

课程大纲

COURSE SYLLABUS

1.	课程代码/名称 Course Code/Title	凸优化与信号处理 Convex Optimization for Signal Processing
2.	课程性质 Compulsory/Elective	专业选修课 Major Elective Courses
3.	开课单位 Offering Dept.	系统设计与智能制造学院 School of System Design and Intelligent Manufacturing (SDIM)
4.	课程学分/学时 Course Credit/Hours	3 学分/48 学时 3 Credits/48 Hours
5.	授课语言 Teaching Language	中英双语 English & Chinese
6.	授课教师 Instructor(s)	刘凡 Fan Liu
7.	开课学期 Semester	春季 Spring
8.	是否面向本科生开放 Open to undergraduates or not	否 No
9.	先修要求 Pre-requisites	线性代数, 微积分 Linear Algebra, Calculus
10.	教学目标 Course Objectives	<p>本课程聚焦于介绍凸优化基本原理及其在信号处理中的应用。重点讲授凸集、凸函数、凸优化问题的概念与定义，拉格朗日对偶理论，线性规划、二阶锥规划、二次规划、半正定规划、几何规划等各类优化问题，以及梯度下降法、牛顿法、内点法等典型凸优化问题求解算法的原理。在此基础上，讲授凸优化在典型信号处理问题中的应用，包括滤波器设计、参数估计、模式识别、机器学习、统计推断等。通过本课程的学习，学生将能够掌握凸优化的基本原理，了解到抽象的数学理论如何能够解决实际的工程问题，并初步掌握典型优化算法的设计与实现。</p> <p>This course will focus on teaching the basic concepts and principles of convex sets, convex functions, convex optimization problems, Lagrange duality theory, linear programming, second-order cone programming, quadratic programming, semi-definite programming, geometric programming and other optimization problems, as well as typical algorithms such as gradient descent, Newton's method and interior point method. On this basis, we will teach the application of convex optimization in typical signal processing problems, including filter design, parameter estimation, pattern recognition, machine learning, and statistical inference. Through the study of this course, students will be able to master the basic principles of convex optimization, understand how abstract mathematical theories can be applied to practical engineering problems, as well as the design and implementation principles of typical optimization algorithms.</p>
11.	教学方法 Teaching Methods	<p>本课程教学方法主要为理论课程学习与讲解。 Theoretical tutorial.</p>
12.	教学内容 Course Contents	<p>(如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.)</p>

	Section 1	Overview and Mathematical Background
	Section 2	Convex Sets and Convex Functions
	Section 3	Convex Optimization Problems
	Section 4	Lagrangian Duality
	Section 5	Linear Programming (LP)
	Section 6	Quadratic Programming (QP)
	Section 7	Semidefinite Programming (SDP)
	Section 8	Second-Order Cone Programming (SOCP)
	Section 9	Geometric Programming (GP)
	Section 10	Gradient Descent Methods
	Section 11	Newton's Methods
	Section 12	Interior-Point Methods
	Section 13	Case Study: Digital Filter Design
	Section 14	Case Study: Parameter Estimation
	Section 15	Case Study: Pattern Recognition
	Section 16	Case Study: Statistical Inference
13.	课程考核 Course Assessment	
	①考核形式: 出勤 10%, 期末报告 90% Attendance 10%, Final Presentation 90% ②记分方式: 等级制 Letter Grading	
14.	教材及其它参考资料 Textbook and Supplementary Readings	
	[1] Chi, C.-Y., Li, W.-C., & Lin, C.-H. (2017). Convex Optimization for Signal Processing and Communications: From Fundamentals to Applications (1st ed.). CRC Press, 2017 [2] Boyd, Stephen, Stephen P. Boyd, and Lieven Vandenberghe. Convex optimization. Cambridge university press, 2004. [3] Palomar, D.P. and Eldar, Y.C. eds., 2010. Convex optimization in signal processing and communications. Cambridge university press. [4] Zhi-Quan Luo and Wei Yu, "An introduction to convex optimization for communications and signal processing," in IEEE Journal on Selected Areas in Communications, vol. 24, no. 8, pp. 1426-1438, Aug. 2006	