

# 课程大纲

## COURSE SYLLABUS

1.	<b>课程代码/名称</b> <b>Course Code/Title</b>	地球物理反演理论 (Geophysical Inverse Problem)
2.	<b>课程性质</b> <b>Compulsory/Elective</b>	专业选修课 (specialized elective course)
3.	<b>课程学分/学时</b> <b>Course Credit/Hours</b>	3/48
4.	<b>授课语言</b> <b>Teaching Language</b>	中/英文 (Chinese/English)
5.	<b>授课教师 Instructor(s)</b>	包雪阳 (Bao, Xueyang)
6.	<b>先修要求</b> <b>Pre-requisites</b>	微积分、线性代数、概率论与数理统计、基本编程能力、一定的 MATLAB 基础。 Pre-requisites include calculus, linear algebra, probability and statistics, basic programming skills, and basic Matlab experience.
7.	<b>教学目标 Course Objectives</b>	
	<p>本课程为地球物理学等相关专业的选修课。主要讲述地球物理反演的基本理论和应用，使学生能够（1）理解地球物理反演问题的基本概念、原理和思路，（2）建立、解决与分析基本地球物理反演问题（如地震定位、层析成像、重力反演等），（3）运用理论理解和评价地球物理反演理论或应用的最新进展。</p> <p>This course is specialized for students in geophysics and related areas. Upon completing the course, students are expected to (1) understand the concept, philosophy, and methodology of the geophysical inverse problem, (2) establish, solve, and analyze basic geophysical inversion problem (e.g., earthquake location, seismic tomography, gravity inversion, etc.), and comprehend and assess the recent studies on the theory or applications of geophysical inverse problem.</p>	
8.	<b>教学方法 Teaching Methods</b>	
	<p>本课程注重对理论知识的理解和实用性，通过编程练习加深学生对理论知识的理解，同时培养学生解决实际问题的能力。学生顺利完成本课程后可初步掌握将反演的理论知识应用到具体的研究中。</p> <p>This course highlights the understanding and application of theoretical knowledge. Besides direct instruction, programming exercises for a number of important topics will be given as class assignments in order to enhance students' understanding of the theory and develop their problem solving skills. On completion of this course, students will be able to apply the knowledge gained from this course to particular geophysical problems of their own studies.</p>	
9.	<b>教学内容 Course Contents</b>	
	<b>Section 1</b>	<p>预备知识：线性代数、概率统计和微积分。</p> <p>This section will give an overview of the prior knowledge including linear algebra, probability, calculus, and differential equation. Week 1-2.</p>
	<b>Section 2</b>	<p>反演问题的描述和基本概念。</p> <p>This section will introduce and discuss the description of inverse problem and its basic concept. Week 3-4.</p>
	<b>Section 3</b>	<p>线性反演问题的解：线性回归、奇异值分解、正则化。</p> <p>This section will discuss the solving of linear inverse problem, including linear regression, singular value decomposition, and regularization. Week 5-8.</p>
	<b>Section 4</b>	<p>离散化和迭代。</p> <p>This section will discuss the discretizing of continuous inverse problems and iterative methods. Week 9-10.</p>

<b>Section 5</b>	非线性回归和反演、贝叶斯方法、全局反演和随机反演的概念。 This section will discuss the nonlinear regression and inversion, Bayesian perspective on inverse problems, global optimization, Markov Chain Monte Carlo, etc. Week 11-12.
<b>Section 6</b>	应用举例：地震定位和结构反演。 This section will discuss the application of inverse problem to earthquake location and Earth structures. Week 13.
<b>Section 7</b>	学期项目讨论。 This section will be final project presentation. Week 14-15.
<b>10. 课程考核 Course Assessment</b>	
课程成绩根据平时作业和学期项目口头和书面报告综合评定（课程作业 50% + 项目报告 50%）。 Assessment score will be based on assignments (50%) and final project presentation and written report (50%).	
<b>11. 教材及其它参考资料 Textbook and Supplementary Readings</b>	
<ol style="list-style-type: none"> <li>1. Parameter Estimation and Inverse Problems, Second Edition. R. C. Aster, B. Borchers, and C. H. Thurber, Elsevier Inc.</li> <li>2. Geophysical Data Analysis: Discrete Inverse Theory, Third or Fourth Edition. William Menke, Elsevier Inc.</li> </ol>	