Performance Comparison of Space-Time Block and Trellis Codes in the MIMO Land Mobile Satellite Channels

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Abstract—Due to the crowded orbits and shortage of frequency resources, the use of MIMO technology to improve spectrum efficiency and an increase of the capacity have become a necessary trend of broadband satellite communication. Firstly, we analyze the main influenced factors and compare the bit error rate (BER) performance of space-time block code (STBC) scheme and space-time trellis code (STTC) scheme. Then we build up the model of land mobile satellite (LMS) channel under different environments by using 3-state Markov chain. This paper emphatically studies the BER performance of STTC and STBC in the MIMO satellite channel. The main emphasis is placed on the effects of different factors, such as terminal environment and elevation angles, on the BER performance of STBC and STTC schemes. Simulation results indicate that performance of STTC in Rayleigh channel is obviously improved with the increasing number of transmitting and receiving antennas, but the encoder state has little impact on the performance. In the Rayleigh channel, the performance of Alamouti code is better than that of STTC. In the LMS channel, performance of these two kinds of space-time coding in open area is optimal, and in the urban area it is the worst. Nevertheless, performance of STTC is slightly superior to the performance of STBC under different circumstances. Under the same environmental conditions, BER of STTC and STTC reduces with the increase of the satellite altitude angle, and therefore, the BER curves of STTC fall faster.

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1. INTRODUCTION

Satellite communication has great coverage, wide frequency band and flexibility, and it is able to provide disaster emergency services for areas where ground communication facilities are destroyed by earthquake, tsunami or war, thus satellite communication becomes an indispensable effective information transmission means of global communication network.

At present, due to a sharp increase of business and limited frequency spectrum, satellite communication is facing a dilemma. Limited orbit positions force satellite communication to use high power platforms and high bandwidth repeaters, thus the complexity and difficulty are increasing. Applying MIMO [1] technology to satellite communication system can greatly improve the spectrum efficiency, increase the channel capacity and improve the diversity gain.

Without any expansion in the required bandwidth or increase in the transmit power, the MIMO technology can produce the capacity gain only by increasing the number of transmit and receive antennas. In a transparent forwarding satellite communication system, all implementation difficulties of MIMO technology can be transferred to the ground, so a satellite communication system combined with MIMO technique has a good application prospects.

The commonly used channel models of satellite mobile communication include the C. Loo model [2], Lutz model, the Corazza model, etc., which are based on the propagation characteristics of satellite mobile channel. In 1997, F. P. Fontan proposed a simulator for narrowband land mobile satellite (LMS) channel [3], which is based on a three state Markov model. By processing the measurement data of S-band, the simulator

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