the effective spectrum utilization is improved under a fluctuation traffic environment when the available spectrum is limited. In this paper we proposed a Fuzzy logic based model for improvement of quality of service.

Index Terms: CR, FLS, Quality of service, throughput, propagation delay, round-trip time.

I. INTRODUCTION

Cognitive Radio

A cognitive radio can sense its operating environment's conditions and it is able to reconfigure itself and to communicate with other counterparts based on the status of the environment and also the requirements of the user to meet the optimal communication conditions and to keep quality of service (QoS) as high as possible. Now a day's cognitive radio [1], [2], [3] is currently considered as one of the most promising solutions to the aforementioned scarcity problem by enabling a highly dynamic, device-centric spectrum access in future wireless communication system. The Cognitive radio technology is getting a significant attention, with the approach to solve the issue of scarcity of available radio spectrum, [3]-[5].

Quality of Service

Secondary users directly affect the available spectrum band. As the number of secondary users increases it is mandatory to maintain quality of service. Quality of services (QOS) parameters can be defined in terms of minimum propagation delay, minimum round trip time, and maximize throughput.

II. PARAMETER EFFECTING QUALTIY OF SERVICE

1. Propagation Delay

The time taken for the signal to travel from the sender to the receiver is known as propagation delay. It can be calculated as the ratio of link length and the propagation speed over the medium. Propagation delay = d / s; where d is the distance travelled and s is the propagation.

2. Round Trip Time

Round-trip time is the time it takes for a client to send a request and the server to send a response over the network.

3. Throughput

Throughput can be defined as the total rate at which something can be produced. Thus, maximizing the throughput deals with the data throughput rate of the system. It improves the communications quality of the radio.

III. MODELLING USING FUZZY LOGIC

Fuzzy logic controller is an approach between mathematical control model and human decision making control/ approach [6]. The system structure identifies the fuzzy logic inference flow from the input variables to the output variables. The fuzzification in the input interfaces

translates analog inputs into fuzzy values. The fuzzy inference takes place in rule blocks which contain the linguistic control rules. The output of these rule blocks is linguistic variables. The defuzzification in the output interfaces translates them into analog variables. The following figure shows the whole structure of this fuzzy system including input interfaces, rule blocks and output interfaces. The connecting lines symbolize the data flow.

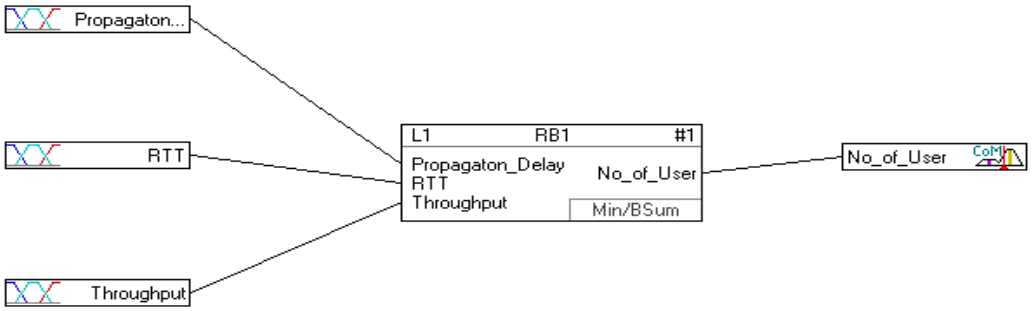

Figure 1: Structure of the Fuzzy Logic System

Input Output Parameter

1. Inputs

S.No	Variable Name	Type	Unit	Min	Max	Default	Term Names
1	Propagaton_Delay		Units	1240000	1580000	1410000	Low medium high
2	RTT		Units	2500000	3150000	2825000	Small medium large
3	Throughput		Units	10000	50000	30000	Low moderate high

Table1: Variables of Group "Inputs"

1.1 Input Variable "Propagatn_Delay"

In first input parameter Propagation Delay it consists of three membership functions. These membership functions are low, medium, and high as shown in figure 2.

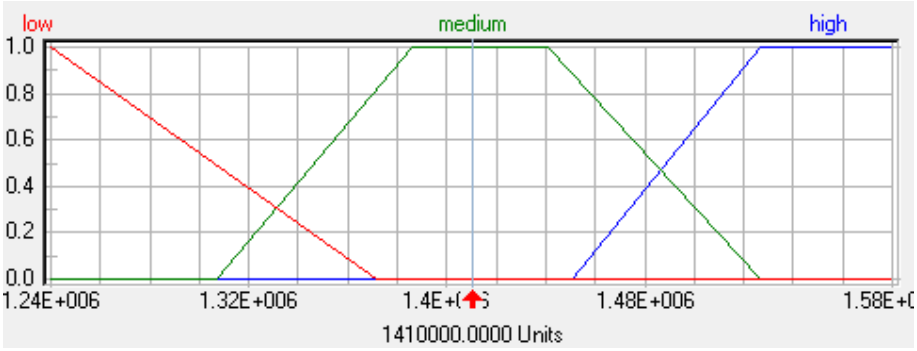

Figure 2: MBF of "Propagatn_Delay"

1.2 Input Variable "RTT"

In second input parameter RTT it consists of three membership functions. These membership functions are small, medium, and large as shown in figure 3.

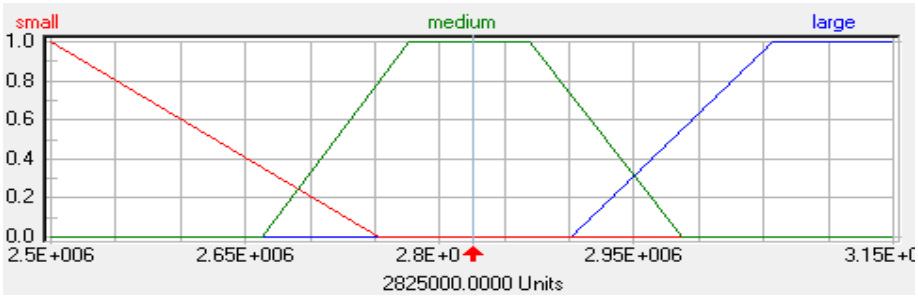

Figure 3: MBF of "RTT"

1.3 Input Variable "Throughput"

In third input parameter Throughput it consists of three membership functions. These membership functions are low, moderate, and high as shown in figure 4.

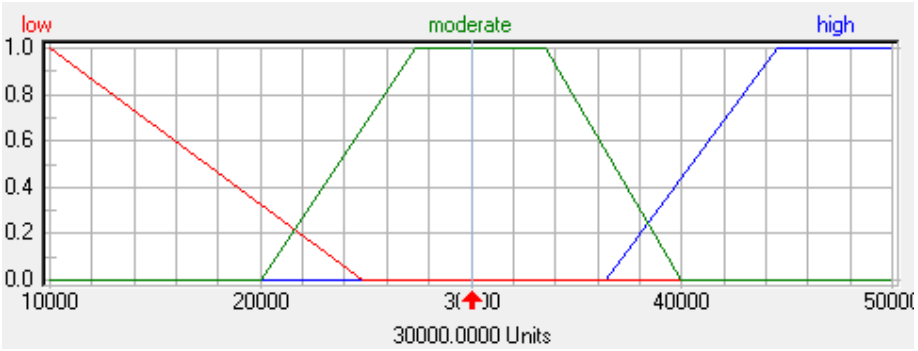

Figure 4: MBF of "Throughput"

II. Outputs

#	Variable Name	Type	Unit	Min	Max	Default	Term Names
4	No_of_Users		Units	1	150	75.5	very_small small medium large very_large

Table 2: Variables of Group "Outputs"

2.1 Output Variable "No_of_Users"

In the output parameter No of User it consists of five membership functions. These membership functions are very small, small, medium, large and very large as shown in figure 5.

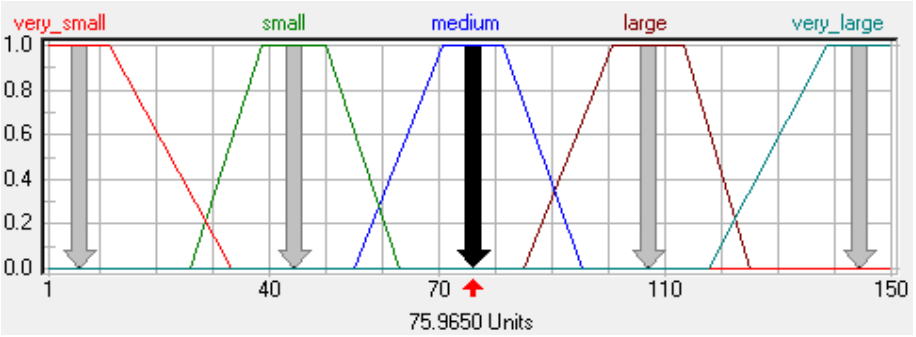

Figure 5: MBF of "No_of_Users"

3. RULE BLOCK

The rule blocks contain the control strategy of a fuzzy logic system. Each rule block confines all rules for the same context. A context is defined by the same input and output variables of the rules.

The rules' 'if' part describes the situation, for which the rules are designed. The 'then' part describes the response of the fuzzy system in this situation. The degree of support (DoS) is used to weigh each rule according to its importance.

Parameter

Aggregation:	MINMAX
Parameter:	0.00
Result Aggregation:	BSUM
Number of Inputs:	3
Number of Outputs:	1
Number of Rules:	27

IF			THEN	
Propagaton_Delay	**RTT**	**Throughput**	**DoS**	**No_of_User**
Low	Small	Low	1.00	Large
Low	Small	Moderate	1.00	Large
Low	Small	High	1.00	very_large
Low	Medium	Low	1.00	Medium
Low	Medium	Moderate	1.00	Large
Low	Medium	High	1.00	Large
Low	Large	Low	1.00	Small
Low	Large	Moderate	1.00	Medium
Low	Large	High	1.00	Medium
Medium	Small	Low	1.00	Medium
Medium	Small	Moderate	1.00	Large
Medium	Small	High	1.00	Large
Medium	Medium	Low	1.00	Small
Medium	Medium	Moderate	1.00	Medium
Medium	Medium	High	1.00	Large
Medium	Large	Low	1.00	Small
Medium	Large	Moderate	1.00	Small
Medium	Large	High	1.00	Medium
High	Small	Low	1.00	Medium
High	Small	Moderate	1.00	Medium
High	Small	High	1.00	Large
High	Medium	Low	1.00	Small
High	Medium	Moderate	1.00	Small
High	Medium	High	1.00	Medium
High	Large	Low	1.00	very_small
High	Large	Moderate	1.00	Small
High	Large	High	1.00	Small

Table 3: Rules of the Rule Block "RB1"

IV. SIMULATION & RESULT

In this section, we present simulation results of our proposed work based on Fuzzy Logic System. We randomly generated 150 secondary users. Every input was divided into three sets. The simulation results use 27 rules which are shown in Table 3. The surface curve for the four input parameters and output parameter are shown in Fig. 6, 7, and 8.

In the proposed work, the propagation delay is inversely proportional to the number of user. As the number of user increases, propagation delay decreases.

Overall throughput of the system is directly proportional to the number of user. So,

maximization of the throughput gives increase in the number of user.

Round-trip time is important parameter in broadband connections. It minimizes the number of requests that the secondary user needs to make. In this paper, the number of user increases the RTT value decreases, as to minimize the number of round trip. Hence, the Quality of service improves.

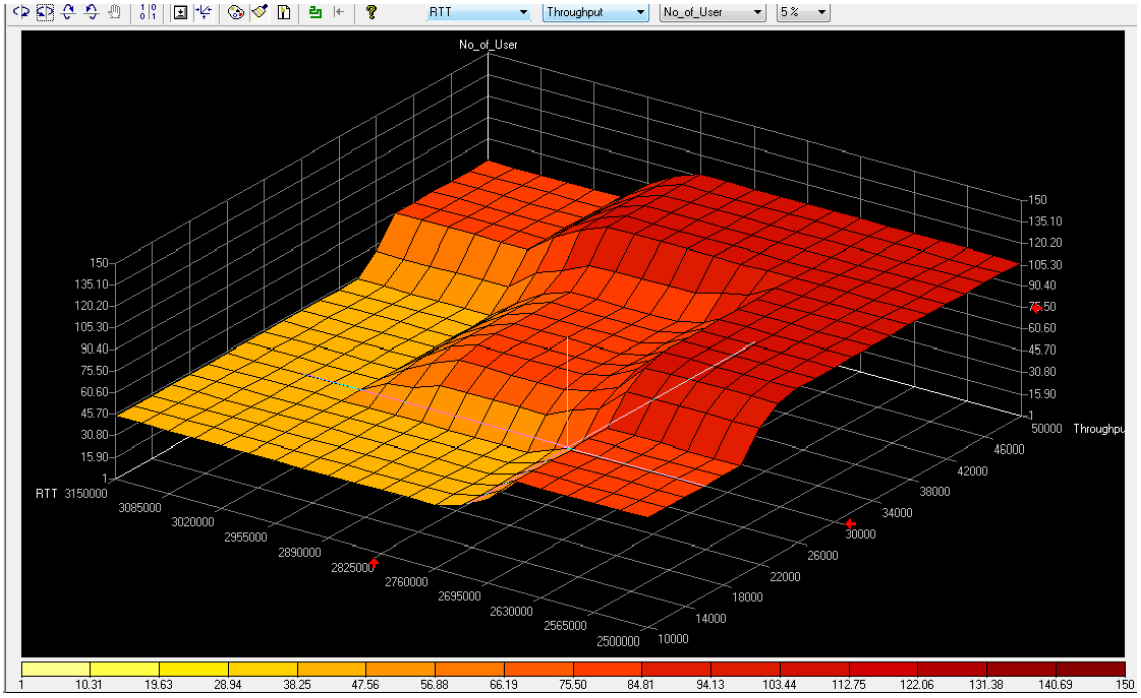

Fig.6. Surface curve for input parameter "RTT", "Throughput" and output parameter "No_of_User".

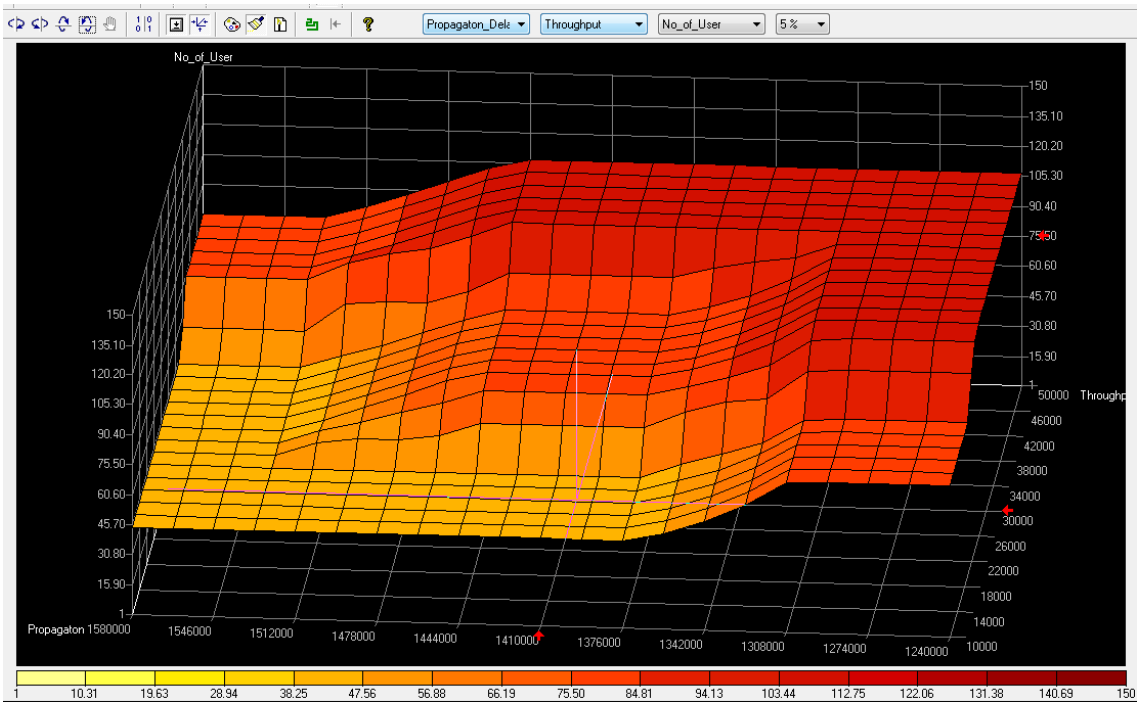

Fig.7. Surface curve for input parameter "Propagation_Delay", "Throughput" and output parameter "No_of_User".

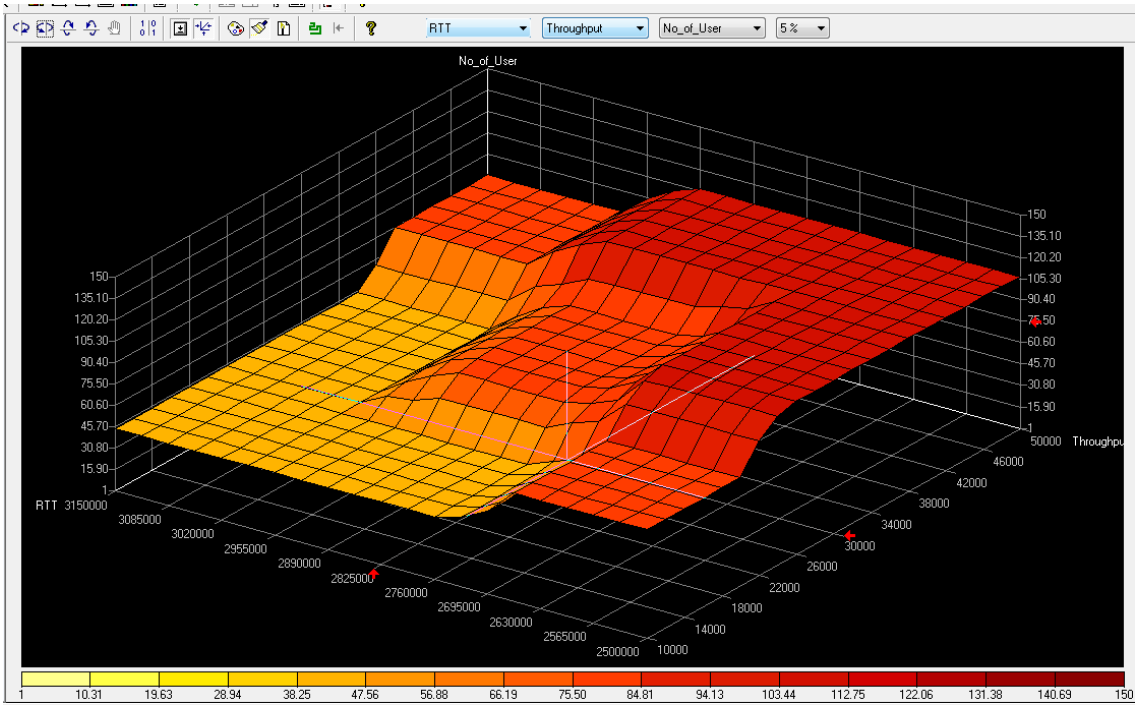

Fig.8. Surface curve for input parameter "RTT", "Throughput" and output parameter "No_of_User".

V. REFRENCE

[1] Danijela Cabric, Shridhar Mubaraq Mishra, Robert W. Brodersen, "Implementation Issues in Spectrum Sensing for Cognitive Radios" in Proc. 38th Asilomar Conf. Signals, Systems and Computers, Pacific Grove, CA, Nov. 2004, pp.772–776.

[2] F. Akyildiz, W. Y. Lee, M. C. Vuran, S. Mohanty, "NeXt generation dynamic spectrum access cognitive radio wireless networks: A survey," Computer *Networks* Journal (Elsevier), 2006, Vol. 50, pp. 2127-2159.

[3] Lars Berlemann, George Dimitrakopoulos, Klaus Moessner, Jim Hoffmeyer, "Cognitive Radio and Management of Spectrum and Radio Resources in Reconfigurable Network", Wireless World Research Forum, 2005.

[4] Jon M. Peha, "Emerging Technology and Spectrum Policy Reform", International Telecommunications Union (ITU) Workshop on Market Mechanisms for Spectrum Management, ITU Headquarters, Geneva, January 2007.

[5] R. Etkin, A. Parekh, and D.Tse, "Spectrum sharing for Unlicensed bands," in IEEE International Symposium on New Frontiers in Dynamic Spectrum Access, 2005, pp 251-258.

[6] Chuen Chine Lee "Fuzzy Logic Control Systems Fuzzy logic controller Part".