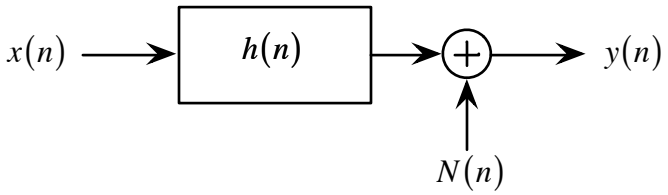
EE3318 Project (Team of 3)
Due Date: 5/7/2015 (Th)

Title: Digital channel sounding and noise filtering

Introduction:

A digital wireless communication channel can be modeled as a discrete-time LTI system with additive noise. The following figure shows the block diagram of the channel model in which $x(n)$ is the transmitted signal, $h(n)$ is the channel's unit sample response, $N(n)$ is the noise, and $y(n)$ is the received signal. The effects of additive noise could be reduced via noise filtering.



Objectives:

The objectives of this project are:
(1) to estimate (must ensure convergence) the amplitude frequency-response of a digital wireless channel between a transmitter and a receiver in the frequency range of 200 Hz to 14 kHz.;
(2) to design a digital filter for reducing additive noise in the wireless transmission of telephony speech signal;
(3) apply the filter for transmission of telephony speech signal (300 Hz – 3300 Hz), the duration of the speech signal is at least 10 seconds.

Project requirements:

(1) Estimate the frequency-responses of the channel for a transmitter-receiver distances of 5 m at the following locations: (a) on a bridge above Cooper St., (b) inside the classroom.
Design the test setup using two laptop computers; and develop and implement associated algorithm in MATLAB. (note: you should use single-channel external speaker and microphone)
(2) MATLAB functions: the use of advanced Matlab functions is permitted provided that you understand and able to explain how the functions work (including theory and implementation). Otherwise, no credits for parts of the project that utilize those functions.
(3) A sampling rate of 36,000 samples/sec should be used in this project.

Tasks:

1. Perform theoretical study of the problem; develop problem formulation and explore potential solution approaches.
2. Perform block diagram level design for your system.
3. Develop a high level algorithm (sketch the flowchart) for this project; identify major functions/operations for the entire program.
4. Develop and validate the computer program in Matlab.
5. Analyze and present the measurement results.
6. Demonstrate the channel sounding and noise filtering system.
7. Analyze and demonstrate the digital transmission system.
8. Submit a project report (in MS Word) with at least the following sections (i.e. follow the IEEE format):
   - Abstract of this study
   - Introduction (i.e. address Who cares? What has been done? And what you are proposing)
   - Theory section which includes
     (i) brief descriptions of the concepts wireless channel, channel response, channel sounding, and additive noise
     (ii) descriptions of your channel sounding and noise filtering methods
     (iii) identify and explain the relevant MATLAB functions for your methods
     (iv) description of your equalizer and filter design
   - Validation and result analysis (i.e. prove that your approach/method works)
   - Summary/Conclusions of this project
9. Submit the project report (printed copy) in class and email the GTA the electronic file for the report along with the complete MATLAB program.
10. Be prepared to provide a short (< 5 min) presentation and demonstration of your project.

Grading:

Project report: 50%
- Correctness (does your method work?): 50%
- Solution/design with theoretical justification: 15%
- Results validation, analyses, and conclusions: 15%
- Quality and structure of the report (including technical writing, graphics/tables, and references/citations): 20%

Presentation & demonstration: 50%
- Project demonstration (work?): 50%
- Presentation (content, flow, clarity; does analysis results support conclusions?): 20%
- Team work (including all team members understand project details, how the team work together): 10%
- Ability to address technical concerns and answer questions: 20%