Machine Learning Classification of Wireless Communication Signals

SenSIP Algorithms and Devices REU

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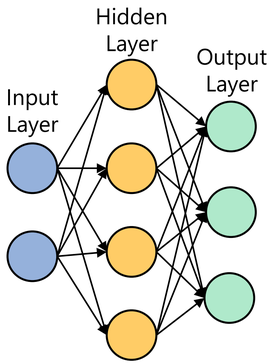
ABSTRACT

- Machine learning enhances classification efficiency of wireless transmissions
- Classification reveals transmission techniques for signal decoding
- Applications: Cognitive radios, QoS, and military uses

MOTIVATION

Civil Applications

- Improve data traffic management
- Optimize cognitive radios and quality of service (QoS) of transmissions



Military Applications

- Transmission schemes are generally unknown
- Signal classification necessary for decoding

MIMO

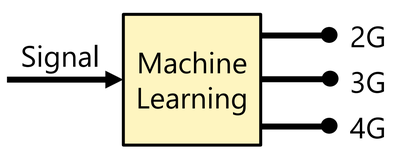
- Increases transmission rates, reduces bit error rate

Artificial Intelligence/Machine Learning

- Using algorithms to automate signal classification

PROBLEM STATEMENT

- Detect signals with LimeSDR
- Use convolutional neural networks to classify signals as 2G, 3G, or 4G (LTE)

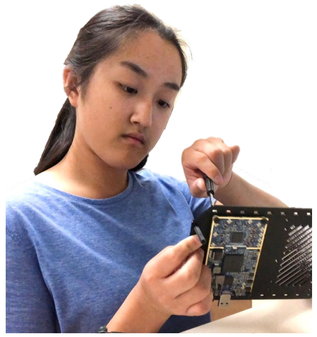


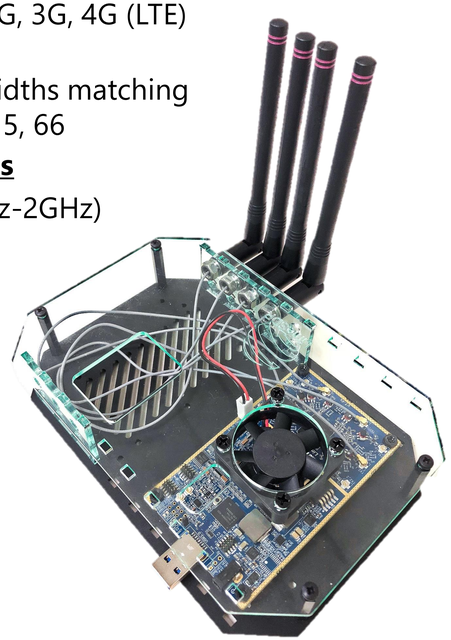
METHODS

- Manual scanning of 2G, 3G, 4G (LTE) frequency bands
- Identify signal bandwidths matching standards of Bands 2, 5, 66

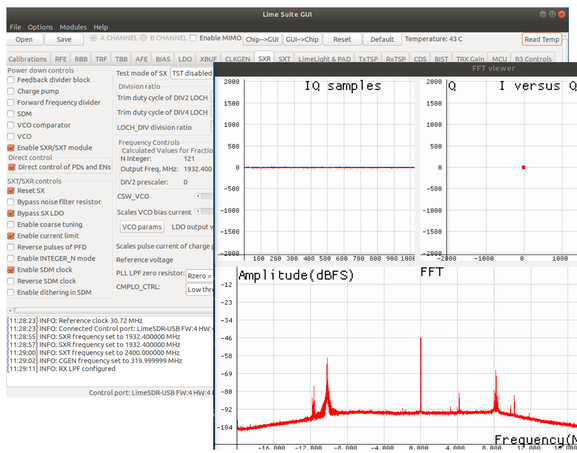
Antenna Configurations

- **Rx**: Wideband (10MHz-2GHz)
- **Tx**: All Frequencies





- Using LimeSuiteGUI interface to operate LimeSDR-USB



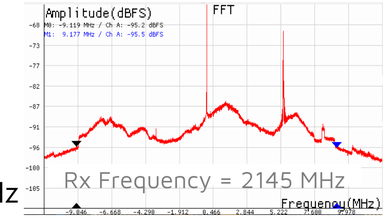
FFT Viewer

PRELIMINARY RESULTS

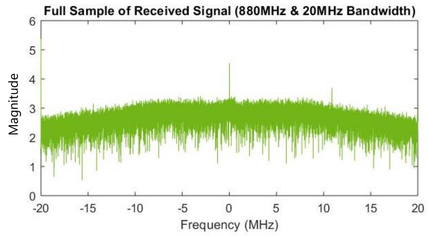
LimeSuiteGUI

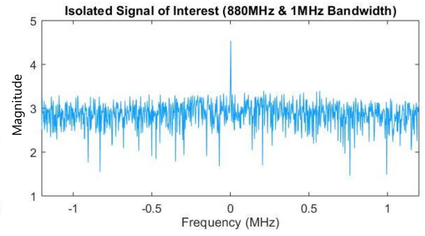
Frequencies of Interest:

- Band 2: 1932.4, 1934.4 MHz
- Band 5: 880.0, 890.9 MHz
- Band 66: 2115.4, 2127, 2145 MHz



MATLAB





- Signal recreated in MATLAB with LimeSuiteGUI I/Q samples
- Determined specific channels to isolate signals

CONCLUDING REMARKS

What I Learned:

- SDRs use software to implement hardware components

Next Steps:

- Switch to signal transmissions simulated by USRPs
- Analyze signal samples for features; train machine learning

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