

# A Novel Approach of Cooperative Sharing Based On Hybrid Relaying Scheme of Chase Algo and Decode & Forward Using Fuzzy Logic in Cognitive Radio

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**Abstract** :Throughput of Cooperative network can be enhanced by using different relay selection scheme ,therefore interest in relay selection is going upwards .It an open research topic these days.We proposed a relay selection algorithm named as chase algorithm which select the best relay on the basis of some parameters like SNR, channel allocation, power allocation, interference constraint .Further at every relay node, Decode & Forward protocol is used for removing the noise in further stages .Finally with the help of fuzzy controller in which the SNR,channel allocation ,power allocation,interference constraint are the fuzzy parameters ,we propose an expected model that reduce some computational load and enhance the channel rate.

**Keywords**—*CooperativeCommunication , ChaseAlgo, Decode and forward , FuzzyLogic*

## I. INTRODUCTION

Nowadays Cooperative Communication has been widely used.By cooperative Communication not only the throughput increase but the power is sufficiently allocated ,acquire better quality of service ,improving spatial diversity,good transmission opportunities exploitation and SNR also gets improved.So that is the reason ,Cooperative Spectrum Sharing has a great zeal and a open research topics these days[1-2].For exploiting the diverse attributes of the wireless communication, Relays came into a picture between source & destination which in simpler way acts as a forwarding the signal from Source to destination .Here making secondary users(SU's) as a relay for opportunistically exploitation of spectrum which is basic requirement well discussed in DSA(Dynamic Spectrum Access) technique[3].The relays forwards the message by some relaying protocols mention as Amplify and Forward , Decode and Forward ,Compressed and Forward etc[4].Relay selection is studied broadly nowadays by researchers and splendid work being going in this field[5-7].So,broadly categorize the relay selection into 5 major classification as on the basis of technique selection.

**a.Geographical information based relay selection:**This relay selection method based upon the distance from source to relay and from relay to destination .its aim to reduce the symbol error probability but this proposed algo is not suitable for practical situation cases because of shadowing and channel effects.[8]

**b.Energy efficient based relay selection:**Generally total energy is used to explore the best relay.[9].with the motive of reducing the overall lifetime of network ,power aware relay selection is proposed .furthermore ,optimal power allocation also came into picture.[10]

**c. Outage probability based relay selection:**In this case of outage probability based relay selection scheme best relay is selected on the basis of its maximum probability without disturbing the performance and with the amendments in network lifetime.[11]

**d.interference aware relay selection:**In case of wireless communication ,interference is the very common hurdle ,and it is more severe in multihop transmissions by interference based relay selection .we can explored the maximization of mutual information on cooperative communication network with the limited interference distribution.[12]

**e.Channel state information(CSI) based relay selection:**Opportunistic relay is one of the best technique for relay selection because in this source have a full knowledge of source to relay and from relay to destination ,only then source identify the best relay [13].The Author in [14] exploit the outdated CSI(channel state information) for selecting the best feasible relay .Moreover in [15], Author took residual energy and CSI as the input fuzzy parameters for selecting the best relay.

So this paper includes section II as the System Model of chase algorithm which is designed for selecting the best relay based on some parameters with the decode & forward protocol used at the relay node by the use of a fuzzy logic. Section III consists of Chase algo with Fuzzy based decision .

## II. SYSTEM MODEL

Consider the cooperative communication, we propose an *expected* system model consists of Source(S), Destination(D), & N no. of relays (N- (j=1,2,3,...N)). Source being transmitting the signal to destination via relay. Each relay is well equipped by single antenna and assumption made that all relays are working in half duplex mode. Here distance from source to relay and relay to source are equal. Different parameters on which the selection scheme. However fairness results are more better in relay selection parameters depends upon are: SNR, Channel Allocation, Power Allocation, Interference Temperature. and let  $h_{S-D}$ ,  $h_{S-rj}$ ,  $h_{rj-D}$  are the channel coefficients from source to destination, source to relay and from relay to destination respectively

### 1. SNR for direct path transmission as [16]

$$\alpha_{S-D} = \frac{|h_{S-D}|}{N_D} \quad (1)$$

SNR for 1st hop for jth relay SNR  $S_{-rj}$  and is

$$\alpha_{S-rj} = \frac{|h_{S-rj}|}{N_{rj}} \quad (2)$$

The decoded message /signal is forwarded to destination in 2<sup>nd</sup> hop. SNR at 2<sup>nd</sup> hop for jth relay is

$P_1$ , and a Node B having power  $P_2$ , so maximum power is formulated as

$$\max_{P_1, P_2} P_a(P_1, P_2) \quad (6)$$

**4. Interference power constraint** : Interference power threshold is used with the objective to minimize the power consumption and channel estimation load. It is defined as interference temperature also denoted by  $T_c$ .

$$T_c = P_j(f_c, b_c) \quad (7)$$

$$k * b_c$$

where  $k$  is the boltzman constant  $= 1.38 * 10^{-23} \text{ m}^2 \text{ kg s}^{-2} \text{ k}^{-1}$

In the next section consisting these 4 parameters as fuzzy parameters based on fuzzy logic design.

## III. CHASE ALGO WITH FUZZY BASED DECISION

Chase algorithm is basically preferred for selecting the best relay path based on above mentioned four criteria as SNR, channel allocation, power allocation, interference constraint.

$$\alpha_{rj-d} = \frac{\beta |h_{S-rj}|^2 |h_{rj-D}|^2}{|h_{S-D}|^2} \quad (3)$$

*Step1*: Initiate  $j=0$

*Step2* : Increment  $j$  by 1

### Chase algo

$$N_{rj}(\beta^2 |h_{S-rj}|^2 + 1)$$

*Step3* : Calculate fuzzy parameter for  $j^{\text{th}}$  relay

*Step4*: Findout degree of competence  $f(\alpha, R_{\max}, P_a)$

*Step5*: if  $f(\alpha, R_{\max}, P_a) > T_c$  then stop , go to step8, else

$\beta$  is the container of the decoded message . For ultimate relay selection ,the minimum SNR out of the two hop is used.

$$\alpha_j = \min(\text{SNR}_{S-r_j}, \text{SNR}_{r_j-d}) \quad (4)$$

**2. Relay selection with channel allocation :**As the cognitive radio source (CRS) don't have an initial knowledge that which relay is best one so depending on the channel allocation  $\text{CRR}_{j \in \{1, \dots, N\}}$ -CRD links the best CRR(cognitive radio relay) is chosen .  
continue.

*Step6:* else if  $j=N$ ,then continue lest jump to step 2

*Step7:* Compare the degree of competence of each relay and select the relay having maximum degree of competence

*Step8:*  $R_j$  is selected as best relay.

$$R_{\max}^{\text{best CRR}} = \max_{1 \leq m \leq N} |h^b d|^2 \quad (5)$$

Where  $R_{\max}^{\text{best CRR}}$  designated as index of the selected best CRR,best CRR is selected from N relay (CRR's) and channel allocation is performed with this best CRR.basically there are 4 mode for channel allocation as:

**Mode 1:** Direct transmission from the source to the destination.

**Mode 2:** Dual-hop transmission from the source to the relay.

**Mode3:**Dual-hop transmission from the relay to the destination.

**Mode 4:** Relay diversity transmission by using all three links with cooperative relay protocols

**3. Power allocation:**Estimate which secondary node acquire more power allocated .Suppose ,a Node A having power

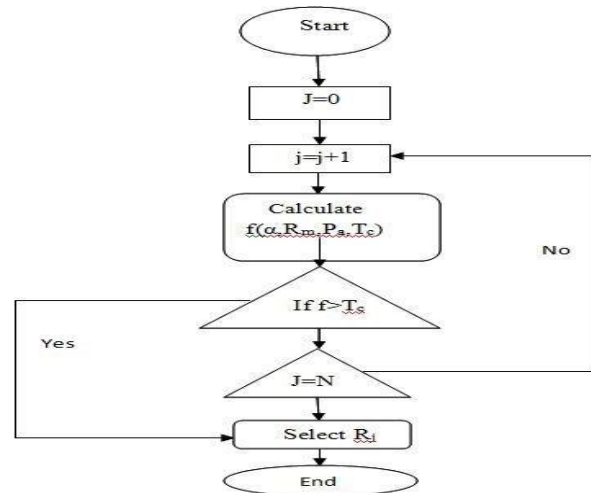


Fig1 Relay selection algo(Chase algo)

**Fuzzification:**Portraying the crisp set domain to fuzzy domain i.e.from a very small no. Of membership functions to parameters(SNR,channel allocation,power allocation,interference constraint ).Association of each term to the grade is what the membership function performed.These large no. Of values being represented by membership function greatly

minimizes the load of processing of so different values[17].Assigning each linguistic value to their fuzzy variable is possible by intuition method. Derived form the capacity of humans to develop the membership function through their own intelligence & understanding is what the Intuition method proposed.The four parameters mention above (SNR,channel allocation,interference constraint,power allocation) works as a fuzzy parameters.and getting the membership functions for different fuzzy parameters.Every parameter has five membership functions:Very low(VL),Low(L),Medium(m),High(H),Very high(VH).

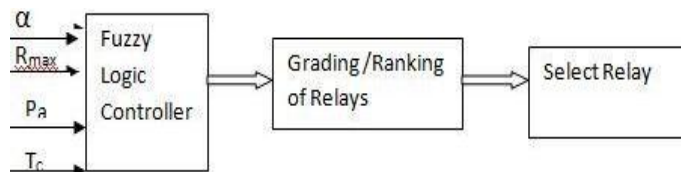


Fig2 Block diagram of Relay selection with fuzzy controller

We perform it in **Mamdani fuzzy inference system(FIS)** for fuzzification.

**Defuzzification:** Conversion of fuzzy set into Crisp number

.It is the inverse transformation of fuzzification which works as an feedback to send the output from fuzzy range of values to Crisp set of values.COA(centre of area) is one of the method to evaluates the centroid of the fusion area representing the output of fuzzy term.

#### IV. CONCLUSION AND FUTURE SCOPE

In this paper, with the help of chase algo and decode and forward protocol at the relay node ,we facilitate the cooperative sharing and choose the best relay path .Here distance taken is same from source to relay and relay to destination.We are expecting that the proposed chase algo based fuzzy decision gives better results comparing to some conventional approaches. In future, we extend our work to relay position at different distance and we also try to explore BER(Bit error Ratio) too and compare it over different fading channels.We can also make the secondary user as a relay in reconfigurable mode.

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