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Communication Satellite Link Budget Optimization Using a New Hybrid PSOGSA Algorithm

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ABSTRACT:

The paper presents the various component parts necessary for designing satellite link. The key issue in the design of communication satellite is the link budget optimization such as (C/N) for uplink and downlink**.** The communication link between a satellite and the Earth Station (ES) is consists of noise, rain, atmospheric attenuations, antenna misalignment and polarization. This paper presents the fundamentals of a satellite link budget of generic communication satellite. In this paper a Gravitational Search Algorithm based on the law of gravity and masses. Also in this paper PSOGSA algorithm is proposed which is combination of PSO (particle swarm optimization) and GSA (Gravitational Search algorithm) algorithms in evolving the best solution. From this algorithm shows that better capability to escapes is prevent in hybrid algorithm than that of standard PSO & GSA.

KEYWORDS:

Gravitational Search Algorithm (GSA); Particle Swarm Optimization (PSO); Communication Satellite; Function optimization; link budget; Earth station.

I.INTRODUCTION

This paper is based on the MATLAB simulation. The basic objectives of this simulator were to make it easy to use and to provide effective visualization capability suitable for presentations as well as individual studies.

This educational simulator was developed by MATLAB 2010b. MATLAB is a scientific computing language developed by The Math works, Inc. that is run in an interpreter mode on a wide variety of operating systems. It is extremely powerful, simple to use, and can be found in most research and engineering environments.
The motivation for the development of this simulator is to provide the students with a simple and useable tool for gaining an intuitive feel for the PSO algorithm, mathematical and power system optimization problems.

The uplink performance of the satellite communication network depends on receiver antenna gain and noise temperature of the satellite receiver. The conduit factors include such a factor's as:

- Earth space & space.
- Earth path (uplink and downlink) effect on signal propagation, quality of the earth station equipment medium in the frequency that of interest etc.

The content factor deal mainly with type of message transmits and the devices involved in its transmitter from one to another for suitability for transmitter over a microwave medium. These is turn must guarantee delivery objectives for quality, reliability and availability.

Satellite link is nothing but the terrestrial microwave radio link which required the re-transmissions of the signals. Transmission of signal over the communication link requires Line Of Sight (LOS) communication.

II.PROBLEM STATEMENT

To establish a list of parameters that must be considered when the link power budget of a communication system satellite is established, and the conditions in which these settings apply. The various component parts necessary for designing a Robust satellite link with appreciable availability
And required signal/noise ratios.

III.OBJECTIVE

The objective of this paper to find out the optimized link in the communication satellite with the help of the PSOGSA algorithm. The optimized link is nothing but the approximate values which is calculated by the link parameters of the satellite.

To establish a list of parameters that must be considered when the link power budget of a communication satellite is established. Also deliver services with the best quality and reliability, under strict cost constraints...

IV.LINK BUDGET

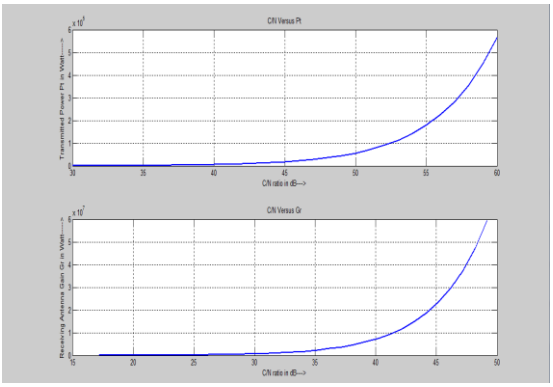
The Link budget played a vital role in the deployment of any radio frequency network. It defines the amount of power available in the communication link and signal-to-noise ratio required to perform transmission with the required quality [5]. Link budget is a method to evaluate the received power and noise power in a radio link and is the result of the summary of all gain and losses that affect the signal along the path, such as decibel units are more practical for those quantities.

- Satellite link-

Transmitting path between satellite & earth station.

- Link Budget-

The link budget analysis the process of adding the all gain & losses incurred operating a communication link.
It consist of- 1) Uplink Budget.
2) Downlink Budget.



C/N ratio calculation is simplified by the use of link budgets. Evaluation of the received power and noise power in radio link. The link budget must be calculated for individual transponder and for each link. When a bent pipe transponder is used the uplink and down link C/N ratios must be combined to give an overall C/N. The major frequency bands are 6/4 GHz, 14/11 GHz and 30/20 GHz (Uplink/Downlink) geostationary orbit there is already satellites using both 6/4 and 14/11 GHz every 2˚ (minimum space to avoid interference from uplink earth stations)

➢ Link Budget Parameters:-

- Transmitted power at antenna.
- Receiving power antenna.
- Antenna gain compared to isotropic radiator.
- EIRP
- Free space path loss.
- System noise temperature.
- Figure to merit for receiving system.
- Carrier to thermal noise ratio.
- Carrier to noise density ratio.
- Carrier to noise ratio.

VI.GRAVITATIONAL SEARCH ALGORITHM

The basic physical theory which GSA is inspired from is the Newton's laws of gravity and law of motion. The algorithm considers agents as objects consisting of different masses proportional to their value of fitness function.

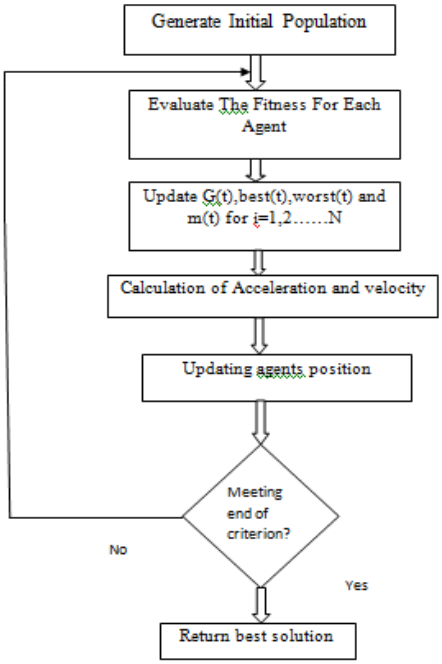
1) Law of gravity-

"Every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them."

2) Law of motion-

"Some of the forces 'F' on an object are equal to the mass 'm' of the object multiplied by the acceleration 'a' of the object."

GSA algorithm consists of following steps:-



VII. PARTICLE SWARM OPTIMIZATION

Particle Swarm Optimization(PSO)Proposed by James Kennedy & Russell Eberhart in 1995.Inspired by social behavior of birds and fishes. Population-based optimization.

- PSO Algorithm is based on the following concepts:

A. Collision Avoidance- Avoid Collision with neighboring satellite.

B. Velocity Matching-Match the velocity of neighboring satellite.

C. Flock Centering-Stay near neighboring satellite.

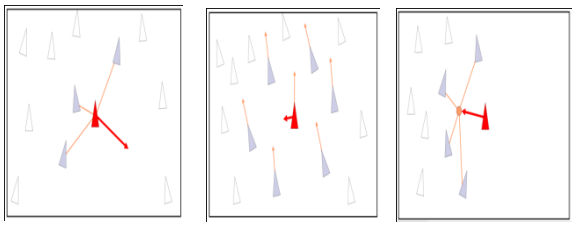
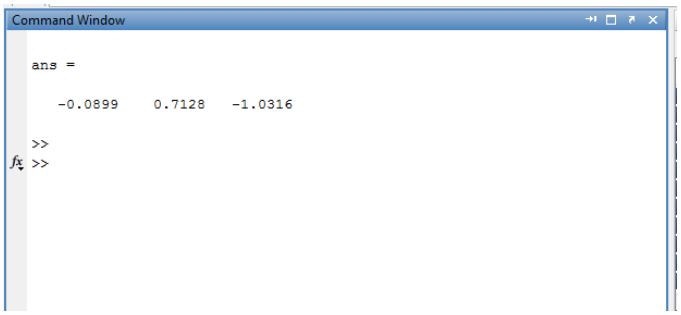


Fig –a Fig –b Fig –c

VIII.PSOGSA

A PSOGSA is proposed with the combination of Particle Swarm Optimization (PSO) and Gravitational Search Algorithm (GSA). The main idea is to integrate the ability of exploitation in PSO with the ability of exploration in GSA to synthesize both algorithms' strength. Some benchmark test functions are used to compare the hybrid algorithm with both the standard PSO and GSA algorithms in evolving best solution.



VI.RESULT

The first result shows the graph of transmitting power verses carrier to noise and the receiving power verses carrier t noise ratio. Here transmitting power is greater than the receiving power because the earth station consist of the large amount of thermal noise. Due to that noise we want to increase the signal to noise ratio so that ratio increase the transmitting power. In the second result shows the graph of the fitness values. This fitness values shows the particular position of the satellite.

VII.ADVANTAGES

1. Simple implementation.
2. Easily parallelized for concurrent processing
3. Very low algorithm parameters.
4. Very efficient global search algorithm.

VIII.CONCLUSION

This paper presents in detail background and implementation of a particle swarm optimization algorithm and GSA algorithm suitable for constraint structural optimization task. The effectiveness of the approach is illustrated by the graph...

Result shows the ability of propose methodology to find better optimal solutions for optimization task than other optimization algorithm and provide a better understanding of the dynamic of the PSOGSA,and provide a selecting control parameters.

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