MA 773 – Selected Topics in Analysis
Spring 2018
Topics in Inverse Problems

Syllabus

Instructor: Francis Chung
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Office Hours: Tues 10-11, or by appointment.
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Class Meetings: MWF 12-1pm, CB 7^3.

Course Content and Goals: In a typical PDE problem, we have a PDE with known coefficients, and we want to derive information about the solutions. An *inverse problem* is one that goes the other way around: we are given information about the solutions to a PDE, usually on the boundary of some domain, and we want to derive information about the coefficients. These problems arise in a number of practical contexts, from medical imaging to mineral exploration.

The goal of this course is to serve as an introduction to a variety of topics in inverse problems. The intention is to run the course as a series of minicourses, each discussing a different topic. As the backbone of the course, we will begin by considering three inverse problems in *optical tomography*, each corresponding to a different level of optical scattering: Radon and X-ray transforms (no scattering); inverse transport problems (intermediate scattering); Calderón type problems (high scattering). From there the selection of topics depends on time and instructor and student interest.

Course Texts: There are no required texts for this course. For the opening three units, we will be roughly following several resources available online and linked from the Canvas site.

- Radon and X-ray transforms: course notes from Gunther Uhlmann's courses on this topic, available in one form from the man himself at
    https://catalyst.uw.edu/workspace/file/download/
    4336399b22c0f49e8ba50bf73bf890166ce9dafea1b15897c317b35f9d98d69a
    and also in another form from Rolfe Schmidt at
    https://rrschmidt.wordpress.com/inverse-problems-course-notes/
- Inverse transport: "An inverse boundary value problem for the stationary transport equation", by M. Choulli and P. Stefanov, in Osaka J. Math., **36** (1999), p. 87-104.
- Calderón-type problems: course notes from Mikko Salo, available at
    http://users.jyu.fi/∼ salomi/lecturenotes/calderon_lectures.pdf.

    Evans's PDE book is a good reference for background material. In addition it is my intention to post course notes of my own on the class website.

Assessment and Grading: This course is divided into a number of minicourses which are intended to occupy a middle ground between a class and a seminar. Students are expected to be present and engaged in class. To formalize this to some extent, each student will submit a "Three Things" exercise (see http://math.stanford.edu/∼vakil/threethings.html) at the end of each week. This exercise will typically be assigned on Friday and due by Monday of the following week at 11am.

In addition, each student will give an oral presentation on a topic of their choosing towards the end of the semester.

Accomodations: If you have a documented disability that requires academic accommodations, please see me as soon as possible. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center, which coordinates campus disability services available to students with disabilities.

Updates to this document, along with additional course documents, will be posted on my website under "Teaching".