

Mathematics 601E: Topics in Analysis, Winter/Spring 2020

Decoupling theory

Section 201: MWF 10:00-10:50, MATX 1102. Credit value: 3 credits.

Instructor: Professor I. Laba

- **Bio:** Ph.D. 1994 (University of Toronto). At UBC since 2000. Full Professor since 2005.
- **Contact information:** Math Bldg 200, (604) 822 4457, ilaba@math.ubc.ca
- **Office hours:** tentatively, Mon 11-12, Wed 1-2, and by appointment, in MATH 200.
- The best way to contact the instructor is by email. Please note that email received on evenings and weekends will be answered on the next business day.
- If you cannot attend regular office hours due to schedule conflict, you can request an appointment. Please make your request at least one day in advance. Our schedules can fill up, so that drop-ins and same-day requests for appointments can be difficult or impossible to accommodate.

Prerequisites: MATH 420/507 and 404/541, or equivalent background in real and harmonic analysis.

Course structure: 3 lecture hours per week, supplemented by office hours, regular homework, and discussion boards on Canvas and Piazza. There will also be opportunities to ask questions during class.

Required learning materials: There is no required textbook for the course. Suggested and recommended reading materials are as follows.

- [Ciprian Demeter, "Fourier Restriction, Decoupling and Applications"](#), Cambridge University Press, published online in December 2019, print publication in early 2020.
- Bourgain-Demeter expository paper: [arXiv link](#)
- Larry Guth's lecture notes: [2014 decoupling seminar](#), [2017 graduate course](#)

Additional reading suggestions for specific topics will be posted as we go.

Course topics and learning objectives: Decoupling theory is a timely and exciting area of harmonic analysis. Its origins go back to the work of Wolff in the early 2000s, but the current form of decoupling theory was developed more recently, starting with the work of Bourgain and Demeter on the decoupling conjecture for the sphere. Decoupling methods have led to major advances in both harmonic analysis (restriction theory) and number theory (Vinogradov's conjecture), including the work of Bourgain, Demeter, Guth, and others. There is a significant and sustained interest among mathematicians in learning the subject. The proposed course will focus on the harmonic-analytic side of decoupling. We will be aiming towards the proof of the Bourgain-Demeter theorem, with the necessary background and techniques. The course will be modelled in part on the two graduate courses taught by Larry Guth at MIT, and should be accessible to all students who have taken MATH 541 or have equivalent background.

Tentative schedule:

- Decoupling basics: localization, scaling, weighted norms, "almost constant" properties, etc. (2 weeks)
- Brascamp-Lieb and multilinear Kakeya inequalities. (2 weeks)
- Linear and multilinear restriction for the paraboloid. (2 weeks)
- Linear and multilinear decoupling. (2 weeks)
- Induction on scales. (2 weeks)
- Induction on dimension (narrow and broad estimates). (2 weeks)
- The Bourgain-Demeter proof of the decoupling conjecture for the sphere. (1 week)

Detailed updates on class topics covered each week and reference materials will be posted regularly on this page.

Your course mark will be based on a presentation of a suitable topic in decoupling theory, chosen in consultation with the instructor. Either a written submission or an oral presentation in class will be acceptable.

Academic concession: The rules and procedures for obtaining academic concession are governed by [UBC Policy V-135 on Academic Concession](#). The presentation deadlines in this class will be flexible, so there should not be a problem with obtaining an extension if necessary.

Academic misconduct: UBC takes cheating incidents very seriously. After due investigation, students found guilty of cheating on tests and examinations are usually given a final grade of 0 in the course and suspended from UBC for one year. [See here for more information.](#)

- While students are encouraged to study together, they should be aware that blatant copying of another student's work is a serious breach of academic integrity. Your final write-up should be your own.
- Academic misconduct includes misrepresenting a medical excuse or other personal situation for the purposes of postponing an examination or quiz or otherwise obtaining an academic concession.

Statement about the University's values and policies, mandated by [UBC Policy V-130](#): UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available [here](#).

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