Team Control Number

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Summary Sheet.

HF Radio Propagation under Different Terrains

Summary

Even in the satellite era, high-frequency (HF) signal communication still plays an important role in everyday communications. In order to clearly understand the communication process of HF waves and its influencing factors, we first design a mathematical model of signal reflection off the ocean. Based on this model, we build the ground signal reflection model and compare the two. Besides, we study the communication process of vessel receivers on a turbulent sea.

We begin with the establishment of a mathematical model of signal reflection at sea from two aspects. On the one hand, we study the basic loss of the HF sky wave transmission process. On the other hand, we investigate the surface properties of the sea. We classify the ocean surface as a smooth and a rough sea. Based on the Fresnel reflection coefficient equation, we obtain the reflection intensity of rough and smooth sea surface. And their ratio equals to the square of the roughness correction factor. We select specific parameters for getting the specific value. Then we get the first reflection power of rough sea surface is 0.4378mW, and the first reflection power of smooth sea surface is 0.2832mW. The first reflection power of rough sea surface is 0.6469 times smooth sea surface. As a result, using this model, we can easily simulate the multi-hop path of the signal. Taking the selected specific value as the parameter, we calculate the maximum number of hops to 8 times if the signal-noise ratio threshold is not exceeded.

Next, based on the above models, we set up the mathematical model of ground signal reflection. Similarly, we classify the terrain as a smooth terrain and a mountainous terrain. The propagation loss of mountainous terrain is classified as diffraction loss of the mountain and absorption loss of the vegetation. We use Epstein-Peterson method to study the typical double-edged peak diffraction problem. Through comparison of the two models, we conclude that the ocean surface is more suitable for the transmission of shortwave skywaves than land surfaces.

What's more, we introduce the ship sway model to further establish the communication model of the ship receiver at sea. The ship can maintain communication while traveling in the signal coverage. We get the longest communication time by calculating the maximum travel time of the ship in the signal coverage area.

Finally, we prepare a synopsis of the results that are suitable as a short note in IEEE Communications Magazine.

We focus on the transmission process of shortwave skywaves off the ocean. The conclusion can help in the communications of maritime transport and fishing industries.

Keywords: Fresnel reflection coefficient equation, Sea signal reflection model, Transmission loss