The Path Search Algorithm by Forecasting of Received Radio Sensitivity in GEO Satellite

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Abstract. In this paper, we propose the path search algorithm that satisfies the various weights. The proposed algorithm satisfies a quality of the satellite services. It controls an suitably the time and the distance it takes to move the searched path. The weights of the path search algorithm are the time, the distance and the received radio sensitivity. The path search algorithm based on one of the weight has disadvantage. The disadvantage according to the weight are deteriorates the quality of the satellite services, increase of the distance and the time. The proposed algorithm searches the path according to the compound weight for solves the disadvantage and decide the most effective path in the searched path.

Keywords: Satellite Communications, Propagation, GEO, Path search algorithm.

1 Introduction

The propagation loss occurs in the satellite communication link[1]. The free-space path loss and the atmospheric absorption (the water vapor and the oxygen in atmospheric) are main causes of the propagation loss in the satellite communications. And, additional propagation loss occurs by an obstacle on the ground as the ground station is moving. Therefore, the characteristics analysis of the receiving environment on the satellite communication is necessary in order to satisfy a quality of the satellite services[2][3][4].

The real-time services in the satellite communication are required without interruption. So, it is very important. This paper analyzes the characteristics of the satellite communication environment. This also presupposes the received sensitivity of the satellite radio. Presuppose of the received radio sensitivity will satisfy a quality of the satellite services.

2 The Satellite Propagation Attenuation

Generally, the equation of the satellite communication propagation attenuation between a satellite and receiver is as follows:

$$P_r(dBm) = P_t(dBm) + G_t(dB) + G_r(dB) - L_f(dB) - \alpha(dB) \qquad \textbf{(1)}$$

where P_t is received power, G_t is transmission antenna gain, G_r is received antenna gain. And α is additional attenuation factor such as the atmospheric absorption and the ground obstacles. In this paper, the antenna gain is 0.

The free space path loss model represents the basic radio path loss. It is as follows[2].

The atmosphere absorption loss occurs in the satellite communication. It is as follows:

$$A = \frac{\gamma_o h_o + \gamma_w h_w}{\sin\varphi} \qquad \textbf{(3)}$$

where $\gamma_o h_o$ and $\gamma_w h_w$ are given by the following equations in ITU-R P.676, $\sin\varphi$ is elevation angle between the satellite and the ground station.[3]

The ground obstacles can be divided as knife edge, round edge and vegetation. This way, we can estimate to attenuation by the ground obstacles. The knife edge model can be applied to diffract the attenuation by the building. Because, the top of the building considered a pointed end. It is as follows ITU-R P.526[5].

The round edge model can be applied to diffract the attenuation by the mountainous terrain. Because, the top of the mountainous terrain considered circular. The diffraction attenuation due to the rounded edge can be obtained as follows[5]:

$$L_{diff\_R} = J(v) + T(m,n) \qquad \textbf{(4)}$$

in this case, J (v) is shown in Equation of knife edge model. But here, the geometric coefficient v of the equation is shown below:

$$v = 0.0316h\left[\frac{2(d_1 + d_2)}{\lambda d_1 d_2}\right]^{1/2} \qquad \textbf{(5)}$$

also, T(m,n) of equation 4 as follows ITU-R P.526.

The estimation method of the attenuation by vegetation various types exist. The vegetation attenuation model can be classified such as ITU-R, Weissberger, COST235, FITU-R, MAR and NZG[6][7]. Among them, we use the MAR model in this paper.

3 Simulation

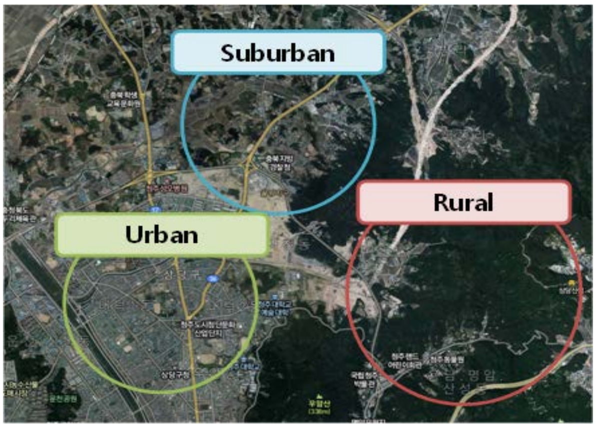

Fig. 1. The receiving environment for propagation sensitivity.

Table 1. Simulation setting of each environment.

Received environment	*Urban*	*Suburban*	*rural*
The obstacle density(%)	80	50	10
The average height(m)	60	30	20
Height standard deviation(m)	10	10	10

This section makes the virtual map for inspect the algorithm. The weight factors for a searching path are the distance, the time required and the received radio sensitivity. The receiving environment can be classified such as Fig. 1. So, the received radio sensitivity is presupposition by the building, the mountainous terrain and the vegetation. The received radio sensitivity in each environment is set according to Table 1. The time required take migrating between the node and the node. It followed the width of the road.

Table 2. Simulation result

Weight value (the received sensitivity%)	*Total distance (m)*	*Total time (s)*	*Average of the received sensitivity (dB)*
0	16360	1176.3	-170.167
48	16450	1095.3	-164.889
68	16510	1090.125	-163.333
74	16570	1225.35	-162.167
81	17150	1177.425	-154.611
96	17570	904.95	-153.778

This paper checked how another path search when the weight value of the received radio sensitivity is changed from 0 to 100%. In Table 2, the simulation results show the change of the weight value(the received sensitivity). If the value of the received radio sensitivity for guarantee a stable satellite service is -160dB. Then if the factor to determine the path is the distance, the value of total time is 1177.425(s) and the weight value(the received radio sensitivity) is 81 percent. It can guarantee a stable satellite service and satisfies a suitable distance.

4 Conclusion

In this paper, the path searched should be based on the weight by the received radio sensitivity-centered. And the algorithm search the path in scope(can provision of stable satellite services) for prevents the increase of the distance and the time. This paper proposed the path search algorithm. It guarantees the received radio sensitivity and checks the increase of the distance and the time. It provides an effective and reliable satellite services.

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