Final Project Introduction

NTU communication lab

Spring 18

Directions for Final Project

- Single USRP:
  - Audio streaming system
  - Video streaming system
  - ZigBee(900 MHz) Receiver implementation
- Two USRPs:
  - MIMO-STBC
  - MIMO-OFDM
  - Spectrum sensing system
  - Distributed communication system
  - Multiple access communication
  - Gesture recognition

Audio Streaming

- Challenges:
  - Convert analog audio data to digital audio data
  - Real-time transmission
- Resources:
  - LabVIEW real time module
  - LabVIEW built-in audio player (wav. only)

Video Streaming

- Challenges:
  - Real-time transmission
  - Smoothness of display quality
- Resources:
  - LabVIEW Vision development(.avi)
  - LabVIEW Vision acquisition(USB camera)

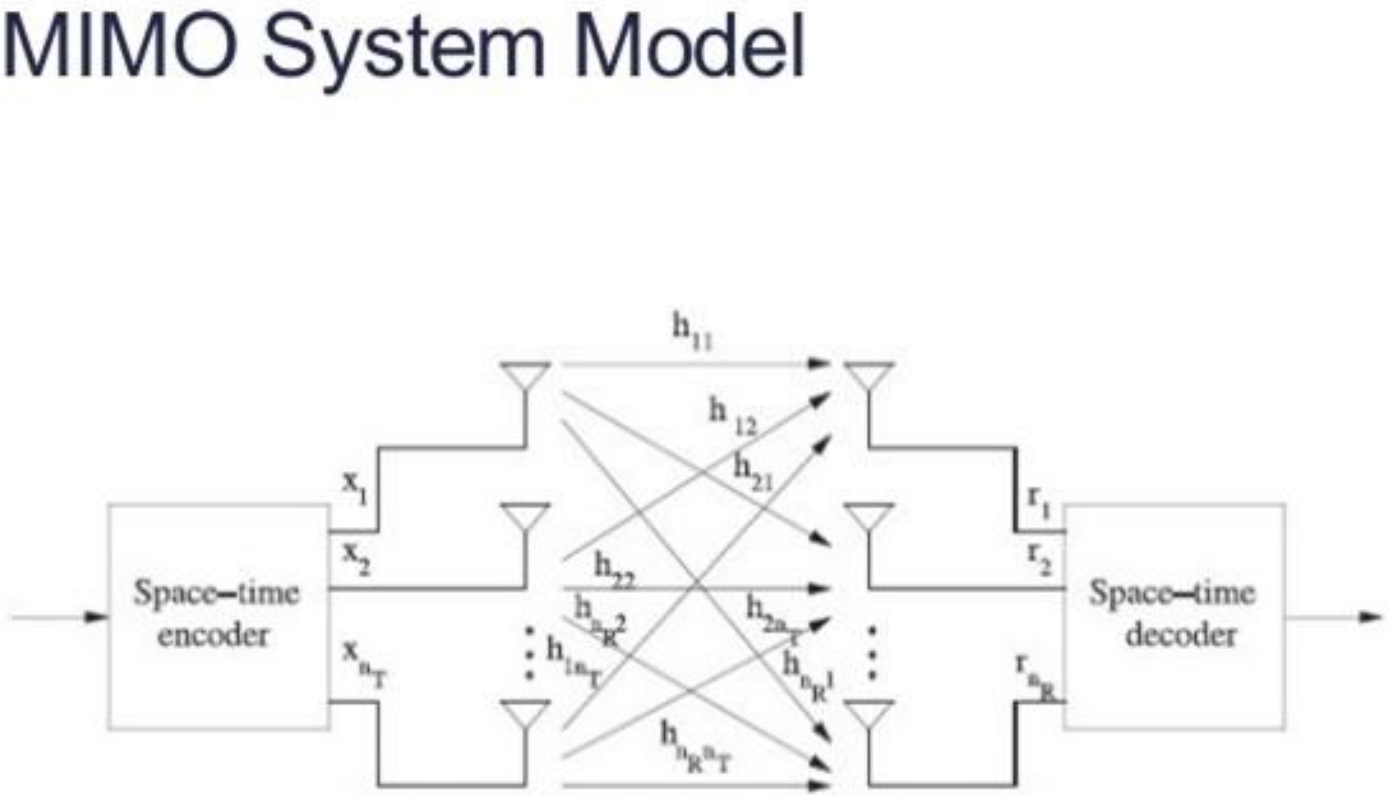
ZigBee(900 MHz) Receiver Implementation

- Challenges:
  - Receive signals from commercial communication devices (ZigBee)
  - Building receiver from scratch
- Resources:
  - A pair of ZigBee commercial devices
  - 802.15.4 standard document
  - XBee device software

Source: https://www.digi.com/

MIMO-STBC

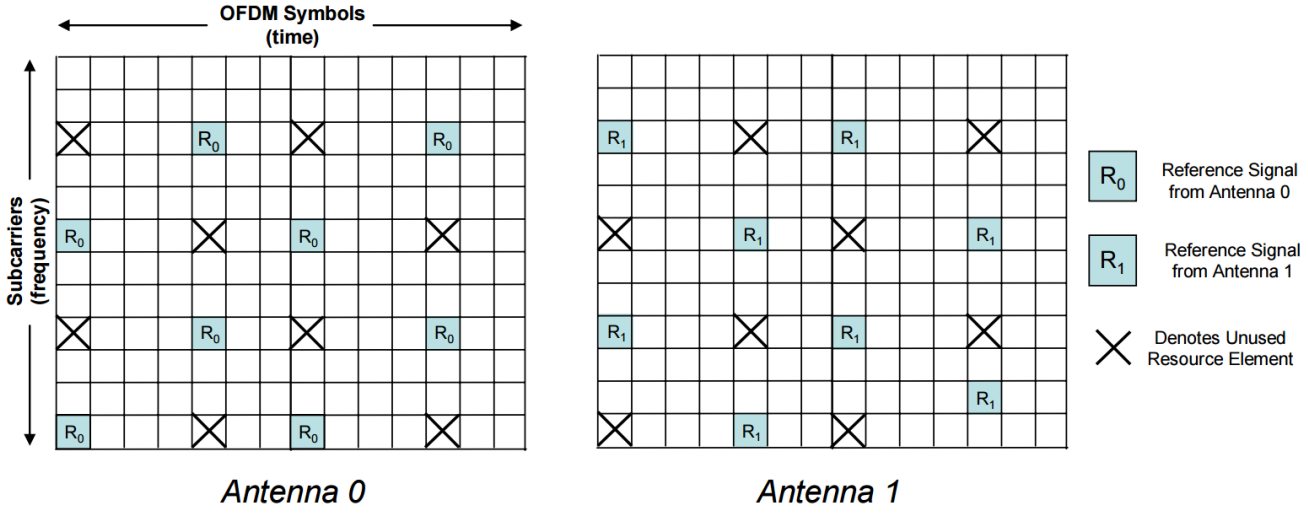
- Challenges:
  - Space-time block codes among multiple antennas
  - MIMO transmission
- Resources:
  - NI-MIMO cable
  - Template of LabVIEW MIMO script



MIMO-OFDM

- Challenges:
  - Space-time codes among multiple antennas
  - OFDM subcarriers across antennas
- Resources:
  - NI-MIMO cable
  - Template of LabVIEW MIMO script

Figure 2.4-3 Reference Signals Transmitted Sequentially to Compute Channel Responses for MIMO Operation

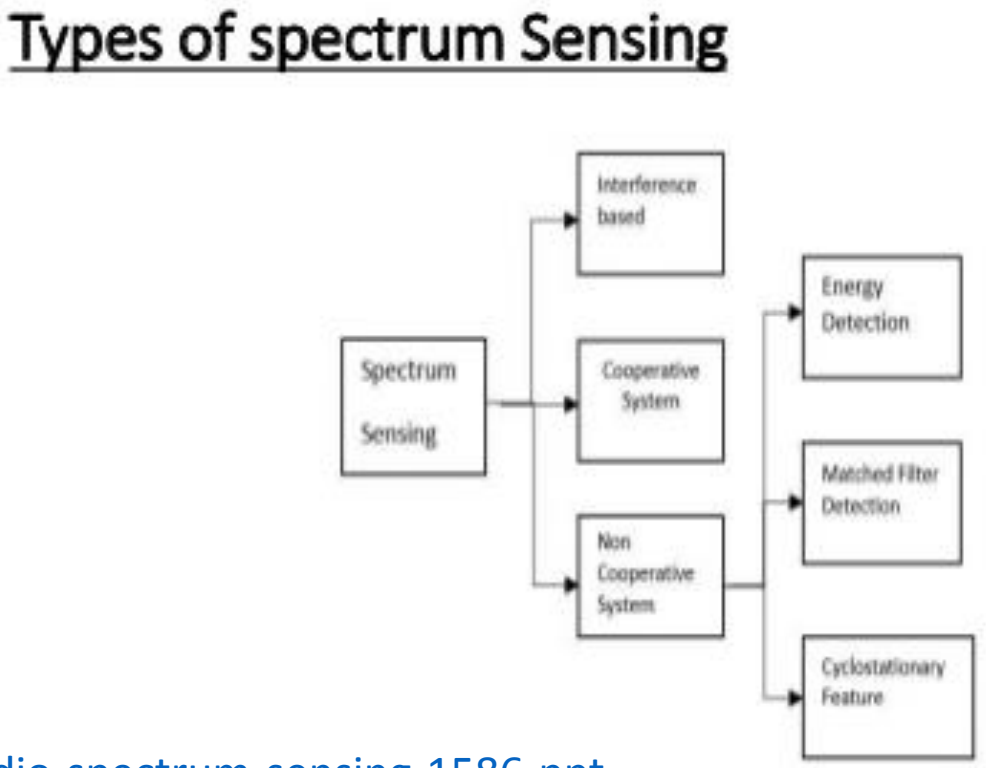


In order to successfully receive a MIMO transmission, the receiver must determine the channel impulse response from each transmitting antenna. In LTE, channel impulse responses are determined by sequentially transmitting known reference signals from each transmitting antenna as shown in Figure 2.4-3.

[1] Jim Zyren, "Overview of the 3GPP Long Term Evolution Physical Layer," 3GPPEVOLUTIONWP, 2007

Spectrum Sensing

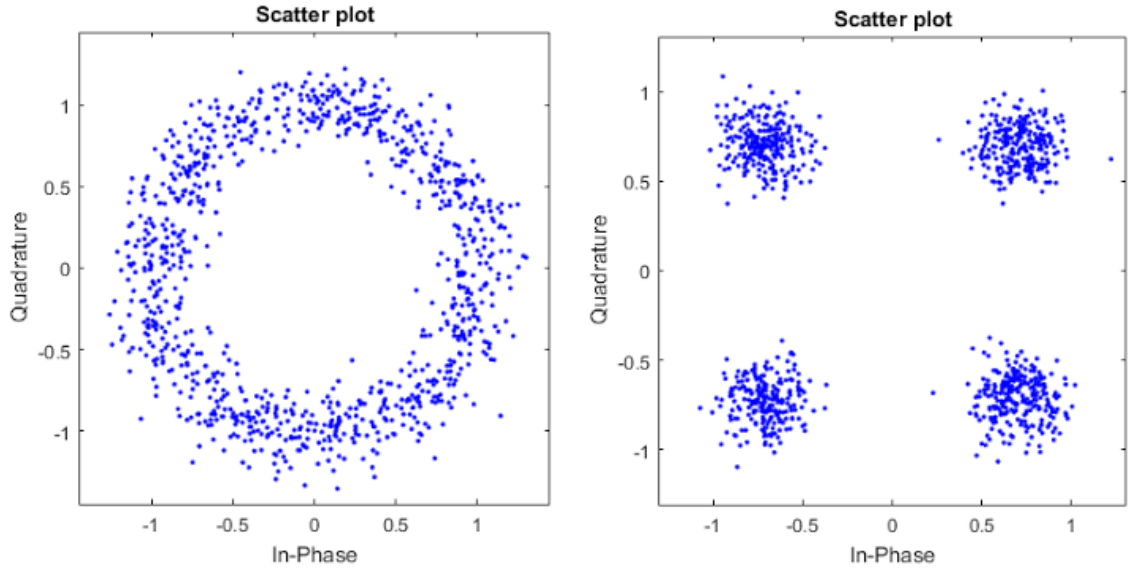
- Challenges:
  - Sense the spectrum occupancy
  - Spectrum sensing accuracy
- Resources:
  - Cognitive Radio research
  - Cognitive Radio Techniques on NI USRP



[1] https://chandrahaststy.github.io/Cogintive-Radio/#ss
[2] https://www.slideshare.net/AnupamYadav15/cognitive-radio-spectrum-sensing-1586-ppt

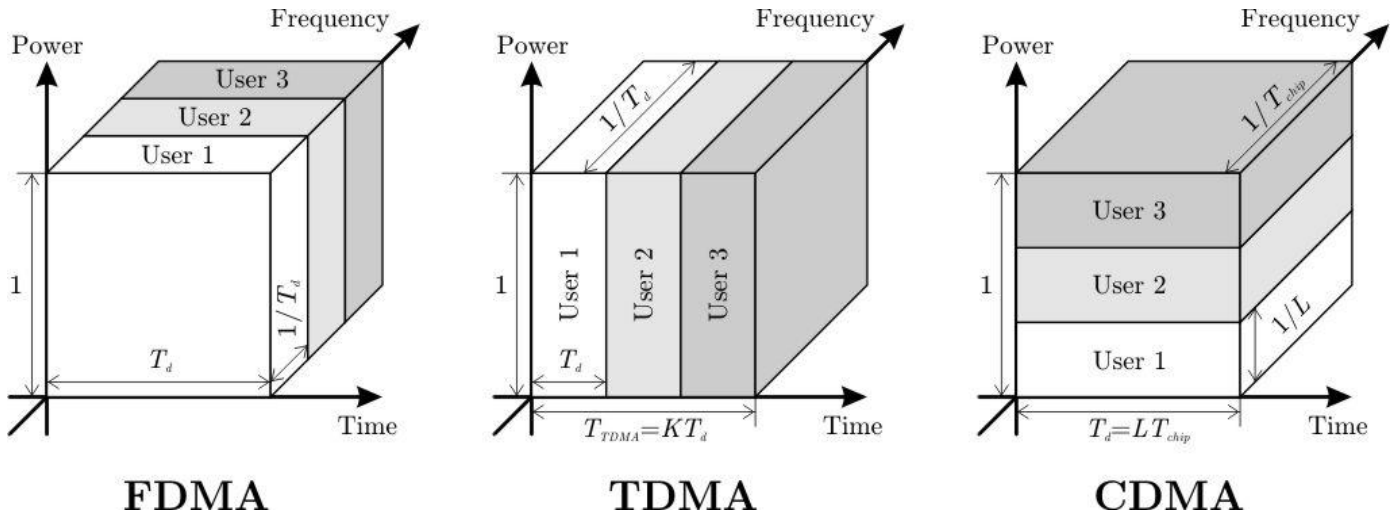
Distributed System

- Challenges:
  - Clock recovery and carrier frequency offset correction
  - Construct reliable wireless communication
- Resources:
  - [1] Digital communications: a discrete-time approach
  - GNUradio Doxygen



Multiple Access Communication

- Challenges:
  - Implementation of schemes such as: TDMA, FDMA, CDMA.
  - Handshaking protocols implementation
- Resources:
  - LabVIEW Synchronization modules
  - MIMO cable



Gesture Recognition

- Challenges:
  - Tracking Doppler shift and multipath distortion
  - Differentiate movements from received signals
- Resources:
  - WiSee
  - MIMO cable

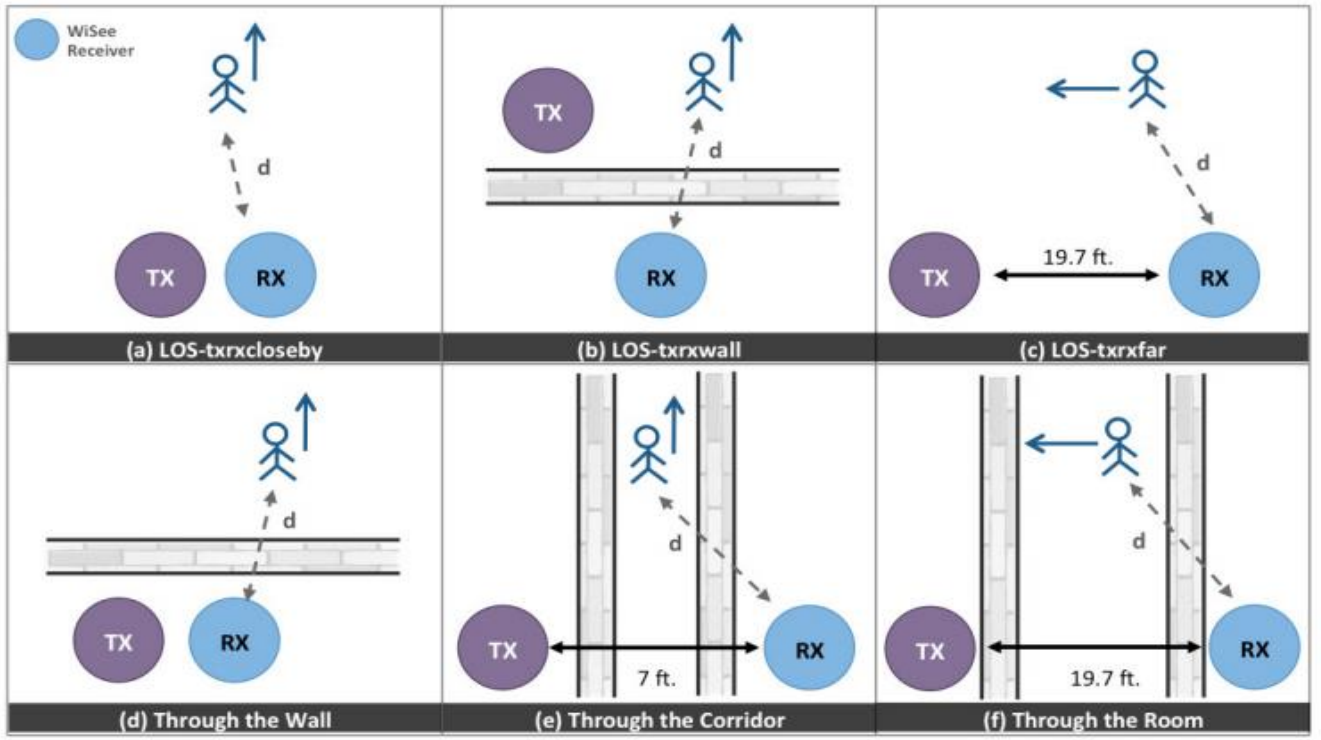


Figure 8—Scenario layouts.

1. Qifan Pu, Sidhant Gupta, Shyamnath Gollakota, and Shwetak Patel. 2013. Whole-home gesture recognition using wireless signals.

Other references

- Shyamnath Gollakota, Samuel David Perli, and Dina Katabi. 2009. Interference alignment and cancellation. SIGCOMM Comput. Commun. Rev. 39, 4 (August 2009), 159-170.
- Shyamnath Gollakota and Dina Katabi. 2008. Zigzag decoding: combating hidden terminals in wireless networks. SIGCOMM Comput. Commun. Rev. 38, 4 (August 2008), 159-170.
- Qifan Pu, Sidhant Gupta, Shyamnath Gollakota, and Shwetak Patel. 2013. Whole-home gesture recognition using wireless signals. In Proceedings of the 19th annual international conference on Mobile computing & networking (MobiCom '13). ACM, New York, NY, USA, 27-38.
- Massey JW, Starr J, Lee S, Lee D, Gerstlauer A, Heath RW. Implementation of a real-time wireless interference alignment network. In Conference Record - Asilomar Conference on Signals, Systems and Computers. 2012. p. 104-108. 6488968.