Fall 2017

COM524500 Optimization for Communications
Term Project

Report Deadline: 23:59, January 18, 2018

Presentation time: 08:30 (a.m.)−12:30 (p.m.), January 19 (Friday), 2018 (To be determined)

- The objective of the term project is to let you have hands-on experience on using convex optimization tools in practice. Therefore, being able to perform simulations is an integral part of the project.
- You can team up with one of your classmates to do this project. The group can at most have 2 students. Of course, you are also welcome to 'act alone'.
- You will need to submit a project report on one convex optimization application. You should understand how the convex optimization method works for that application, and carry out some simulations to test the performance of the convex optimization method. Like a technical article, the report should include
  - Introduction
  - Problem statement or formulation
  - The method
  - Simulation results
- Try to limit the page length to no more than 20 and limit your presentation no more than 20 minutes. The evaluation of your report will be mainly based on technical accuracy, presentation clarity, consistency, and whether the simulations are properly done.
- **Please send the pdf files of your report (in font size 12) to the TAs via email (roy50408@gmail.com, a.jalily@gmail.com) by the report deadline and submit a hard copy on January 19.**
- ***All of the team members* have to demonstrate the details and results at the presentation time (08:30–12:30, January 19, 2018).**
- Plagiarism is strictly prohibited and will be severely penalized (it may result in zero score for the entire course).
- The topic should be one of the following.

1. **Discrete sum rate maximization for MISO:**

   H. T. Wai, Q. Li and W. K. Ma, "Discrete sum rate maximization for MISO interference broadcast channels: Convex approximations and efficient algorithms," *IEEE Trans. Signal Processing*, vol. 64, no. 16, pp. 4323-4336, Aug. 2016.

2. **Power efficiency of relaying networks:**

   X. Xu, X. Chen, M. Zhao, S. Zhou, Chong-Yung Chi, and J. Wang, "Power-efficient distributed beamforming for full-duplex MIMO relaying networks," *IEEE Trans. Vehicular Technology*, vol. 66, no. 2, pp. 1087-1103, Feb. 2017.

3. **Robust multiuser MISO systems:**

   K.-Y. Wang, A. M.-C. So, T.-H. Chang, W.-K. Ma, and Chong-Yung Chi, "Outage constrained robust transmit optimization for multiuser MISO downlinks: Tractable approximations by conic optimization," *IEEE Trans. Signal Processing*, vol. 62, no. 21, pp. 5690-5705, Nov. 2014.

   W. Xu, Y. Cui, H. Zhang, G. Y. Li and X. You, "Robust beamforming with partial channel state information for energy efficient networks," *IEEE Journal on Selected Areas in Communications*, vol. 33, no. 12, pp. 2920-2935, Dec. 2015.

3. **Multicell coordinated beamforming:**

   M. F. Hanif, L.-N. Tran, A. Tölli, M. Juntti, and S. Glisic, "Efficient solutions for weighted sum rate maximization in multicellular networks with channel uncertainties," *IEEE Trans. Signal Processing*, vol. 61, no. 22, pp. 5659-5674, Nov. 2013.

   C. Shen, T.-H. Chang, K.-Y. Wang, Z. Qiu, and Chong-Yung Chi, "Distributed robust multi-cell coordinated beamforming with imperfect CSI: An ADMM approach," *IEEE Trans. Signal Processing*, vol. 60, no. 6, pp. 2988-3003, Jun. 2012.

4. **Secrecy communications:**

   T.-H. Chang, W.-C. Chiang, Y.-W. P. Hong, and Chong-Yung Chi, "Training sequence design for discriminatory channel estimation in wireless MIMO systems," *IEEE Trans. Signal Processing*, vol. 58, no. 12, pp. 6223-6237, Dec. 2010.

   W.-C. Liao, T.-H. Chang, W.-K. Ma, and Chong-Yung Chi, "Qos-based transmit beamforming in the presence of eavesdroppers: An optimized artificial-noise-aided approach," *IEEE Trans. Signal Processing*, vol. 59, no. 3, pp. 1202-1216, Mar. 2011.

5. **Blind source separation for image applications:**

   T.-H. Chan, A. Ambikapathi, W.-K. Ma, and Chong-Yung Chi, "Robust affine set fitting and fast simplex volume max-min for hyperspectral endmember extraction," *IEEE Trans. Geoscience and Remote Sensing*, vol. 51, no. 7, pp. 3982-3997, July 2013.

   C.-H. Lin, Chong-Yung Chi, Y.-H. Wang, and T.-H. Chan, "A fast hyperplane-based minimum-volume enclosing simplex algorithm for blind hyperspectral unmixing," *IEEE Trans. Signal Processing*, vol. 64, no. 8, pp. 1946-1961, Apr. 2016.

   C.-H. Lin, F. Ma, Chong-Yung Chi, and C.-H. Hsieh, "A convex optimization based coupled non-negative matrix factorization algorithm for hyperspectral and multispectral data fusion," accepted for publication as a regular paper in *IEEE Trans. Geoscience and Remote Sensing* (which can be downloaded in our webpage).

- You are strongly suggested to use MATLAB to perform your simulations. It is probably the most popular software for simulations of signal processing and communications problems. MATLAB itself does not include a convex optimization tool, but you can download one such as the famous SeDuMi package (`http://sedumi.mcmaster.ca/`) and/or the CVX (`http://www.stanford.edu/~boyd/cvx/`).