International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 02 | Feb-2018 www.irjet.net p-ISSN: 2395-0072

An Efficient Approach for Handover Decision Making In Wireless Networks

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Abstract - *In cellular networks, handover is the process that maintains the user's active sessions during mobile terminal changes its connection point to the access network. The decision taken by handover depends upon several (QoS) Quality of Service parameters. There are several methods have been studied for handover decision making and it has been concluded that soft computing such as fuzzy inference system and optimization algorithm such as firefly algorithm prove the most prominent mechanism for handover decisions. Taking into account, a prominent method for handover decision on the basis of fuzzy inference system with firefly optimization algorithm has proposed. This work aims to develop an adaptive method for parameters evaluations by applying firefly optimization algorithm automatically as the existing method was based on the manual evaluation and was difficult to operate on large scale. Experimental analysis has performed using both traditional and proposed technique. From the acquired results, it has been accomplished that proposed technique achieves less probability of disconnection with respect to traditional technique in view of random and straight terminal movement.*

Keywords- Handoff, Fuzzy Inference system, Firefly Optimization Algorithm, Quality of Service parameters.

1. Introduction

Initially, the concept of handoff was initiated to make an efficient communication between the mobile users without having any kind of interruption. The term handoff defined the process which is used to transfer the ongoing call or a data session from one connected channel to another channel. Whereas, in satellite communication, the handoff term is used to describe the transferring of satellite control responsibility from one earth station without any loss or interruption to another earth station [1]. This transferring of station has done through the time slot, code word, frequency band or their combination for TDMA i.e. Time division Multiple Access, CDMA i.e. Code-Division Multiple Access, FDMA i.e. Frequency Division Multiple Access or a hybrid of these accesses. Another term used for handoff is handover. The basic form of handover is considered at the time when phone call is in progress and directed to the current cell as a source to a target cell. The source and the target cells in terrestrial networks can be at two different cell sites or from one cell site or at the same cell site. These two cells are generally referred as two sectors on cell site [4]. In case, where source and target are in different cells then it is considered as inter-cell handover. The main idea of using this handover is to maintain the call while the subcarrier moves out of the covered area by the source cell and entered in the target cell's area. Customer satisfaction regarding the available services is one of the major goals in cellular networks and handling handoff is the domain for providing the customer satisfaction is communication. Efficient handoff handling leads an improvement in receiving rate of calls and hence satisfies the customers [6]. The handoff frequently occurs in mobile communication thus it becomes important to handle it effectively so that the performance of the communication can be enhanced. Handoff is done to manage the resources in cellular network. It is important to consider that the handoff should be done in such a way that it should not leads to the interference whether after shortage of available resources, it did not avoided. Thus handoff handling is one of the important tasks in cellular network to satisfy the customers by enhancing the levels of the services and to manage the resources of the network.

2. PROBLEM FORMULATION

Handover in cellular networks is the process of maintaining the user's active sessions when a mobile terminal changes its connection point to the access network. The decision of handover is based upon various QoS (Quality of Service) parameters. Various methods have been studied for handover decision making and it was reviewed that soft computing such as fuzzy inference system, artificial neural network prove the most prominent mechanism for handover decisions. In [1] a prominent method for handover decision was developed on the basis of fuzzy inference system by using two parameters i.e. coverage and speed. The consideration of lesser parameters for handover can affects the decision capability of the network. Also the evaluation of the input parameters was done manually. Hence there is a requirement to develop such a mechanism which can consider higher number of parameters for handover decision.

3. Proposed work

As reviewed from the previous section that there are some open research topics in handover that still require enhancements. The lesser number of parameter consideration, manual evaluation of parameters etc are example of such topics. The manual evaluation of the parameters is only suitable for the small systems but when the implementation is done on large scale systems or real time based systems then the manual evaluation of the parameters is quite difficult task and sometimes can also leads to the falls evaluation which directly effects the

handover decisions. Therefore the proposed work aims to develop an adaptive method for parameters evaluations by applying firefly optimization algorithm. Since the firefly optimization algorithm is one of the prominent optimization algorithms. Also the proposed work utilizes the following parameters for handover decision:

a. Coverage
b. Speed
c. Distance
d. Load
e. Received Signal Strength

The methodology of proposed work has mentioned in the following steps which are followed to attain the handover decision.

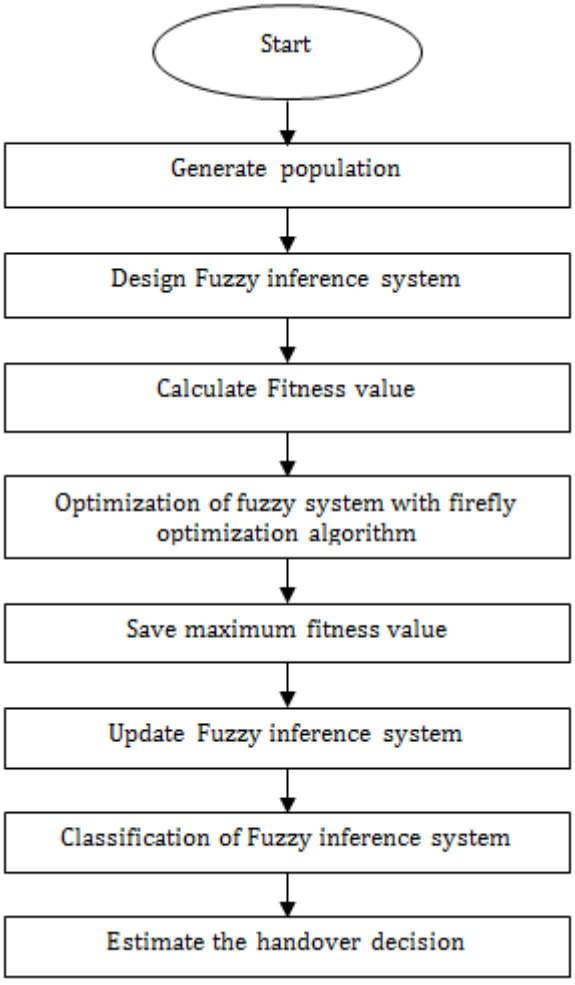

Fig-1: Proposed Methodology

1. Initially, generate the population for firefly optimization algorithm in fuzzy inference system.
2. Further, design fuzzy inference system where number of input and output variables is defined along with membership functions. In addition to this, rules are also defined based on which an output is achieved.
3. Evaluate fitness value based upon which system will update.
4. Then, Optimize designed fuzzy inference system with firefly optimization algorithm for effective handover decision.
5. Evaluate the fitness value and save maximum achieved fitness value. This maximum fitness value updates fuzzy inference system.
6. Finally, classification of fuzzy system has performed and handover decision is taken accordingly.

4. Results and discussion

This section represents the graphs of results which are obtained after implementing the proposed method for handoff decision making. This work purposes a fuzzy system for increasing the handoff decision making capability.

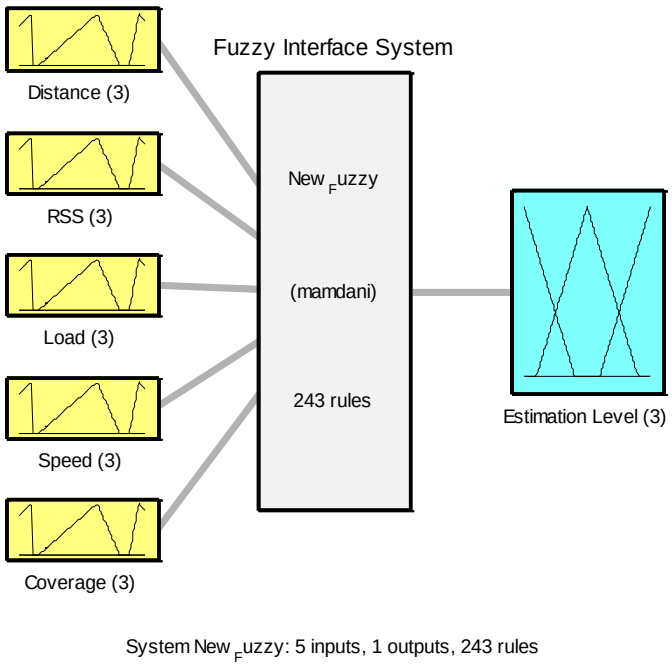

Fig-2: Fuzzy Interface of first layer of the Multi layered fuzzy Interface

This figure explicates that the network takes five inputs and on the basis of 243 rules after the implication of Mamdani fuzzy interface, it generates the single output regarding the handoff decision. Each input has 3 membership functions based upon which an estimation level has defined.

After inputting the parameters to the fuzzy interface it takes some decision on the basis of rules that are predefined. The membership functions which forwards to the fuzzy system are explained in the below figures 3, 4, 5, 6, and 7. Figure 8 is the membership function of the output parameter which is Estimation Level. The range lies from 0 to 1.

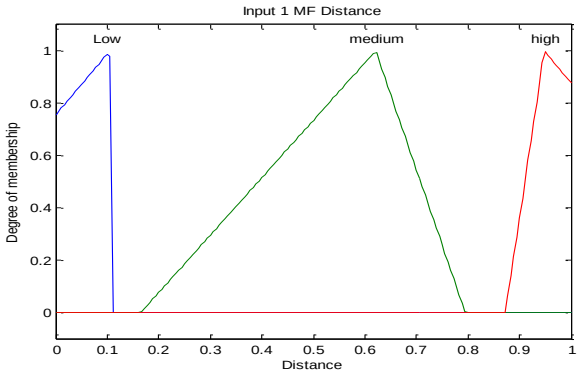

Fig-3: Membership function of Distance

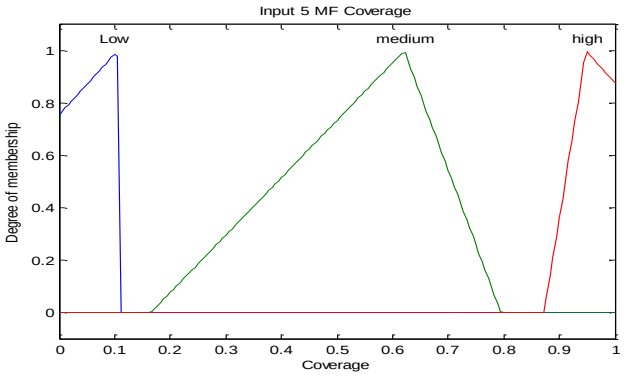

Fig-7: Membership function of Coverage

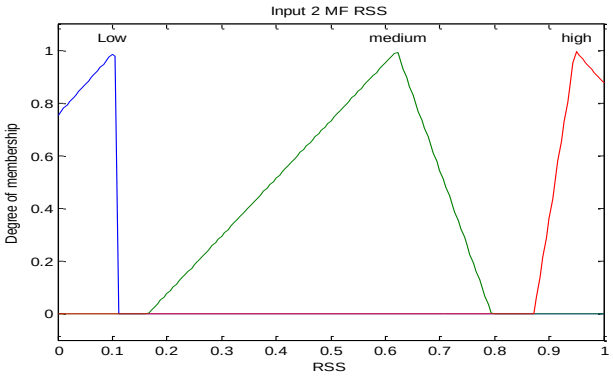

Fig-4: Membership function of RSS

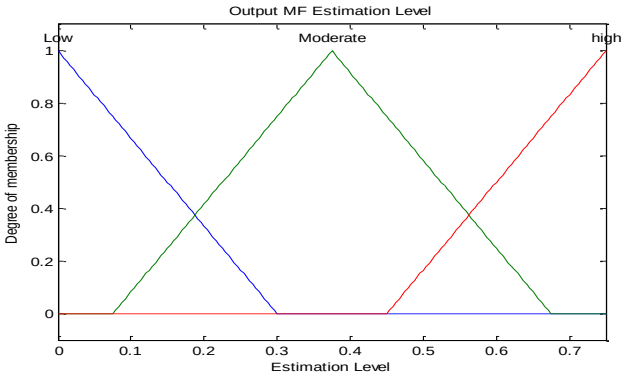

Fig-8: Membership function of Estimation Level

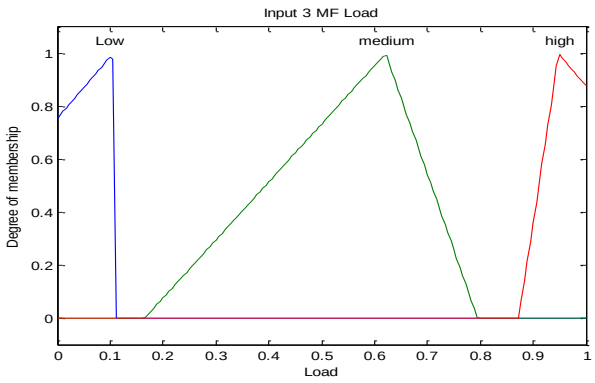

Fig-5: Membership function of Load

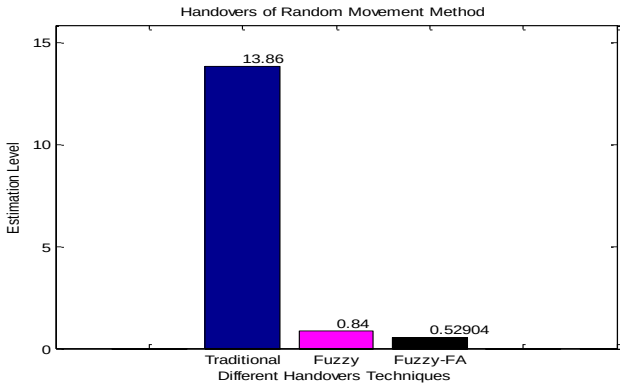

Chart-1: Handovers of random movement method

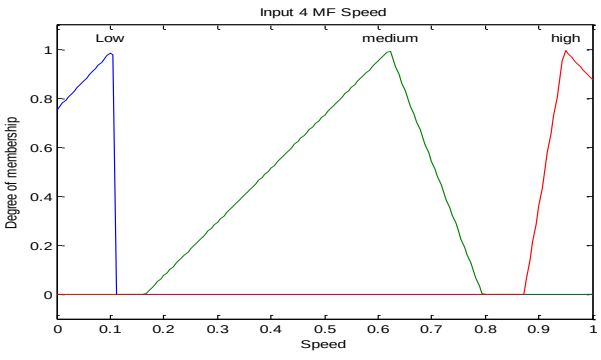

Fig-6: Membership function of Speed

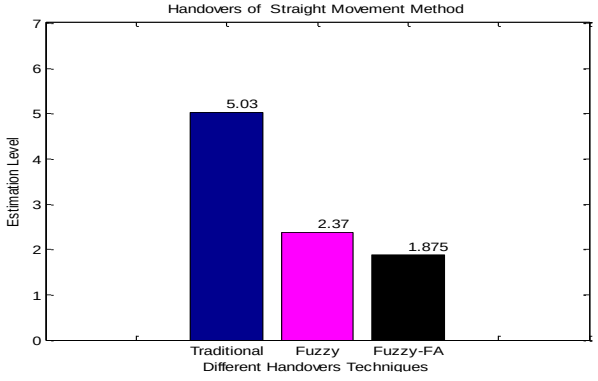

Chart-2: Handovers of straight movement method

Chart 1 and 2 depicts the comparison of handovers of straight and random movement method. From the comparison performed, it has been confirmed that fuzzy with firefly optimization algorithm outperforms traditional and fuzzy technique. In traditional technique, estimation level reached at 13.86 in random terminal movement whereas fuzzy acquires, 0.84 and fuzzy with firefly achieves 0.52256 of estimation level. Therefore, fuzzy with firefly optimization algorithm performs efficiently. Similarly, in straight movement method, estimation level achieves best using fuzzy with Firefly optimization algorithm. In traditional and fuzzy method, the estimation level was 5.03 and 2.37 respectively. Among these, fuzzy with FA performed effectively and acquires estimation level of 1.875.

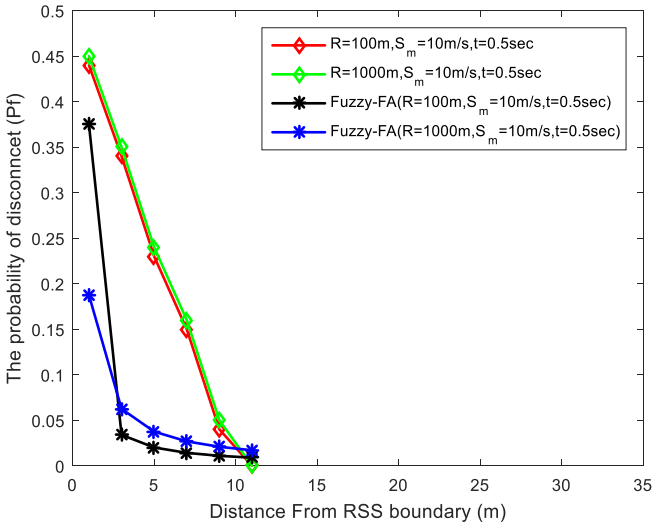

Chart-3: Probability of disconnection with respect to distance

Chart 3 shows the probability of disconnection with respect to distance. For the simulation analysis, traditional technique has compared with the proposed fuzzy FA technique. From the results acquired, it is concluded that proposed technique achieves less probability of disconnection with respect to other techniques. As the distance increased, the probability of disconnection has also been decreased but in proposed technique it decreases efficiently in view of different traditional techniques.

5. Conclusion and future scope

In this work, a handover decision method has presented. This method involved distance, coverage, speed, load and RSS, all of which affect the process of communication. These parameters are considered as input variables for fuzzy inference system based on which estimation level has evaluated and decision has taken. Moreover, based on the handover decision parameters, reasoning rules are designed while considering their logical relationships. The fuzzy inference system is considered to be a suitable system for reason based on non-linear data i.e. terminal as well as network information. In the proposed work, fuzzy inference system was combined with the firefly optimization algorithm for enhanced estimation level. The simulation results are analyzed using MATLAB software in view of traditional techniques with respect to random and straight terminal movement. From the results acquired, it has been concluded that proposed technique outperforms traditional and simple fuzzy inference system. The probability of disconnection in proposed system is lesser in comparison with other techniques while varying distance. However, the handover probability with respect to distance, speed, coverage, RSS and load influences the estimation level in the proposed work.

In future, neuro fuzzy inference system can be used for handover decision. The collaboration of two techniques such as neural network and fuzzy inference system can perform more efficiently and can make system innovatory.

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