Cuckoo Search Algorithm for Satellite Communication Link Budget Optimization

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Abstract— In fast changing global socioeconomic development satellite communication act as backbone. Satellite connects one point to another point of earth. It provides communication capabilities spanning long distance & also in circumstances where other form of communication is inoperable. It is now used in controlling Power distribution & transmission with the support of supervisory control and Data acquisition system (SCADA). Satellite communication (SATCOM) increased the modernity and advancement of the communication path. In this research, Cuckoo search algorithm improves the link budget performance in satellite communication system by the optimization. The effective cuckoo search algorithms find the parameters that provide the maximum (or minimum) value of a target function.

Keywords—*Satellite communication, Cuckoo search, SCADA system*

I. INTRODUCTION

Modern System demands monitoring and controlling in automation System. That's why SCADA used nowadays is more automated and most important cost effective also [1]. The Remote control server (RCS) microwave communication network and remote telemetry unit (RTU) are considered as the backbone of the SCADA system. RTU collects the information from substation & transfer the information to a central host by microwave linkage [2]. But, for the large and critical geographical area, enhancement of communication system is required in the industries. The modernize satellite communications (SATCOM) is best suitable wireless media for SCADA [3]. Satellite communications generally consist of a satellite and several ground stations (transmitter/receiver). The satellite receives the uplink frequency, repeats the signal, and transmits downlink frequency, the transponder is very helpful in large amount of data transmitted. But there are some limitations also; So SATCOM faces major loss [4]. To Overcome those losses, the most used approach is to calculate link margin performance in a transponder SATCOM system [5]. Therefore, a system which helps in minimizing the noise and maximize the data transferring capacity is preferred.

II. CONNECTED EFFORT

Investigated various reliability characteristic of a satellite communication system [6]. Evaluated complete satellite system and the failure caused due to transmitter and receiver systems. For the credibility of the satellite communication systems, the MATLAB modelling and simulation is very helpful to assess the functioning of the various attributes. The sensitivity analyses show that system sensitiveness increases as terrestrial system complexity increases. So, Power Transmission System is ready to come up with new ideas in Satellite Communication [5]. For the proper formation of production, wireless communication media is a very popular way in SCADA industries. Satellite Communication is the best option as a wireless media for maximum geographical area in remote and rural sites with high speed. SATCOM divided in three parts transponder, uplink and downlink and provides link margins against losses. The proposed work algorithm, which provides a set of SATCOM links with a desired quality of service requirements and sufficient uplink and downlink margins. The joint power control algorithm simulation results show highest link margin to tackle random uplink and downlink losses. The study proposes a wireless SATCOM system for SCADA water station [7]. Communication protection and security issues occurred in the whole transmission process, so few features are suggested. The SATCOM plays a very important role in the development of the country where the payload complexity increases the SATCOM design trade-offs. All the effective structure of the satellite has been accomplished before main design installation. Before the satellite is deployed in the design of all the attenuation scenarios is performed. Here, the basics of the satellite link budget are introduced [8]. The gravitational search algorithm is a combination of the law of gravity and mass interaction for the rigorous testing of the satellite link. So, its performance is very effective. The present study explains the link between an earth station and used by Geo Stationary satellite with the Ka Frequency band [9]. The simple architecture is preferred for future aspect,Which is helpful in finding link budget performance. The application used to help in calculating the link budget in uplink and downlink. The design of the future communication satellite for Ka band is proposed by considering the simple architecture. Without Software simulation, can't check the viability of the proposed system. The software is developed for checking the feasibility of the proposed system. The final conclusion shows some noise gap between uplink and downlink margin, such as 8.17dB and 8.2dB. For the circuit simplicity and high-speed performance, new techniques of modulation and demodulation are introduced at high bit rate of multilevel digital carrier transmission [10]. System

control plays an important part in control philosophy for link availability, which is used in high speed digital microwave, millimetre-wave and satellite communication systems.

III. CUCKOO SEARCH ALGORITHM

It is stimulated by the cuckoo bird (population-based algorithm) with the levy flight behavior to discover preeminent link, which is entirely built on the optimized carrier to noise ratio. For the communication performance enhancement of industries, Cuckoo search algorithm is finest optimization concept in SATCOM systems. By implementing this algorithm, undesirable parameter means noise can be minimized, and desired parameter maximized. So carrier to noise ratio is also exploited.

Cuckoo search algorithm

Begin
Initialize the populations: n host nests(solutions)
$x_i(i=1,2,\cdots,n)$
Calculate the fitness value $F_i(i=1,2,\cdots,n)$
***While** (Stop criterion)*
Generate a new solution (Cuckoo) x_k via Levy flight and calculate the corresponding fitness value F_k
Select a net x_j randomly and the corresponding fitness value F_j
***If**(F_k>F_j)*
replace x_j by x_k
End if
Abandon a solution by p_a (0<p_a<1) and rebuild a new solution randomly
Keep the best solution
End while
End

The algorithm is shown above. As per Algorithm, subsequently the search operation, lots of optimized new links produced. So, although producing new links the search ability is achieved thereby optimization rate is different and the number of new links is produced after the search operation. Thus, the new link model is found to conclude the optimal top total carrier to noise ratio value.

IV. ASSESSMENT AND OUTCOMES

In this exploration, MATLAB 2017a is reflected for the software simulation to find the top optimization value by cuckoo search algorithms. The design parameters are estimated to the range values and related with cuckoo search algorithms and their acquired values. The ranges are stated in the below table,

Table 1 Ranges of Design Parameters

DESIGN PARAMETERS	RANGES
Uplink frequency	5.8-6.9 GHZ
Downlink frequency	3.7-4.3 GHZ
Earth transmit power	25-30 dB
Earth transmit and receive antenna efficiency	55-75 %
Earth transmit and receive antenna diameter	2.6-4.6 m

The carrier to noise ratio for both uplink and downlink earth stations and the overall satellite communication system is analyzed for cuckoo search algorithms and reference satellite model is also involved for the comparison purpose and is given as,

Table 2 Carrier to noise ratio of Parameters

CARRIER TO NOISE RATIO	Reference satellite Model	CUCKOO SEARCH
Uplink (dB)	104.8	151.60
Downlink (dB)	84.6	151.44
Total (dB)	85.4	149.51

The simulation is performed for the design parameters and comparison table is formed below.

Table 3 Comparison between PSO and CUCKOO Design Parameters

DESIGN PARAMETERS	RANGES	CUCKOO SEARCH-OPTIMIZED VALUE
Uplink frequency	5.8-6.9 GHZ	6.75 GHz
Downlink frequency	3.7-4.3 GHZ	4.2 GHz
Earth transmit power	25-30 dB	28.40 dB
Earth transmit antenna efficiency	55-75 %	62.04%
Earth receive antenna efficiency	55-75 %	66.90%
Earth transmit antenna diameter	2.6- 4.6 m	3.22 m
Earth receive antenna diameter	2.6-4.6 m	4.11 m

V. CONCLUSION

In this exploration, an proficient optimization technique, cuckoo search algorithm is suggested for providing the top optimized link value in satellite communications. The outcome is simulated for uplink frequency, downlink frequency, antenna transmits efficiency etc. This algorithm provides the best carrier to noise ratio in all the earth stations, comprising complete satellite communication systems and the estimated outcomes for different design parameters are extra active in terms of data transmission.

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VI. REFERENCES

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