WAM 2019 Yearbook
Topics in Geometric Analysis

Institute for Advanced Study, Princeton
May 18-24, 2019

This is a compilation of activities and resources contributed by participants during the 2019 Women and Mathematics Program. We hope this can serve as a mathematical and professional reference guide for women mathematicians around the country.

I. Mathematical Talks

A. Terng Lectures:

Tatiana Toro, University of Washington, "Uniform Rectifiability via Perimeter Minimization"

Abstract: Quantitative geometric measure theory has played a fundamental role in the development of harmonic analysis, potential theory and partial differential equations on non-smooth domains. In general the tools used in this area differ greatly from those used in geometric measure theory as it appears in the context of geometric analysis. In this course we will discuss how ideas arising when studying perimeter minimization questions yield interesting and powerful results concerning uniform rectifiability of sets. The course will be mostly self-contained.

Terng Review Sessions: Zihui Zhao, IAS

- Preview (Zihui Zhao)
- Lecture 1:
    - Video
    - Afternoon review
- Lecture 2:
    - Video
    - Afternoon review
- Lecture 3:
    - Video
- Lecture 4:
    - Video

B. Uhlenbeck Lectures:

Panagiota Daskalopoulos, Columbia University, "Ancient solutions to geometric flows"

Abstract: Some of the most important problems in *geometric* evolution partial differential equations are related to the understanding of *singularities*. This usually happens through a blow up procedure near the singularity which uses the scaling properties of the equation. In the case of a *parabolic* equation the blow up analysis often leads to special solutions which are defined for all time $-\infty<t\leq T$, for some $T\leq+\infty$. We refer to them as *ancient* solutions. The classification of such solutions often sheds new insight upon the singularity analysis.

In this lecture series we will discuss *Uniqueness Theorems* for ancient solutions to parabolic partial differential equations, starting from the Heat equation and extending to the Semi-linear heat equation, the Mean curvature flow, the Ricci flow and the Yamabe flow. We will also discuss the construction of new solutions from the gluing of two more solitons.

Uhlenbeck Review Sessions: Robin Neumayer, IAS

- Preview (Liu Wang)
- Lecture 1:
    - Video
    - Lecture notes
- Lecture 2:
    - Video
    - Lecture notes
- Lecture 3:
    - Video
    - Lecture notes
- Lecture 4:
    - Video

References

Terng Lectures:

L. C. Evans and R. F. Gariepy, Measure Theory and Fine Properties of Functions, Revised Edition. Textbooks in Mathematics. CRC Press, Boca Raton FL 2015.

F. Maggi, Sets of Finite Perimeter and Geometric Variational Problems, An introduction to geometric measure theory. Cambridge Studies in Advanced Mathematics, 135. Cambridge University Press, Cambridge 2012.

M. Spivak, Calculus on manifolds : a modern approach to classical theorems of advanced calculus. Westview Press, Boulder, 1998.

Uhlenbeck Lectures:

L. Evans, Partial Differential Equations. Second Edition. Graduate Studies in Mathematics, 19. AMS, Providence RI 2010.

D. Gilbarg and N. Trudinger, Elliptic Partial Differential Equations of Second Order. Reprint of the 1998 edition. Classics in Mathematics. Springer-Verlag, 2001.

B. Chow and D. Knopf, The Ricci Flow: An Introduction. Mathematical Surveys and Monographs, 110. AMS, Providence RI 2004.

K. Ecker, Regularity Theory for Mean Curvature Flow. Progress in Nonlinear Differential Equations and their Applications, 57. Birkhauser Boston Inc., 2004.

C. Colloquium

Daniela De Silva, Columbia University, "Viscosity solutions approach to variational problems."

Abstract: In this talk we discuss some extensions of the classical Krylov-Safonov Harnack inequality. After reviewing the standard regularity theory, we will introduce a weaker notion of viscosity solutions. The novelty is that we consider functions that do not necessarily satisfy an infinitesimal equation but rather exhibit a two-scale behavior. Roughly, our viscosity solutions satisfy comparison in a neighborhood of a touching point whose size depends on the properties of the test functions.

As an application, we recover the $C^{1\alpha}$ estimates of Almgren and Tamanini for quasi-minimizers of the perimeter functional. We also establish the regularity of the free boundary for almost minimizers of one-phase type problems.

Video

D. Research Seminar

Organized by Rosa Fuster Aguilera and Rong Tang.

- Betul Orcan-Ekmekci, Rice University, "Geometric properties of Euler equation on the torus"
- Paula Burkhardt-Guim, University of California, Berkeley, "Pointwise lower scalar curvature bounds for C^0 metrics via regularizing Ricci flow"
- Raquel Perales, UNAM, "Maximal volume entropy rigidity for RCD*(-(N-1),N) spaces"
- Alice Lim, Syracuse University, "Loops to infinity and beyond"
- Lisa Naples, University of Connecticut, "An Analyst's Traveling Salesman Theorem for Hölder Curves"
- Liangbing Luo, University of Connecticut, "Logarithmic Sobolev inequality on Heisenberg group"

E. Princeton University Day

Talks by:

- Casey Kelleher, Instructor of Mathematics and NSF Postdoctoral Fellow, Princeton University, “Some old and new problems in Yang--Mills theory”
- Otis Chodosh, Veblen Instructor of Mathematics, Princeton University, “Minimal surfaces in Euclidean space”
- Fernando Codá Marques, Professor of Mathematics, Princeton University, “Abundance of minimal surfaces”

Computer Workshop:

- Instructor: Sigurd Angenent, Professor of Mathematics, University of Wisconsin
- TA: Linda Cook, Graduate Student, Applied & Computational Mathematics, Princeton University

II. Women in Science Seminars

A. NSF grant proposal tips Michelle Manes, NSF
B. Gender pay gap, Michelle Issadore, NCHERM
C. Professional courtesy, Evelyn Grammar
D. Career panel, moderated by Margaret Readdy (IAS/U Kentucky).
   Panel: Kirsten Lum, J&J (Business); Michelle Manes, NSF (Government); Rasha Abadir, SWMHS (K-12); Alina Bucur, IAS (Academia);
E. #metoo Michelle Issadore, NCHERM

E. Resources:
   Michelle Manes: NSF Funding in Mathematics
   Early Career Programs:
   Graduate Research Fellowship Program (undergrad/1st or 2nd year grad)

Math Sciences Postdoctoral Research Fellowship (up to 2 years since PhD)
Standard Research Grants
CAREER grants
Conference/Workshop Grants
Other Programs: REUs, Focused Research Groups, joint initiatives; See NSF main website

Michelle Issadore on Gender Pay Gap:

- When negotiating a higher salary, remember to: Assess, Plan, Ask, Package Proposal.
- See Michelle Issadore's wage gap notes
- Individual salary data is public information for public universities. Google individual universities for data.

Evelyn Grammar on Professional Courtesy:

5 Key Attributes:

1. **Build Credibility** (follow through promises; deliver on time with high quality; If cannot deliver promise on time, notify all parties and find a reasonable new deadline)
2. **Respect & Courtesy** (treat everyone at all levels of your organization with respect; Listen; Accept criticism and advice)
3. **Be Timely & Punctual** (In-person, phone or virtual meetings)
4. **Phone/Email Etiquette** (Answer emails within 24 hours; Not responding is a good way to burn professional bridges; Listen, take notes, follow-up)
5. **Communicate** (Keep all parties informed; overcommunicate, if necessary)

Career panel:

- Develop work skills: Things like comedy improv, technical skills, writing for your university newspaper, will all come to use.

- Take advantage of training opportunities: For example, J&J holds a Women's Initiative Leadership Program and sponsors other programs to connect people together.
- Learn how to be a mentee and how to be a mentor: Rather than putting all of your mentoring needs on the shoulders of one individual, split your mentoring needs up. (Remember you will need 3 letters of recommendation for the academic job market, so you need to talk with people in your department and your field.) Thank your mentors in words and actions by becoming a mentor yourself.
- Take care of your physical and mental self: Practice yoga, meditation, eat well, exercise.
- Advice to Navigate the Work Place

#metoo Michelle Issadore, NCHERM

- **Title IX of the Education Amendments of 1972** is a federal law which prohibits discrimination on the basis of sex in any federally funded education program or activity. Statement and resources from Dept. of Education.
- **Title VII of the Civil Rights Act of 1964** prohibits employment discrimination based on race, color, religion, sex and national origin. Statement and resources from US Equal Employment and Opportunity Commission.
- AAUW **(American Association of University Women)**

Opportunities to Apply for:

- 2019 Grow Conference, October 4-6, 2019, University of Illinois at Urbana-Champaign. Conference for female-identified undergrads to learn about graduate research in math, networking, advice to apply to graduate school. **Application due date: July 15, 2019.**
- **NSA:**

    - Cooperative Education Program: Eligible students are undergraduate 2nd semester freshmen or undergrad sophomores. Alternate work rotations at NSA and college. Majors: EE, Computer Engineering, CS, Cybersecurity, Chinese Language & Studies. See NSA College Programs
    - Internship Programs. This includes the director's Summer Program, Graduate Mathematics Program, Human Resources Intern Program, Civil Liberties and Privacy Summer Intern Program.
    - See https://www.intelligencecareers.gov/icstudents.html for intelligence career opportunities for students.
    - NOTE: you must be a US citizen and must go through a background check. **It is suggested to apply no later than the summer before the program (10 to 12 months prior to start date).**
- Summer Collaborators Program: The IAS School of Mathematics has a summer collaborators program for small groups of researchers for 2-4 weeks. **Application due date: December 1, 2019.**
- **Heidelberg Laureate Forum.** One-week September conference for young people in math and computer science to interact with world experts in these fields. Undergrads, graduate PhD candidates, and young researchers at the postdoctoral level can apply. This includes recent PhDs working in a non-scientific environment. **Application due date: February 14, 2020.**

Further resources:

- The 2016 WAM Yearbook has resources on careers in math, GRE advice, travel grants, gender issues in STEM, starting on page 7.
- The 2017 WAM Yearbook has resources for organizing an Ambassador program activity and work/life balance.
- The 2018 WAM Yearbook has suggestions for negotiating your work conditions, selecting a PhD advisor, resources from the AWM

III. Outreach

A. "Math Carnival" at Princeton Public Library.
Organized by Margaret Readdy with help from Allegra Allgeier, Maxine Calle, Julia Costacurta, Hindy Drillick, Aisha Mercery, Rebecca Rechkin and Cheng Cheng Yang.

B. Introduction to Ambassador Program

Thanks to a generous grant from Lisa Simonyi, the IAS Women and Mathematics Program will fund annually up to three (3) postdoctoral or advanced graduate ambassadors and up to six (6) graduate ambassadors to build support and outreach networks across the country.

WAM Ambassador selection criteria include previous participation in the Women and Mathematics summer program, mathematical expertise, and enthusiasm. Each lead conference organizer and graduate ambassador should have a faculty sponsor (male or female) at their home institution. They must also have matching funds committed to the project.

WAM Ambassadors must also fulfill these requirements:

1. Submit a summary report within 30 days of the completion of the proposed activity.
2. Acknowledge IAS Women and Mathematics and Lisa Simonyi in activity announcements (print and online) and in any publication that results from the activity.
3. Participate in the WAM annual meeting the following May to share best practices and new outreach ideas, and to help train new WAM Ambassadors.

See Ambassador program website for details.

C. Ambassador Program Reports

The WAM participants listened to one representative from each of the funded groups and were able to ask questions regarding organizing similar activities in their own region. Video

The funded activities were:

1. A one-on-one mentoring program for 10 female undergrad/grad pairs held at Virginia Tech to address difficulties in one of their classes. Other activities included a career panel and hosting a public speaker. Dr. Nicole Joseph, an African American professor of mathematics and science education, spoke about the challenges faced by African American women pursuing higher education in STEM.
2. Wikipedia Edit-A-Thon hosted by Clemson University to edit and write Wikipedia biographies of women, especially women mathematicians. Marie

Vitulli (U Oregon), Director of Women in Math Web Project, was the guest facilitator.

3. Student-led AWM Piedmont-Triad conference at Wake Forest University.
4. Inaugural Florida Women in Math Day. One day networking and mathematics immersion experience.
5. One day workshop for Upstate New York area undergraduate and graduate students held at Cornell University. Talks from Cornell faculty, Johns Hopkins Applied Physics Lab, and Corning Incorporated, as well as 3 graduate student speakers.
6. Beyond the Binary Undergraduate Mathematics Conference at the University of Hartford. Conference to promote gender diversity in mathematics and to explore career opportunities.

III. Karen Uhlenbeck, the 2019 Abel Prize Laureate

Photo by Elizabeth Boluch Wood

2019 Abel Prize website
The Award Ceremony

Abel Lectures at the University of Oslo:

- Karen Keskulla Uhlenbeck, University of Texas, Austin: The Abel lecture
- Chuu-LianTerng, UC Irvine: Solitons in Geometry
- Robert Bryant, Duke University: Limits, Bubbles, and Singularities: An introduction to the fundamental ideas of Karen Uhlenbeck
- Matt Parker, Standup Mathematician: Popular lecture: An Attempt to Visualise Minimal Surfaces and Maximum Dimensions

More WAM 2019 photos...

Links to stay in touch:

2019 WAM Program

WAM website

IAS

IAS (@the_IAS) Twitter