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THE EFFICIENT SELF-ADAPTIVE SNR ESTIMATION METHOD WITH MINIMAL RESOURCE COST FOR MARS EXPLORATION

Abstract

Mars is the next milestone in our exploration of solar system. Because of the really long distance, 20 minutes are needed to transmit a message between Mars and earth. Therefore a total automatic communication system is needed between the Mars rover and orbiter. In order to maximize the transmission of valuable data information within the visible arc, the communication system needs to accurately identify the dramatic changes in the receiver's SNR caused by the real-time changes in relative distance and relative attitude, and adjust the bidirectional code rate in real time, almost to maximize the transmission of data within the Shannon limit of the channel. The traditional SNR estimation algorithm either has high estimation accuracy but consumes a lot of resources, or has less resources but the estimation accuracy is low. None of them can meet the requirements of deep space exploration missions represented by Mars exploration. In this paper, the efficient self-adaptive SNR estimation method with minimal resource cost for Mars exploration is presented, which could take advantage of the characteristics of Manchester code in PM modulation defined by CCSDS prxomity-1, and only use adder and look-up table to realize algorithm functions, so as to achieve SNR estimation accuracy of 0.02dB under the premise of greatly saving hardware resources. The method is also used in Chinese first Mars exploration mission (TW-1). By using the conception product with limited FPGA resource, real test shows that the presented method performs well in any possible communication arc.