Machine Learning for Reliable MIMO Systems

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MOTIVATION

Open problems in MIMO communication:

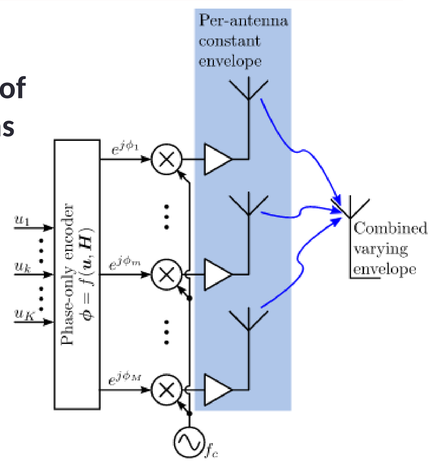
- **Coordination of adjacent cells to reduce inter-cell interference [1].**
- **Number of pilot signals required to model the channel increase with the number of antennas [1].**
- **Computational costs grow as cubic function of the number of antennas [1].**

MACHINE LEARNING APPLICATIONS [2]

- **MIMO channel learning**
- **User/Cell Association**
- **Signal Dimension Reduction**
- **Autoencoder based physical layer**

MIMO ANTENNA ARRAY

- **Example Implementation of Massive MIMO as described in [4].**



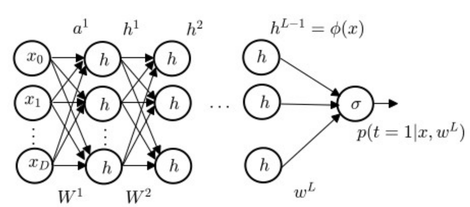
METHOD

Hardware

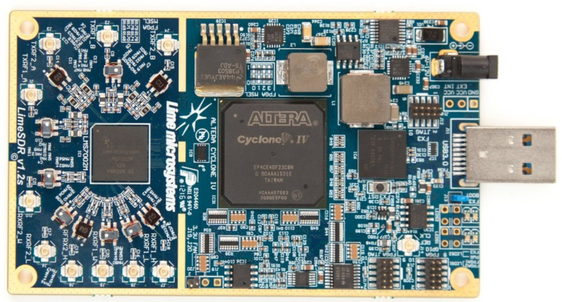
- **Combine 2 LimeSDR-USB boards to achieve a 4 input / 4 output MIMO testbench.**
- **60 MHz bandwidth with a continuous frequency range of 100 MHz to 3.8 GHz [5].**

Software

- **GNU Radio for Software Defined Radio**
- **Tensorflow for Machine Learning**
- **Wireless Insite for realistic simulations**



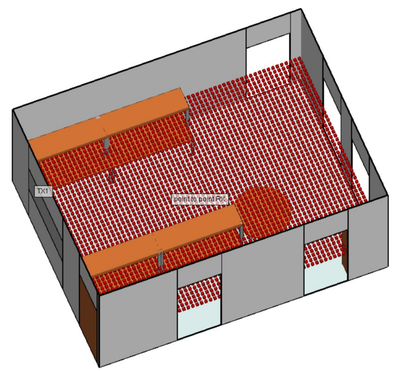
Neural Network from [3].

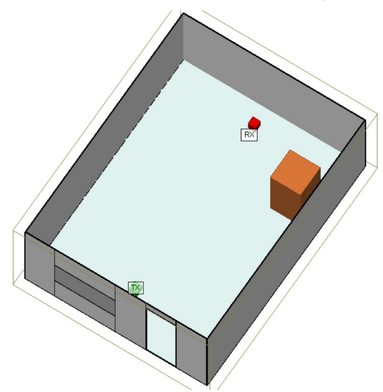


LimeSDR Software Defined Radio System [5]

PRELIMINARY RESULTS

- **Simulations to generate data for testing MIMO Channel Mapping.**





ONGOING & PLANNED WORK

- **Simulate the working evironment to test NN for Channel mapping in space, frequency, and/or time.**
- **Measure real world channels to get realistic data for verification of NN.**
- **Compare real world results to simulated results. Specifically look at effect of noise on the accuracy of the NN.**
- **Implement system to demonstrate channel mapping in real time.**
- **Enable the designed MIMO system to act as a phased array.**

REFERENCES

[1] R. C. D. Lamare, "MIMO Systems: Signal Processing Challenges and Future Trends," vol. 347, pp. 8-20 October 2013.
[2] C. Jiang, H. Zhang, Y. Ren, Z. Han, K. C. Chen, and L. Hanzo, "Machine Learning Paradigms for Next-Generation Wireless Networks," IEEE Wireless Communications, vol. 24, no2, pp. 98-105, 2017.
[3] O. Simeone, "A Very Brief Introduction to Machine Learning with Applications to Communication Systems," IEEE TCCN vol. 4, no. 4, pp. 648-664, 2018.
[4] E. G. Larsson, O. Edfors, F. Tufvesson, and T. L. Marzetta, "Massive MIMO for next generation wireless systems," arXiv preprint arXiv:1304.6690, 2013.
[5] MyriadRF, "LiveSDR USB," 2019.

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POUNDRA

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