COM-500 Mini-Project
Group Throughput optimization in Wireless Communications via Spatial Beamforming

Mini-Project Goals

Each mini-project proposes to deep-dive into one of the statistical signal and data processing tools seen in class.
The general tasks to be executed are:

- Implement the assigned tool (Python or Matlab);
- Test it on simulated and real data. (Real data will be provided.)
- Consult the suggested literature for another tool, not presented in class, outperforming the assigned tool;
- Implement the new tool (Python or Matlab);
- Prepare a demo (on simulated and real data) comparing the tools;
- Prepare $\simeq 5$ slides to present the tools to the class, how they compare, and a demo.

You will be evaluated on these tasks.

Mini-Project Description

The capacity of a wireless communication channel increases with the SNR at the receiver (RX). To achieve high instantaneous data rates, 5G transmitters (TX) leverage multi-antenna systems and *spatial beamforming* to specifically target individual users in sequence.
The canonical beamforming strategy employed in 5G systems is *matched beamforming* (MB) due to its high spatial selectivity and peak transmittance. The drawback is the need for TX/RX pairs to often share synchronization messages to locate each other prior to beamforming data to the other party.
The goal of this project is to explore alternative beamforming strategies and assess whether one can improve the expected data rate achieved by a pool of users despite their less-selective spatial properties.

References

- H. Krim, M. Viberg (1996). Two decades of array signal processing research: the parametric approach. IEEE signal processing magazine, 13(4), 67-94.
- P. Hurley, M. Simeoni (2016). Beamforming towards regions of interest for multi-site mobile networks. In International Zurich Seminar on Communications-Proceedings (pp. 94-98).
- P. Hurley, M. Simeoni. (2016). Flexibeam: analytic spatial filtering by beamforming. In 2016 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) (pp. 2877-2880).