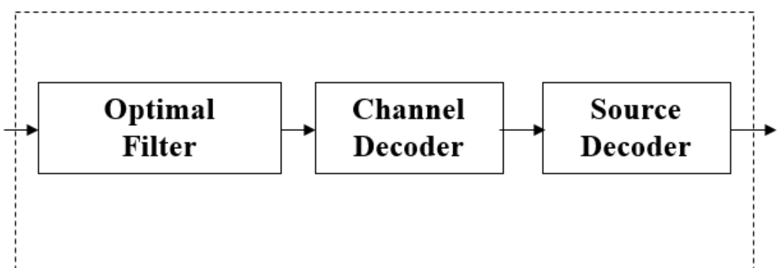
ESE 471 Assignment #4

Receiver Design

Assigned Date: April 15, 2016

Due Date: April 27, 2016 in class.

We now turn our focus to the receiver, which is depicted below. There are three boxes in the receiver, just like we had three boxes in the transmitter. The box labeled as the "channel decoder" decodes (i.e., reverses) the channel-encoded bit sequences. For example, if the channel encoder used a 3-bit repetition code for the forward error correction, the channel decoder takes three bits at a time and makes determination as to whether "1" or "0" was sent based on the majority rule. Similarly, the box labeled as the "source decoder" reverses the source encoded bit sequences to obtain the original binary bit sequence, e.g., NY Times article before the source encoding.

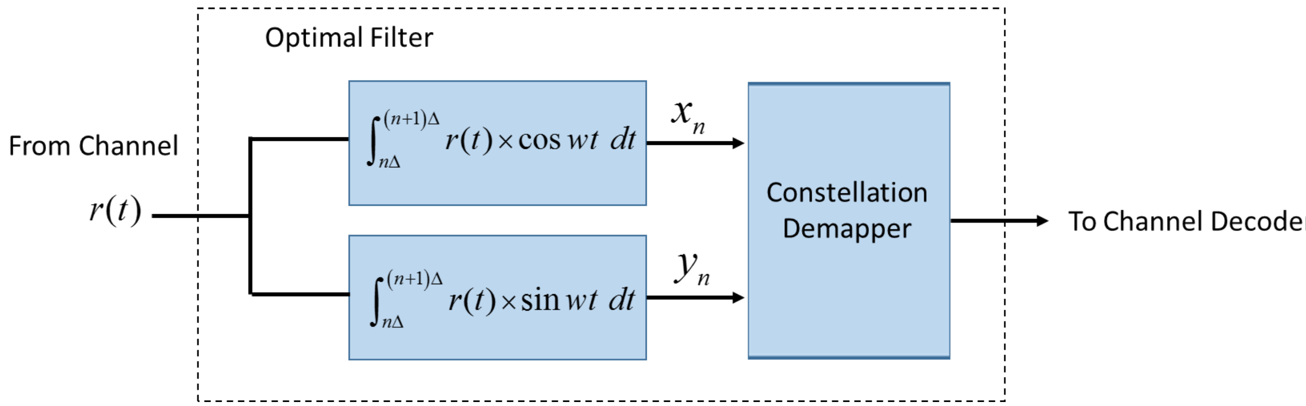


The box labeled the "optimal filter" is the focus of this assignment.

In assignment 3, your group mapped the channel encoded bit sequence into three different constellations. Each of the three mappings resulted in a 12 microsecond-worth of physical signal comprising sine and cosine waves at 2 Mhz.

Assume now that these 12 microsecond-worth of physical signals were received at the receiver. In reality, these physical signals would be corrupted with noise and would be attenuated while coming through the channel. In this assignment, you may assume that the physical signals arrive at the receiver as they were sent by the transmitter, without noise and without attenuation.

An optimal filter is a filter that extracts the binary signals (i.e., 1s and 0s) from the received physical signals (sines and cosines) in an optimal way. For example, the following corresponds to an optimal filter for the signal mapping methods used in your assignment 3.



r(t) is the physical signal received from the channel. For signal mapping method 1 of assignment 3, $n = 0, 1, 2, \ldots 11$ and $\Delta = 1$ mircosecond. In the constellation demapper, the results of the integration, i.e., x_n and y_n are compared with the positions in the BPSK constellation, and determine the position (out of the two in the constellation), which is the closest. Out of the constellation demapper is the channel coded bits to be send to the channel decoder. For signal mapping method 2, $n = 0, 1, 2, \ldots 5$ and $\Delta = 2$ mircoseconds, and the QPSK constellation is used. For signal mapping method 3, $n = 0, 1, 2, 3,$ and $\Delta = 3$ mircoseconds, and the 8QAM constellation is used.

<u>To do:</u>

Your group will use the physical signals generated from your last assignments. Design the optimal filters for the three different physical signals received, each of which is based on one of the three constellations.