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Investigation of "Direct Sequence Spread Spectrum" Technologies for Satellite Applications.

ABSTRACT - Masterthesis

In this thesis, we investigate a system based on direct sequence spread spectrum (DSSS) with BCH error correction codes and QPSK modulation technique to protect the system for unnecessary errors in satellite applications. Direct sequence spread spectrum is a method for communication systems, in which source coded data with different error correction is being transmitted, and is spread over the whole band-width of the system. In such systems, we can spread the data and put the energy level of this sequence below the noise level. Furthermore the transmitted signal is cryptic and heavy detectable to third parties. Among the possible ways to achieve the best solution of an errorless communication, we first introduce the limits of AWGN channels mentioned by Shannon. Moreover the basics and the mathematically derivation of the channel capacity and band-width efficiency are described in detail and we show the analysis of such fundamentals in a visualized design.

Additionally, we also investigate the application of graph-based BCH codes for DSSS systems. First different varieties of BCH error corrections are implemented and evaluated with the corresponding advantages and disadvantages. By means of such error correction codes, the restriction of codeword lengths and message lengths is necessary to guarantee correct a calculation of the whole system.

As a third contribution to DSSS systems, we introduce a whole schematic and analysis of the DSSS system of unnecessary error protecting via BCH error correction codes. We derive each structure for the transmitter, channel and receiver and also propose a fourth scheme, where we investigate multipath propagation of Rayleigh fading channels in DSSS systems. Compared to white noise, which has a constant spectral density, Rayleigh fading models assume that the magnitude of a signal that has passed through a transmission channel will vary randomly or fade according to a Rayleigh distribution.

Within this framework the spread code of the DSSS system is implemented twice. It can vary between a linear feedback shift register or a Walsh-Hadamard-Code, which are different in their orthogonality structure and have different advantages and disadvantages for each application.

In the last part of the thesis, we investigate on the basis of the simulations that the proposed system shows a significant reduction of errors caused by encoding the messages that correspond to unspread QPSK modulated patterns, as well to spread QPSK modulated patterns and of course to correctable QPSK modulated patterns via BCH error correction codes. Due to get more practical and realistic simulation results, the Rayleigh fading channel model is replaced as transmission channel. This channel has no direct path to the receiver, whereas multipath propagation is achieved with different path delays and gains.