COM5999 Optimization for Communications
Term Project

Report Deadline: 23:59, January 17, 2019

Presentation time: 08:30(a.m.)−12:30(p.m.), January 18, 2019

- 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 and part of codes 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 length of report to no more than 20 pages 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) and source code (including the platform details) to the TAs via email (lywei0306@gapp.nthu.edu.tw, a.jalily@gmail.com) by the report deadline and submit a hard copy on January 18, 2019.**
- ***All of the team members* have to demonstrate the details and results at the presentation time. at 08:30–12:30, January 18, 2019.**
- **Plagiarism is strictly prohibited and will be severely penalized (it may result in zero score for the term project)**.
- The topic should be one of the following.

1. **OFDM signal processing:**

   Wang, Yongchao and Wang, Yanjiao and Shi, Qingjiang, "Optimized Signal Distortion for PAPR Reduction of OFDM Signals with IFFT/FFT Complexity via ADMM Approaches" *IEEE Trans. Signal Processing*, Early Access, Aug. 2018.

   H. Qin, Y. Sun, T.-H. Chang, X. Chen, Chong-Yung Chi, M. Zhao, and J. Wang, "Power allocation and time-domain artificial noise design for wiretap OFDM with discrete inputs" *IEEE Trans. Wireless Communications,*, vol. 12, no. 6, pp. 2717-2729, Jun. 2013.

2. **Robust communication system design and Secrecy communications:**

   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. (2018 IEEE SPS Best Paper Award)

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.

3. **Beamforming:**

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.

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.

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. **Hyperspectral image applications:**

C.-H. Lin, R. Wu, W.-K. Ma, Chong-Yung Chi, and Y. Wang, "Maximum volume inscribed ellipsoid: A new simplex-structured matrix factorization framework via facet enumeration and convex optimization," SIAM Journal on Imaging Sciences, vol. 11, no. 2, pp. 1651-1679, Jun. 2018.

C.-H. Lin, W.-K. Ma, W.-C. Li, Chong-Yung Chi, and A. Ambikapathi, "Identifiability of the simplex volume minimization criterion for blind hyperspectral unmixing: The no pure-pixel case," IEEE Trans. Geoscience and Remote Sensing, vol. 53, no.10, pp. 5530-5546, Oct. 2015.

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.

- You are strongly recommended to use MATLAB or python to perform your simulations. The CVX/SeDuMi toolbox on MATLAB and the CVXPY/CVXOPT library are probably the most popular softwares for solving convex 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/`). For python, you may refer the CVXPY (`http://www.cvxpy.org/index.html`) or the CVXOPT (`http://cvxopt.org/`).