Energy efficient 5G/6G MISO-NOMA schemes

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Context

The dramatically increased demand of data traffic and the prevalence of intelligent applications, e.g., augmented reality (AR), intelligent computing, internet-of-things (IoT), have imposed great challenges for the future wireless communication networks (5G/6G) in providing massive connectivity with satisfied user's quality of service. The concept of multiple-input single-output (MISO) non-orthogonal multiple access (NOMA) was initially proposed in [1], which has attracted considerable attentions since then. Several papers have studied energy efficiency and power minimization problems of such MISO-NOMA systems in the literature. In [2], a joint beamforming and power allocation Gauss-Seidel algorithm for a two-user MISO-NOMA system is proposed to minimize total transmit power. The minimum power and the optimal precoding vector of the two-user MISO-NOMA system are obtained through Newton's iterative algorithm in [3]. The authors of [4] investigate the power minimization problem for a two-cell MISO-NOMA system. Nevertheless, power minimization for general multi-cell MISO-NOMA systems is highly favorable for energy-efficient 5G/6G systems and remains an open problem.

Objective

The objective of this project is to study energy efficiency and power minimization problem for 5G/6G multi-cell MISO-NOMA systems. The student will first study previous algorithms developed in the team, then extend them to multi-cell distributed environment. He/she will also have access to a simulation framework developed in Matlab and Python. Therefore, intermediate level in programming is required. Basic understanding of MIMO, MISO and NOMA is a definite plus. The student will work in a strong team of international research collaboration and finalize its training by describing the work in a technical report. It is the objective to submit suitable technical contributions as 5G/6G proposals and to summarize the most relevant results in a research paper, which can be submitted to a distinguished research conference or journal. It can also be considered as a preliminary work for a PhD program.

Tasks

- Analyze energy efficiency problems in MISO-NOMA systems of multiple cells
- Design user-grouping, beamforming and power allocation schemes
- Implement new and existing algorithms (e.g., in Matlab or Python) based on our existing software framework
- Performance simulations and evaluation and interact in our project team

Criteria skills

- Programming: intermediate level in Matlab, Python or similar
- Basic knowledge of multiple access schemes (e.g. OFDMA, NOMA, MIMO, MISO, etc.)
- Interests in mathematical optimization and distributed algorithms and is a definite plus
- Language: fluent English, we are in a multi-culture multi-language work environment

References

[1] Y. Saito, Y. Kishiyama, A. Benjebbour, T. Nakamura, A. Li, and K. Higuchi, "Non-orthogonal multiple access NOMA for future radio access," *IEEE Vehicular Technology Conference (VTC)*, 2013.

[2] J. Choi, "Minimum power multicast beamforming with superposition coding for multiresolution broadcast and application to NOMA systems," *IEEE Transactions on Communications*, vol. 63, no. 3, pp. 791–800, Mar. 2016.

[3] Z. Chen, Z. Ding, P. Xu, and X. Dai, "Optimal precoding for a QoS optimization problem in two-user MISO-NOMA downlink," *IEEE Communications Letters*, vol. 20, no. 6, pp. 1263–1266, Jun. 2016.

[4] Y. Fu, L. Salaun, C. W. Sung, and C. S. Chen, "Distributed power allocation for the downlink of a two-cell MISO-NOMA system," *IEEE Vehicular Technology Conference (VTC Spring)*, 2018.