Simple CDMA: Decoding the Secret Message

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***Abstract*—The purpose of this project was to decode a secre message received from a simple CDMA system. The forwar block diagram was given, so recovering the original messag from the received signal required reversing a root raised cosin filter, finding timing offset by correlating with the m sequence upsampling, descrambling, correcting phase offset, applying th 8-ary Hadamard transform to decode, demodulating, and con verting from binary to decimal to characters to ultimately fin the secret message "I've got a theory, it could be bunnies...", quote from Buffy the Vampire Slayer.**

***Index Terms*—CDMA, Hadamard, m-sequence**

I. Introduction

Code Division Multiple Access is a channel access metho that relies on spread spectrum technology and coding scheme to allow several transmitters to send information over on communication channel simultaneously. In direct sequenc CDMA, the user signal is multiplied by a pseudo-noise se quence of high bandwidth. Common spreading sequences ar M sequences and Walsh/Hadamard sequences. M or maximum length sequences are generated with a linear feedback shift register. The taps that generated the m sequence used to spread this signal were [8 7 6 1] corresponding to a generator polynomial of $G(X) = X^8 + X^7 + X^6 + X + 1$. Walsh/Hadamard spreading was also used to spread this signal. Walsh/Hadamard codes are perfectly orthogonal, making them optimal for avoiding user interference.

II. Methods

A. Unfilter

The received "Rcvd" was filtered using the root raised cosine filter taps given.

B. Find Start of Symbol

An m-sequence was generated from the taps given. The unfiltered received signal was then correlated with an spread version of this m-sequence to find where the symbol began. The maximum correlation was found to be at x = 1044.

C. Downsampling

The unfiltered, received signal was then downsampled by 4 beginning at the 1044th element.

D. Descramble

To descramble the signal, the m-sequence was applied by multiplying a version repeated enough times to that it was the same length as the signal by the signal.

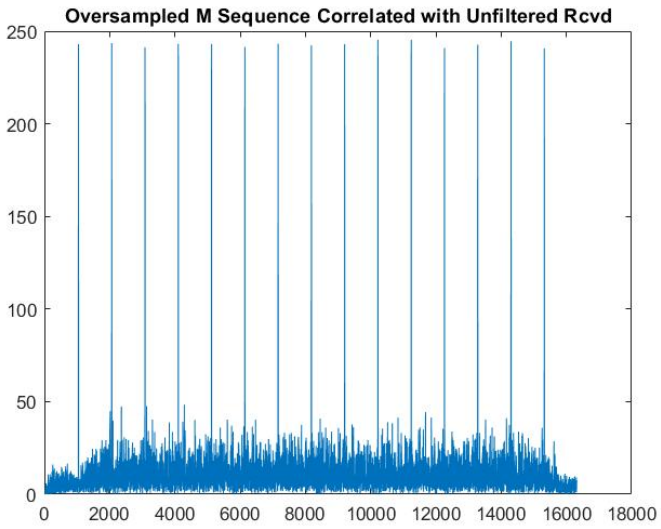

Fig. 1. Correlation between the unfiltered received signal and the spread m sequence.

E. Phase Offset

At this point, the angle of each chip was found. The imaginary art of its conjugate was multiplied by it in order to rotate the signal to the positive x axis.

F. Reshaping and Applying Hadamard

At this point, the signal is in a vector, so it must be arranged into frames. The number of complete frames remaining is found, the frames are arranged so each takes up one column. Each frame is 255 chips, and a maximum of 192 chips per frame carry data (the last 63 or more are zeroes). Thus, the first 192 chips are taken from the signal. The chips are then arranged so that there are 8 per column, making it possible to apply the 8-ary Hadamard matrix. The 8-ary Hadamard matrix was obtained with the MATLAB Hadamard function. It was applied via matrix multiplication of the reshaped signal and the generated matrix. The output is the decoded signal.

G. BPSK Demodulate

The MATLAB built-in pskdemod function was used to demodulate the decoded signal.

H. Binary to Characters

The message was stored on Walsh Channel 5, so the 6th column of the demodulated, decoded data was taken. This was

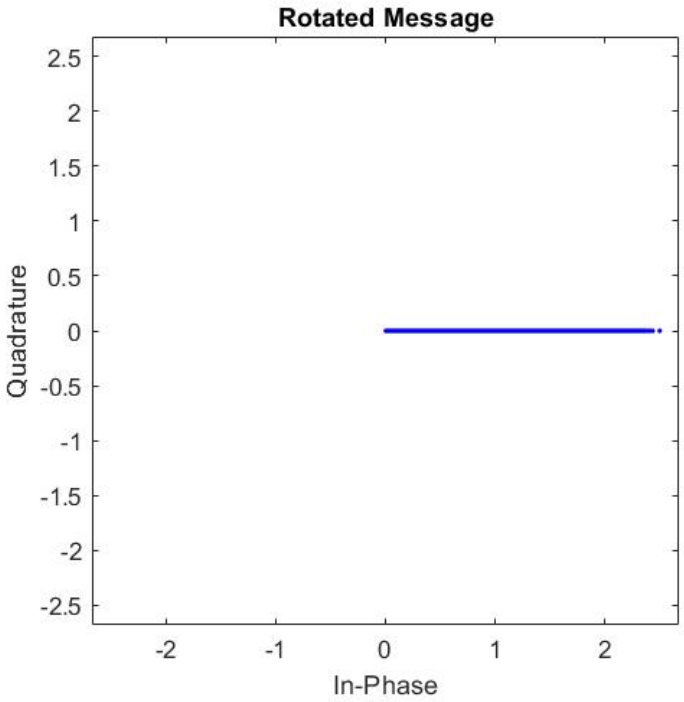

Fig. 2. Unfiltered, upsampled, rotated message. Ready to be reshaped and decoded.

then converted from binary to decimal with the built-in bi2de function. The result was converted to characters using the char function. The result was the Secret Message.

III. Results

The decoded Secret Message was "I've got a theory, it could be bunnies...", a quote from Buffy the Vampire Slayer.

Acknowledgment

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References

$http://in.ncu.edu.tw/ncume_ee/digilogi/prbs.html$