

# Design and Implementation of an Adaptive 256-QAM Receiver

ECE 4601 Project, Fall 2003

## Introduction

In this project you will design and implement a 256-QAM receiver in MATLAB, complete with synchronization and adaptive equalization. Attached you will find the MATLAB routine `send.m` that implements the corresponding 256-QAM transmitter. The routine `send.m` starts with a black-and-white JPEG image “mystery.jpg”, which is unknown to you, and transforms it into a continuous-time 256-QAM signal suitable for transmission. In lecture you will witness a demonstration of how this signal is sent from the speaker of the transmitting computer to the microphone of the receiving computer. The receiving computer records what it hears and saves it to a file. Your job is to write the MATLAB code that processes this audio file so as to recover the source image.

## Objective

To recover and display the mystery image.

## Collaboration

You may work with one other person, or you may work alone. If you choose to work as a team, you must register the name of your teammates by sending e-mail to [barry@ece.gatech.edu](mailto:barry@ece.gatech.edu) before October 31, 2003. No teams may be formed after this date.

## Report

Summarize your design strategy, results, insights, and conclusions in a brief written report. Six or fewer well-written pages should suffice, including figures. Succinctness will be rewarded, and excessive length will be penalized. A lot of information can be conveyed in 6 pages, if you choose your words and figures carefully.

If you work in a team, you must include a section describing the specific contributions made by each member of the team.

The report should contain two appendices, not included in the page limit of six pages: first, a well-documented version of your computer code; and second, this handout.

## Grading Criteria

The project will be graded according to several criteria, including the quality of the design, the achieved performance, the organization and clarity of the report, etc.

## Deadline

A hardcopy of the report is due no later than 6:00 pm on December 4, 2003. Late reports will be accepted only via email, and they will be assessed a penalty of 10% per hour after the deadline.

```
%-- SEND.M: a 256-QAM transmitter for ECE4601, Fall 2003 PROJECT -----%

Rsample = 22050;          % computer sample rate, in Hz
Ltrain = 1000;           % number of training symbols to transmit
f0 = 6000;              % carrier frequency in Hz
q = 8;                  % q = number of samples per baud; baud rate = Rsample/q.

[re,im] = meshgrid(-15:2:15,-15:2:15); alphabet = re(:) + 1i*im(:);

image = imread('mystery.jpg');

Lmsg = prod(size(image));

bits = dec2bin(double(image(:)),8) - '0';

rand('state',0); scramble = round(rand(Lmsg,8));

bits = rem(bits + scramble, 2);

a = alphabet(1 + bits*2.^(0:7).');

rand('state',0); train = alphabet(ceil(256*rand(Ltrain,1)));

chips = [[train.' a.']; zeros(q-1,Ltrain+Lmsg)]; % insert q-1 0's btwn ea symbol

g = sinc((-20*q : 20*q) / q);

s_tilde = conv(g, chips(:));

vco = exp(2i*pi*f0*(1:length(s_tilde)).'/Rsample);

s = real(s_tilde .* vco);

s = s/max(abs(s));

input('Start recording at receiver, then hit return to begin transmission ... ','s');

sound(s, Rsample)

disp('Done. Stop recording at receiver.');
```