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# Single Channel Estimation Algorithm for Acoustic OFDM Communication Systems

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Acoustic Testbed for Network/Communication Applications

Motivation

- **Inexpensive, easy to program wireless communications infrastrcture**
- **Used to validate algorithms for a variety of wireless communication environments**
  - point to point cellular communications
  - cooperative communications
  - multiple-input/multiple-output systems
  - underwater acoustic communication
  - ultrawideband communication
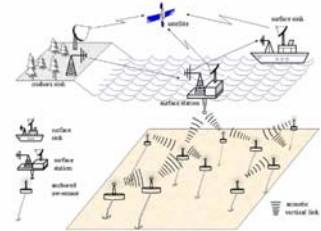
System Hardware

Hardware Specifications

- **M-Audio Delta 1010 24 bit 96 kHz Digital Recording System**
- **SM Pro Audio PR8-MK2 8-channel mic-line preamp**
- **Behringer Studio C-2 Condenser microphones**
- **PC with Matlab/Simulink and speakers**

State of Development: Orthogonal Frequency Division Multiplexing Point-to-Point Link

OFDM Communication

- **Cyclic Prefixes**
  - A segment from the end of data, whose length is longer than the channel impulse response, is repeated at the beginning, thus *eliminating the effects of intersymbol interference (ISI)*
- **Orthogonality of Sub-Carriers**
  - OFDM uses multiple carrier frequencies simultaneously; since they are orthogonal to each other, there is no interference from adjacent subcarriers. This *efficiently uses the available bandwidth*.

Channel Modulation Experiment

- **OFDM Modulator**
  - Messages created by randomly generated QPSK symbols
  - Signal sent over 2048 subcarriers
  - Cyclic prefix 512 samples long
  - Suppression carrier 200 samples long

- **Start of Frame Detector**
  - OFDM block synchronization algorithm evaluates the autocorrelation between two sequences to determine the start of the message

- **OFDM DeModulator**
  - Received signal compared with original message to create frequency channel response

Experiment Results

Experiments performed at USC's UltRa Lab
Sampling Rate - 22050 Hz
Baud Rate – 2000 symbols/sec
Carrier Frequency – 5000 Hz

Frequency Response over Time