

EE 367000 Introduction to Convex Analysis and Optimization  
(凸最佳化導論)  
Spring 2021

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<http://www.ee.nthu.edu.tw/cychi/>

Units: 3

Lecture hours: **M3, M4, W3, W4**

Classroom: **Delta 211**

Course web page: <http://www.ee.nthu.edu.tw/cychi/courses-e.html>.

Office hours: **to be determined**

This course aims to introduce *convex analysis and optimization*. Over the last two decades, convex optimization has been extensively for solving wide range of cutting edge optimization problems in science and engineering, such as (a) blind source separation (BSS) for biomedical and hyperspectral image analysis, (b) computer vision and machine learning, and (c) multiple-input multiple-output (MIMO) wireless communications and networking. This course is to equip you with an essential foundation to efficiently and effectively learn advanced “*Convex Optimization*” (a powerful mathematical tool) for your research need in your graduate study.

**Background & Prerequisite:** A good background in linear algebra and calculus is desirable.

**Outline:**

1. Review on Basics of Linear Algebra, Set Theory and Geometry/Topology
2. Advanced Topics in Linear Algebra, Matrix Theory and Calculus
3. Convex Sets
4. Convex Functions
5. Convex Optimization Problems
6. Geometric Programming
7. Duality (introductory level)
8. Case studies of Convex Optimization in Engineering and Science

**Textbooks:**

- Chong-Yung Chi, Wei-Chiang Li, and Chia-Hsiang Lin, Convex Optimization for Signal Processing and Communications: From Fundamentals to Applications, CRC Press, Boca Raton, FL, 2017.  
<http://st-ebook.com.tw/bookcomment-2.aspx?BOKNO=TKCP00033> (科大文化圖書公司)

† The material of the textbook systematically introduces how to efficiently and effectively solve an optimization problem, from the fundamental theory, problem definition, reformulation into a convex problem, analysis, algorithm implementation, to cutting edge research in signal processing and communications (like an exploration journey rather than pure mathematics). It has been used for my 2-week (32 lecture hours) or 3-week (48 lecture hours) invited short course entitled “Convex Optimization for Signal Processing and Communications” at 10 top ranked universities in Mainland China over the last decade, including Shandong University, Tsinghua University, Tianjin University, Tianjin Beijing Jiaotong University (BJTU), University of Electronic Science and Technology of China, Chengdu (UESTC), Xiamen University, Sun-Yet-Sen University (SYSU), and Beijing University of

*Posts and Telecommunications, Beijing (BUPT), Shandong Normal University, Jinan, and Xidian University.*

***References:***

- S. Boyd and L. Vandenberghe, *Convex Optimization*. Cambridge: Cambridge University Press, 2004. Free electronic version is available at: <http://www.stanford.edu/~boyd/cvxbook/>.
- R. A. Horn and C. R. Johnson, *Matrix Analysis*, 2nd ed. Cambridge: Cambridge University Press, 2012.
- C. H. Edwards, *Advanced Calculus of Several Variables*, Academic Press, 1973.
- Giuseppe Calafiore and Laurent El Ghaoui, *Optimization Models*, University Press, Cambridge, 2014.
- D. P. Bertsekas, *Convex Analysis and Optimization*, Athena Scientific, 2003.

***Grading:***

- Homework: **0%**
- Midterm exam: **50%**
- Final exam: **50%**