Paper ID: 36867
student

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Near-Earth and Interplanetary Communications (6)

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A NOVEL SUPERPOSED FRAME DESCRIPTOR STRUCTURE FOR VCM LEO SATELLITE-GROUND COMMUNICATIONS

Abstract

With relative motion between LEO satellite and ground station, communication link budget varies in the data transmission window following orbital geometry change. To improve the efficiency of space-ground communication system, variable coding modulation scheme (VCM) has been proposed for LEO satellite-ground data transmission system to reduce the link resource waste. The modulation and coding set (MODCOD) information is transmitted in the physical layer frame descriptor (FD) based on VCM protocol. Therefore, the ground station receiver has to detect and decode the FD information for every frame, which seriously reduce the transmission efficiency and increase the receiver demodulation delay. Aiming to this issue, in this paper a novel superposed FD structure is proposed. Instead of placing the FD as part of physical layer header, the FD information is superposed on the previous frame data with superposition coding. Since FD is encoded with first order Reed-Muller code and repetition code over the frame period, it can be accurately recovered under very low signal-to-interference-plus-noise ratio (SINR). Therefore, it only needs to share a small proportion of power with the transmission data. Ground station is able to decode the data and the FD of the coming frame using successive interference cancellation (SIC). As to the low power of FD, its interference to data symbols is limited to an acceptable range. This proposed structure provides better support to parallel processing and helps achieving real-time MODCOD switch. With pre-acquired MODCOD information, ground station receiver is able to make the MODCOD transition smoother when a switch is required for the next frame and also avoiding unnecessary re-setting for the coming frames which keep the same MODCOD. This paper introduces the structure of superposed FD and its implementation. The analysis and system performance simulation results prove that with the proposed structure, the transit period for different CODMOD is significantly reduced, better transmission continuity can be achieved and high data transmission throughput can be kept within a satellite-to-ground data transmission window.