Texas A&M University, Department of Mathematics, Spring 2020

MATH 664 (600) — Compressive Sensing [*]

TR 12:45pm-2:00pm, Zoom meeting: https://tamu.zoom.us/j/120137170

Instructor: Simon Foucart, 502D Blocker Building, foucart@tamu.edu
Office hours: by appointment
Course web page: accessed via eCampus at http://ecampus.tamu.edu/
Textbook: *A Mathematical Introduction to Compressive Sensing*, by S. Foucart and H. Rauhut.

Course Description: Recent years have witnessed the birth of a fascinating field at the intersection of Mathematics, Engineering, and Computer Science. It is called Compressive Sensing, because of its premise that data acquisition and compression can be performed at the same time. As such, the basic objective of Compressive Sensing is to provide concrete protocols for sensing and compressing data simultaneously. This is essential when limited sensing capabilities force the reconstruction of data from sets of measurements that seem highly incomplete at first sight. It turns out that, not only is the reconstruction possible in theory, it can also be carried out efficiently in practice. Such a conclusion is drawn from recent theoretical results that bring appropriate measurement schemes and efficient reconstruction algorithms to light. The course will keep an eye on the application side, but will mainly focus on the underlying mathematical theory. The goal is to provide a comprehensive background for research in this popular field.

Course Content: The following topics will (tentatively) be covered:

- Applications, motivations, and extensions

- Sparse solutions of underdetermined systems

- Greedy and thresholding-based algorithms

- Convex optimization

- Basis pursuit

- Coherence of a matrix

- Restricted isometry property

- Random matrices

- Structured random matrices

- Lossless expanders

- High-dimensional geometry

- Recovery from one-bit measurements

---

[*] this syllabus is a revision prompted by the coronavirus pandemic.

Course Requirement: The course is accessible to Mathematics, Engineering, and Computer Science students alike. It assumes some basic knowledge of linear algebra, analysis, and probability. Familiarity with MATLAB is a plus.

Grading: Still based on class participation and homework.

Attendance Policy: Attendance is not compulsory, but regular attendance is expected — it is in fact essential if you want to do well in the course. Classes to be missed due to religious holidays must be communicated to me during the first week. You are required to arrive on time and stay the length of the class. If you do not attend a class, you are responsible for any announcement made, any material covered, and any additional topic introduced during this class. Office hours cannot be used for this purpose.

Academic Honesty: *"An Aggie does not lie, cheat, or steal or tolerate those who do."* See `http://aggiehonor.tamu.edu` for more information.

Americans with Disabilities: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit `http://disability.tamu.edu`.