IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Volume-3, Issue-7 E-ISSN: 2347-2693

An Improved Fuzzy Logic System for Handoff Controller Design in Micro Cellular Mobile Network

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www.ijcseonline.org

Received: Jun/26/2015 Revised: July/06/2015 Accepted: July/22/2015 Published: July/30/ 2015

***Abstract*—** Wireless and mobile networks are rapidly extending their capabilities. The continuation of an active call is the most important quality measurements in cellular systems. Handoff process provides such a facility for cellular system. Handoff is the mechanism which provides the service of transferring the ongoing call from one Base station (BT) to another when the mobile terminal (MT) crosses the coverage boundary of two networks in order to avoid call termination .Handoff controller takes decision by periodically checking the measurement criteria (parameters) for continuation of an Active Call .To address Better Handoff Controller, The Best Approach is to have more checking parameters (measurement criteria) into account for taking handoff decision .This Paper Represents the use of two more meaning full parameters along with the existing parameters using the fuzzy logic (ANFIS). With this Handoff Decision Improved and Problems such as more network load and interference are removed and Number of Handoffs are Reduced.

***Keywords*—** Handoff, Cellular networks, Fuzzy Logic, QoS , Signal strength, Network load, SIR

I. INTRODUCTION

In cellular network it is required to handoff successfully. Handoff in older Generation system was not difficult to achieve efficiently as cell size was large enough But present cellular systems takes small cell size in order to provide services to maximum number of users by using the concept of frequency reuse. In the case of smaller cell size with increased probability of mobile system (MS) crossing a cell boundary, The Handoff decision becomes more challenging. This problem becomes further complicated by the fact that there is an overlap of signals from different base stations in the vicinity of the cell boundary. Therefore the soft computing techniques based on genetic algorithm (GA), Fuzzy Logic (FL) ,Artificial Neural Network (ANN) are proving efficient for next generation cellular systems. The Better Handoff controller systems Avoids ping pong effects which leads to unwanted handoff thus cause increase in forced call termination probability And also Manage the capacity of the cell by executing handoff of the mobile station(MS) which is roaming inside the overlapped area [i.e. Network Area Receiving Received Signal Strength(RSS) from more than one Base Station(BS)] and making sure the cell site has free channels to provide service.

II. Older generation cellular system techniques

The available users at that time was very limited, so cell size were large enough to provide efficient service. Thus Number of Handoffs occurred quit less. Handoff were concluded by comparing the Received Signal Strength (RSS) coming from the Neighbouring Base Stations (BS) and mobile is handoff to the strongest signal strength Base station. However fluctuation in signal strength causes Ping Pong effect. Some of the main signal strength matrices used to support Handoff decisions are Received signal strength, Received signal strength with threshold, RSS with hysteresis, RSS with threshold and hysteresis.

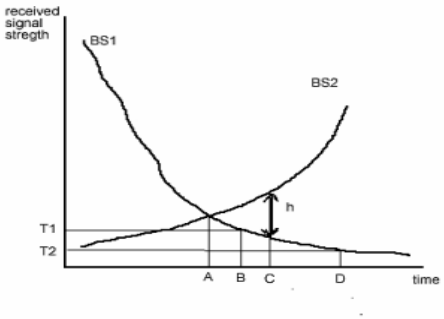

Fig.1 Handoff Based On RSS [1].

All above techniques initiate Handoff before point D called Receiver threshold otherwise the call will get terminated. This method is observed many unnecessary Handoffs even when signal strength of current Base station is still at an acceptable level, Which results poor quality of service (QOS) of cellular system.

III. Conventional Fuzzy Based Handoff Controller Algorithm

A. Basic Introduction

As the number of users increased with time, the frequency reuse concept was adapted and for that the network area was divided into micro cells. In order to overcome ping pong effect instead of just single received signal strength as

handoff measurement parameter ,three parameters were concluded to decide handoff decision.

1) Distance between the mobile station (MS) and the Base station (BS)

2) Received signal strength (RSS)

3) Network load

Fuzzy logic refers to a logical system that generalizes the crisp true or false concept to a matter of degree. Fuzzy logic provides the mechanism by which numerical and linguistic information can be incorporated by systematic manner. Fuzzy logic is based on fuzzy sets, A fuzzy set is class of objects with continuum grades of membership. A fuzzy set has elements belonging to it to some degree of membership. Fuzzy sets represents commonsense linguistic labels like high, medium, low, les, more, etc. various types of membership functions are used like triangular, trapezoidal, Gaussian, sigmoid functions etc . First of all use of linguistic variables, second feature is use of conditional statements to represent relation between variables. Lastly the use of fuzzy algorithm for complex relations.

B. Designing of Fuzzy inference system (FIS)

a) Identify the inputs and outputs using linguistic variables. In this step we have to define the number of inputs and output terms linguistically.
b) Assign membership functions to the variables. In this step we will assign membership functions to the input and output variables.
c) Build a rule base. In this step we will build a rule base between input and output variables. The rule base in a fuzzy system takes the form of IF---AND---OR, THEN with the operations AND, OR, etc.

IV. Proposed Fuzzy Logic Based Handoff Algorithm

Currently, single wireless network technology can not satisfy all of the requirements of mobile users at anywhere and anytime. Due to such requirements as QoS provision, cost efficiency, mobility, and etc. integration of different wireless technologies is necessary, which is done by Handoff techniques.
Proposed system uses five input parameters while the previous research used three input parameters. Lets discuss, "why its need to increase input parameters":

A. Need Of Velocity Parameter

As the network area is divided into micro cells, when the Mobile station is in mobility it continuously passes from one cell into another and so on. At the same time handoff occurs while the Mobile station crosses the cell boundaries. So the number of handoffs are quite large in number. Also if the Mobile station is moving with High speed, The number of handoffs will be even more, it may also cause ping pong effect which can lead to forced call termination.

Here, velocity is taken as input parameter along with previous three previous parameters which solves the problem in this way. As the Mobile station is moving with very high speed , then it is handoff to the larger cell Base station because mobile station was crossing micro cells very frequently which leads to more number of handoffs. In this way as the Mobile station is connected to the larger cell base station and thus number of handoffs are decreased.

B. Need of (SIR) Parameter

As Cellular Networks are using the concept of frequency reuse . sometimes during the call interference of two call occurs between the same frequencies used up by the different cells. In such case theirs need for one of the mobile station to be handoff to another frequency channel within the same cell called intra cell handoff.

Here, SIR is taken as input parameter along with the three previous parameters which solves the problem in this way. If the interference occurs the value of SIR increases . If the value of SIR exceeds the value of threshold then the system executes handoff.

Figure 2. shows the structure of proposed fuzzy Logic based handoff mechanism. It includes Five Input Parameters.

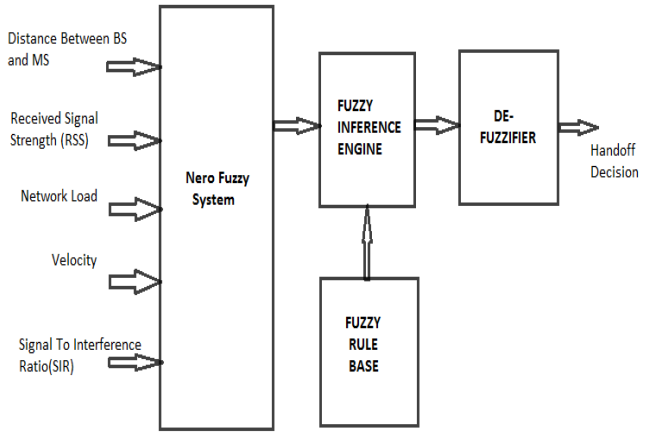

Fig.2 Block diagram Proposed fuzzy logic based handoff mechanism.

This Block Diagram simply shows the Basic idea that how the Work has been achieved. Along with Fuzzy also Neural System was required in order to handle the Velocity and SIR parameters. Hence Adaptive Neural Fuzzy Inference System (ANFIS) Algorithm are developed for wireless heterogeneous network which consist of GSM/GPRS, Wi-Fi, UMTS and WiMAX technologies. Because Handing Five Input parameters needs quit large Rule definition. First of all Rule matrix is defined and training of data is done by

using command epoch equals to 2. Secondly Membership function number and type is defined and plotted. Thirdly FIS is created and membership for Five inputs is plotted. Fourthly ANFIS time is calculated and the average training error and average checking error is concluded. Lastly the Results are shown as soon as the five inputs passed over the system.

V. METHOLODGY

1. Initially generate the rules for handoff. According to which the further steps are taken.
2. Now increase the QOS parameter to enhance the performance of the signal. So that handoff decision can be updated.
3. Next is to create a network. For creating the network there is defined the ANN.
4. To get the output after creating the network makes train of ANN.
5. Now passed the received output to the fuzzy controller. Where it will take the decision.
6. In this step the finally the hybridization of intelligent system with neural fuzzy is done.
7. As controller is used for making decision so a condition is defined for controller to take decision.
8. In this step the condition that is given to controller is evaluated with neural fuzzy hybrid controller.
9. Now the decoding that is finally made by controller after the evaluation of condition with neural fuzzy hybrid.

A.Proceeding figures shows the membership functions for the inputs

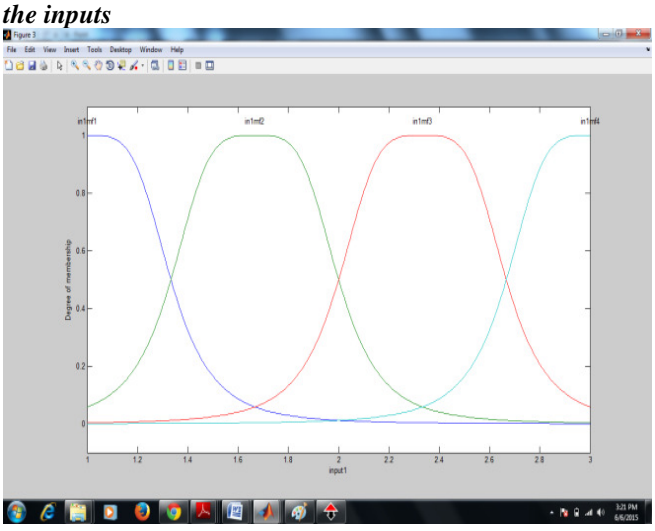

Fig.3. membership function for distance Level

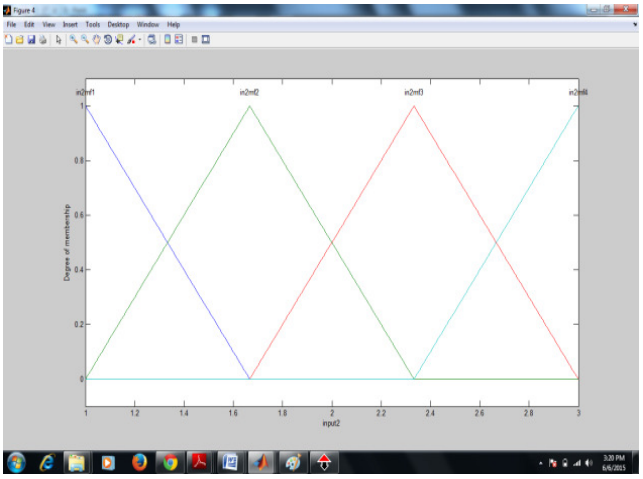

Fig.4. Membership funtion for RSS

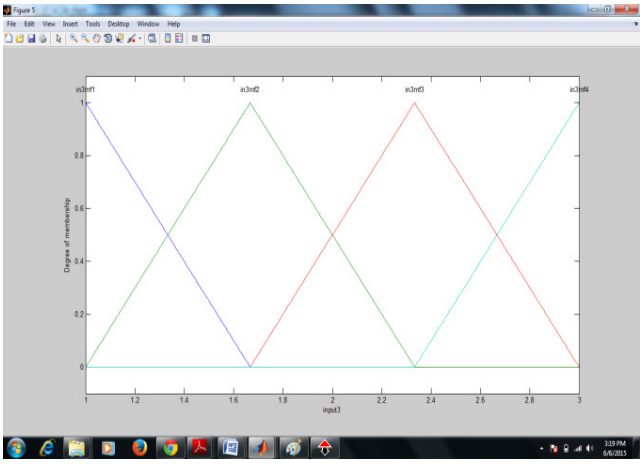

Fig.5. membership function for Load

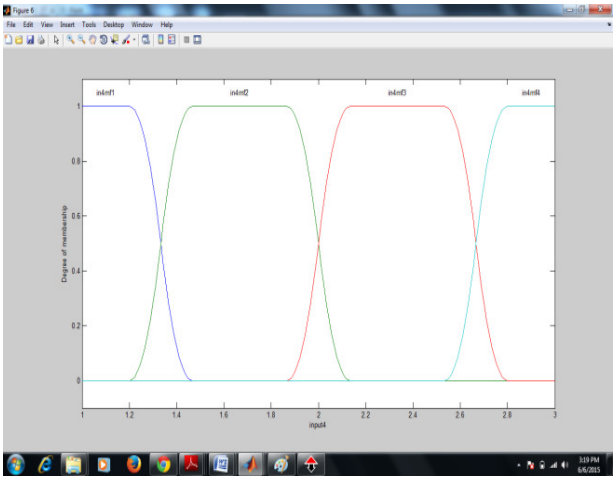

Fig.6. Membership function for Velocity

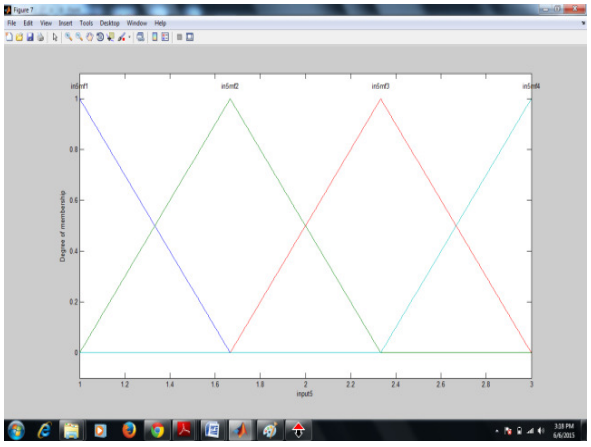

Fig.7. membership function for SNR

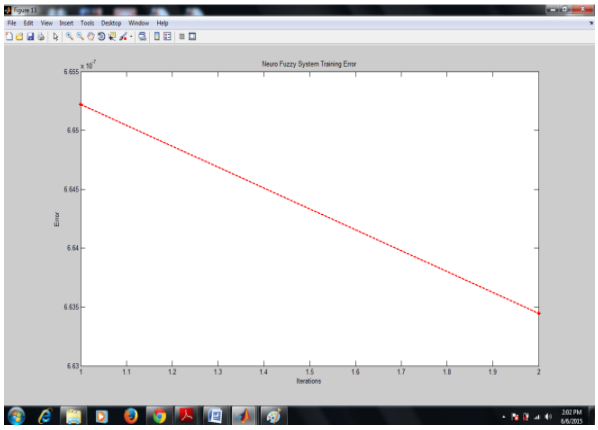

Fig.8 System training Error

The membership function of a fuzzy set is a generalization of the indicator function in classical sets. In fuzzy logic, it represents the degree of truth as an extension of valuation. Commonly used membership functions are triangles , trapezoids , Bell curves , Gaussian , sigmoidal .

Here the membership functions for all the five input parameters is mentioned . output sections provides the handoff decision . the linguistic values used for the output are No Handoff , Wait , Handoff , Be Carefull . Along with the handoff decisions. System also calculates the system accuracy .

VI. RESULTS AND DISCUSSIONS

The results are taken on behalf of input parameters as represented below that in traditional approach the handoff decision is less but as the proposed work has more parameters dependency the rate of handoff is increased the below figure 9 and figure 10 represents the handoff graph with respect to distance variation and the comparison of traditional approach and the proposed handoff decision criteria. It is summarized that the handoff approach of controller is raised as parameters and the intelligent system is upgraded.

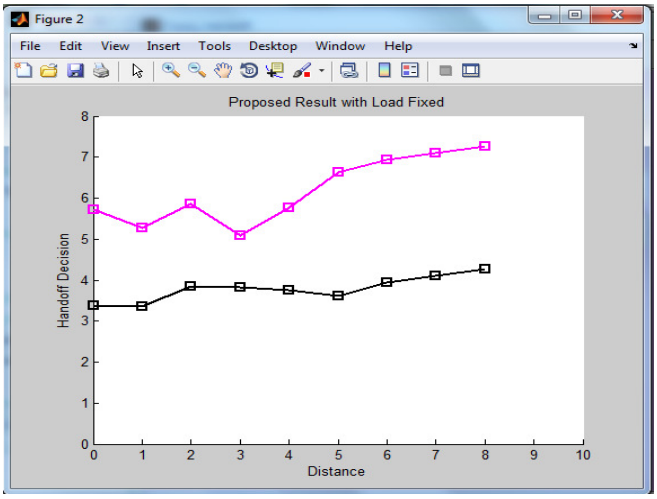

Fig.9 Distance Vs Handoff Graph of Proposed approach

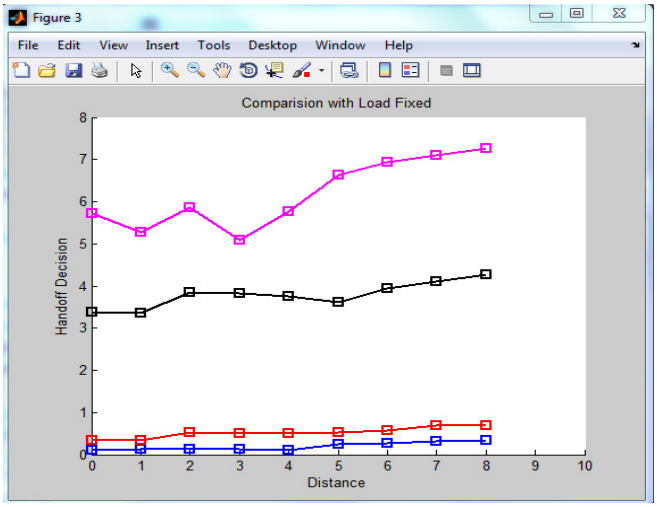

Fig.10 Distance Vs Handoff Graph of Both Comparisons

VII. Conclusion and future scope

After implementing the proposed work their results demonstrate the approach is much better than the tradition ANN dependent and as parameters are raised the controller is providing much better results than the traditional one. The neural and fuzzy combination is also improving the performance of the system. As a future scope further enhancements can be done on upgrading the system by optimization algorithms and can get the best optimal possibilities of the solution.

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