Advanced Digital Communications (EQ2410)

Lecture 9, Period 3, 2016

Task 1 Consider a set of short spreading sequences $\boldsymbol{s}_1, \boldsymbol{s}_2, \ldots$ with length N and elements $s_i[k] \in \{-1, +1\}$.

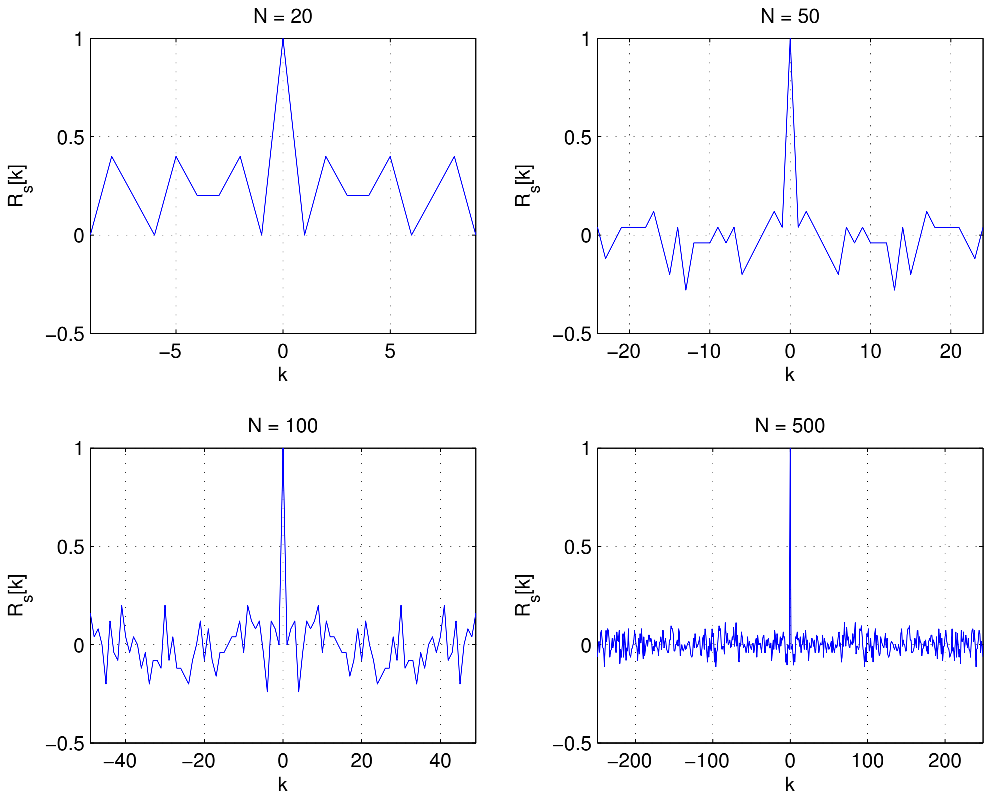
1. For a given N, how many orthogonal spreading sequence do exists such that

$$\begin{aligned} \langle \boldsymbol{s}_i, \boldsymbol{s}_j \rangle &= N, \text{ if } i = j, \text{ and} \\ \langle \boldsymbol{s}_i, \boldsymbol{s}_j \rangle &= 0, \text{ if } i \neq j? \end{aligned}$$

2. For $N = 4$, give an example for the a set of orthogonal spreading sequences!

3. What happens to the orthogonality if the spreading sequences are not synchronized (e.g., since they are shifted by one chip)?

Example The following plots show the (normalized) discrete-time autocorrelation functions for random spreading codes of length $N \in \{10, 25, 50, 100\}$.



Task 2 Explain why long spreading sequences have better autocorrelation properties.

Task 3 How can the rake receiver from slide 12 be realized by a matched filter $S_{MF,m}(t) = s(m; -t)$, a tapped delay line, and a sampler, sampling with symbol rate $1/T$. Consider a simple example with $L = 3$. What happens if the timing of the sampler is not exact?