Abstract

Coherent Schemes for Improved Acquisition and Tracking of the Pseudonoise in Direct-Sequence Spread-Spectrum Systems

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By

Seksan Laitrakun

B.Eng, Sirindhorn International Institute of Technology, Thammasat University, 1997

In this thesis, we consider coherent schemes for code timing synchronization for direct-sequence spread-spectrum (DS/SS) systems in a Gaussian noise environment. Two modified coherent delay-locked-loop (DLL) tracking circuits with branch section algorithms and a coherent acquisition with sectional code phase estimator are proposed.

A DLL with four chips pull-in range is considered. A conventional extended DLL suffers from large tracking jitter noise and mean time to lock. Both problems can be mitigated by using DLL with a branch selection algorithm. In such schemes, the received signal is correlated with local pseudonoise (PN) signals with code phases separated by one chip. The two local PN signals with correlator branches are then selected for used in the tracking process. In previously proposed schemes, the probability of correct branch selection is low. Therefore, we proposed two DLLs using modified branch selection algorithms, called PelDLL and PerDLL, in order to improve the probability of correct branch selection. Both proposed schemes consist of three correlator branches, each correlates the received signal with a designed local signal. For PelDLL, the local signal is the difference between the advance and delay versions of PN signal with early-late spacing, with different timing reference for each correlator. Only the branch possessing the maximum absolute correlation value is selected to further track the incoming code phase. For PerDLL, the local signal is a summation of many advanced and retarded PN signals with different gains, with different timing reference for each local. The PerDLL chooses the branch possessing the minimum absolute value to further track the incoming signal. The selected branch behaves like a early-late PN signal. Expressions of the probability of correct branch selection are derived and evaluated. Results under various parameters show the improvement obtained by the two proposed schemes.

A new coherent acquisition with sectional code phase estimator is also proposed. The proposed scheme consists of two parts: a sectional code phase estimator and an alignment detector. In the sectional code phase estimator, there are several correlator branches, each correlates the received signal with an auxiliary signal. The correlation outputs are used to estimate the section in the uncertainty region that the incoming code phase is most likely located. The estimator supplies the estimated section to the alignment detector, where the code phases in the estimated section are searched for the correct code phase in a serial manner. The sectional code phase estimator periodically supplies a new estimated section until the correct code phase is found by the alignment detector. Expressions of the probabilities of correct estimate and various associated probabilities are derived and evaluated. The performance of the proposed coherent acquisition is measured using the mean and variance of the acquisition time. Comparisons to the conventional single dwell serial search scheme are inspected under various situations. Results show that the several folds of improvement can be obtained.