UNIVERSITY OF MICHIGAN
Department of Mathematics

Seminar & Events Bulletin: Student Analysis

09-01-2012 to 06-30-2013

Thursday, September 13, 2012	
5:10pm-6:00pm	**Student Analysis** -- () *Organizational Meeting* -- 2866 East Hall

Thursday, September 20, 2012	
5:10pm-6:00pm	**Student Analysis** -- Elena Yudovina (UM) *Solving the Dirichlet Problem with Probability* -- 2866 East Hall

Thursday, September 27, 2012	
5:10pm-6:00pm	**Student Analysis** -- Purvi Gupta (UM) *Dissecting Intersection Bodies: A Painless Introduction* -- 2866 East Hall

Thursday, October 04, 2012	
5:10pm-6:00pm	**Student Analysis** -- Rafe Kinsey (University of Michigan) *The Double Layer Potential and the Solution to the Dirichlet Problem* -- 2866 East Hall

Thursday, October 11, 2012	
5:10pm-6:00pm	**Student Analysis** -- Alex Mueller (UM) *Group Theory and Differential Equations* -- 2866 East Hall

Thursday, October 18, 2012	
5:10pm-6:00pm	**Student Analysis** -- Jeff Calder (University of Michigan) *A Deterministic Two-Person Game for Motion by Curvature* -- 2866 East Hall

Thursday, October 25, 2012	
5:10pm-6:00pm	**Student Analysis** -- Jen Beichman (University of Michigan) *1D dispersive PDE and the 2D water wave problem* -- 2866 East Hall

Thursday, November 01, 2012	
5:10pm-6:00pm	**Student Analysis** -- William Gignac (University of Michigan) *...recurrenceurrencrecurrenrrence... in symbolic dynamics* -- 2866 East Hall

Thursday, November 08, 2012	
5:10pm-6:00pm	**Student Analysis** -- Derek Wood (University of Michigan) *Littlewood-Paley Theory: A Brief Introduction* -- 2866 East Hall

Thursday, November 15, 2012	
5:10pm-6:00pm	**Student Analysis** -- Jeremy Hoskins (University of Michigan) *Symmetry and Differential Equations* -- 2866 East Hall

Thursday, November 22, 2012	
5:10pm-6:00pm	**Student Analysis** -- () *No Talk (Thanksgiving Day)* -- 2866 East Hall

Thursday, November 29, 2012	
5:10pm-6:00pm	**Student Analysis** -- Matthew Jacobs (University of Michigan) *Zeta Function Universality* -- 2866 East Hall

Seminar & Events Bulletin: Student Analysis

09-01-2012 to 06-30-2013

Thursday, January 17, 2013	
5:10pm-6:00pm	**Student Analysis** -- () *Organizational Meeting* -- 3096 East Hall

Thursday, January 24, 2013	
5:10pm-6:00pm	**Student Analysis** -- Matt Jacobs (University of Michigan) *The Prime Number Theorem* -- 3096 East Hall

Thursday, January 31, 2013	
5:10pm-6:00pm	**Student Analysis** -- Purvi Gupta (University of Michigan) *Deconstructing the Infinity Laplacian* -- 3096 East Hall

Thursday, February 07, 2013	
5:10pm-6:00pm	**Student Analysis** -- Derek Wood (University of Michigan) *Strichartz Estimates* -- 3096 East Hall

Thursday, February 14, 2013	
5:10pm-6:00pm	**Student Analysis** -- () *No Talk* -- 3096 East Hall

Thursday, February 21, 2013	
5:10pm-6:00pm	**Student Analysis** -- Rafe Kinsey (University of Michigan) *How to Prove Existence of Nonlinear PDE* -- 3096 East Hall

Thursday, February 28, 2013	
5:10pm-6:00pm	**Student Analysis** -- Joe Roberts (University of Michigan) *Ill Posed Problems* -- 3096 East Hall

Thursday, March 07, 2013	
5:10pm-6:00pm	**Student Analysis** -- () *No Talk (Spring Break)* -- 3096 East Hall

Thursday, March 28, 2013	
5:10pm-6:00pm	**Student Analysis** -- Jeff Calder (University of Michigan) *A Hamilton-Jacobi equation for the continuum limit of non-dominated sorting* -- 3096 East Hall

Thursday, April 11, 2013	
5:10pm-6:00pm	**Student Analysis** -- Jeremy Hoskins (University of Michigan) *TBA* -- 3096 East Hall

Seminar & Events Bulletin: Student Analysis

09-01-2012 to 06-30-2013

Abstracts

Student Analysis
Thursday, September 13, 2012, 5:10pm-6:00pm
2866 East Hall
()
Organizational Meeting

We will meet briefly to plan for the semester.

Student Analysis
Thursday, September 20, 2012, 5:10pm-6:00pm
2866 East Hall
Elena Yudovina (UM)
Solving the Dirichlet Problem with Probability

Given a domain D in R^n with nice boundary, and a nice function g(x) defined on its boundary, we will use Brownian motion to prove existence and uniqueness of solutions of the Laplace equation "Laplacian(h) = 0 on D, h=g on the boundary of D". No prior acquaintance with Brownian motion (or the Dirichlet problem) required.

Student Analysis
Thursday, September 27, 2012, 5:10pm-6:00pm
2866 East Hall
Purvi Gupta (UM)
Dissecting Intersection Bodies: A Painless Introduction

In 1956, Busemann and Petty posed the following problem: if the volumes of all the hyperplane sections through the origin of one centrally symmetric convex body are smaller than that of another such body, is its volume also smaller? A unified solution to this problem (1999) was obtained using intersection bodies. In this talk, I will introduce them, discuss a Fourier-analytic characterization, mention some examples and indicate their connection with the Busemann-Petty problem.

Seminar & Events Bulletin: Student Analysis

09-01-2012 to 06-30-2013

Student Analysis
Thursday, October 04, 2012, 5:10pm-6:00pm
2866 East Hall
Rafe Kinsey (University of Michigan)
The Double Layer Potential and the Solution to the Dirichlet Problem

In this talk, I will present one of the many techniques to solve the Dirichlet problem, the double layer potential. I will explain, first, its classical use, via Fredholm theory, to solve the Dirichlet problem on smooth domains. Then I will introduce more recent results, from the 1980s, that applied tools from harmonic analysis to the double layer potential to give solutions to the Dirichlet problem on rough domains. The background assumed will be minimal. Most of the talk requires just basic knowledge of Laplace's equation, Green's identities from multivariable calculus, and rudimentary functional analysis; I will explain the results from harmonic analysis (Calderon-Zygmund operators) I need in the second part for those who haven't seen it before.

Student Analysis
Thursday, October 11, 2012, 5:10pm-6:00pm
2866 East Hall
Alex Mueller (UM)
Group Theory and Differential Equations

I will talk about connections between differential equations on manifolds, covering spaces, and Galois theory.

Student Analysis
Thursday, October 18, 2012, 5:10pm-6:00pm
2866 East Hall
Jeff Calder (University of Michigan)
A Deterministic Two-Person Game for Motion by Curvature

The usual interpretation for motion by curvature involves steepest descent on the perimeter functional. I will present a result by Robert Kohn (2005) which gives an entirely different interpretation involving the value function of a simple deterministic two-person game. The results are surprising as the value function of a deterministic game is usually the solution of a *first-order* Hamilton-Jacobi PDE.

Student Analysis
Thursday, October 25, 2012, 5:10pm-6:00pm
2866 East Hall
Jen Beichman (University of Michigan)
1D dispersive PDE and the 2D water wave problem

The water wave problem in 2D reduces to a 1D problem on the interface which acts like a dispersive PDE in some sense. From this starting point, I will present joint work with Sijue Wu deriving decay estimates for a class of 1D dispersive PDE including the water wave case, with applications to the existence for the solutions of the 2D water wave problem.

Student Analysis
Thursday, November 01, 2012, 5:10pm-6:00pm
2866 East Hall
William Gignac (University of Michigan)
...recurrenceurrencrecurrenrrence... in symbolic dynamics

This will be an introduction to recurrent behavior in dynamical systems. We will prove two basic recurrence theorems, talk about two harder recurrence theorems, and discuss some consequences/applications of them.

Student Analysis
Thursday, November 08, 2012, 5:10pm-6:00pm
2866 East Hall
Derek Wood (University of Michigan)
Littlewood-Paley Theory: A Brief Introduction

The Littlewood-Paley theory was first developed in the 1930s by Littlewood, Paley, Zygmund, and others while studying one dimensional Fourier series. The theory has since been generalized with many useful applications in harmonic analysis and partial differential equations.The focus of this talk will be on the Littlewood-Paley decomposition, which allows one to decompose a function into dyadic sums of frequency localized components. We will cover some of the basic properties of this decomposition, and as time allows we will demonstrate its use through proving some results useful in the study of partial differential equations.

Seminar & Events Bulletin: Student Analysis

09-01-2012 to 06-30-2013

Student Analysis
Thursday, November 15, 2012, 5:10pm-6:00pm
2866 East Hall
Jeremy Hoskins (University of Michigan)
Symmetry and Differential Equations

In the study of differential equations, symmetry analysis is a useful tool for finding and analyzing solutions to differential equations arising in many physical situations. In this talk, we will cover a few classical results and their application to ODEs.

Student Analysis
Thursday, November 22, 2012, 5:10pm-6:00pm
2866 East Hall
()
No Talk (Thanksgiving Day)

Student Analysis
Thursday, November 29, 2012, 5:10pm-6:00pm
2866 East Hall
Matthew Jacobs (University of Michigan)
Zeta Function Universality

A function is said to be universal if it can approximate some class of functions arbitrarily well. The study of these objects began in the early 20th century, but it was not until 1975 that Voronin found the first explicit example of a universal object, the Riemann zeta function. Voronin's Universality Theorem roughly states that the zeta function approximates nonvanishing holomorphic functions arbitrarily well in the critical strip. I will sketch a proof of this theorem and if time allows discuss connections to analytic number theory.

Student Analysis
Thursday, January 17, 2013, 5:10pm-6:00pm
3096 East Hall
()
Organizational Meeting

Seminar & Events Bulletin: Student Analysis

09-01-2012 to 06-30-2013

Student Analysis
Thursday, January 24, 2013, 5:10pm-6:00pm
3096 East Hall
Matt Jacobs (University of Michigan)
The Prime Number Theorem

The prime number theorem (PNT) is the most important result of analytic number theory. The PNT states that the growth of the prime counting function is asymptotic to the logarithmic integral function li(x). A concrete program to attack PNT was first outlined by Riemann in his amazingly influential 1859 paper "On the number of primes less than a given magnitude". The proof was finally completed independently by Hadamard and de la Valle-Poussin in 1896. Though we now have many different proofs of the prime number theorem, the original proof stands out for its beauty and transparency. The proof is notable for combining many different techniques from both real and complex analysis. I will give a detailed outline of the proof and try to explain what I think are the key ideas.

Student Analysis
Thursday, January 31, 2013, 5:10pm-6:00pm
3096 East Hall
Purvi Gupta (University of Michigan)
Deconstructing the Infinity Laplacian

What is common between the optimal Lipschitz extension problem and a game of tug-of-war? One connection is via the infinity Laplacian --- a fully non-linear degenerate elliptic second-order partial differential operator that is obtained as a limit of 'generalized' Laplacians. In this talk, we will first describe the interpolation problem that motivated the study of this operator and then switch gears to see a game-theoretic interpretation of the associated Dirichlet problem. The talk will be elementary, and despite the topic, there will be very little PDE (we won't integrate by parts even once).

Student Analysis
Thursday, February 07, 2013, 5:10pm-6:00pm
3096 East Hall
Derek Wood (University of Michigan)
Strichartz Estimates

Strichartz estimates are powerful tools used in the study of dispersive partial differential equations. They were initially obtained by R. Strichartz using Fourier restriction theorems and a duality argument. They have since been generalized and used extensively. Our focus will be on the Strichartz estimates for the wave equation. We will outline their proof, and apply them to prove a small data global existence result.

Seminar & Events Bulletin: Student Analysis

09-01-2012 to 06-30-2013

Student Analysis
Thursday, February 14, 2013, 5:10pm-6:00pm
3096 East Hall
()
No Talk

Student Analysis
Thursday, February 21, 2013, 5:10pm-6:00pm
3096 East Hall
Rafe Kinsey (University of Michigan)
How to Prove Existence of Nonlinear PDE

My talk will be a relatively elementary introduction to basic concepts in nonlinear (time-dependent) PDE. I'll discuss the basic paradigm we use to prove local-in-time well-posedness: we prove an "a priori" inequality (often called an "energy inequality") and then we use it to prove existence of solutions for a short period of time. These proofs often involve taking tools from the machinery of functional analysis (things like contraction mappings, Banach-Alaoglu, etc.). I'm going to discuss this basic conceptual setup, with a few simple examples, and then survey different specific approaches to proving local existence. Time permitting, I'll then say a few words about global existence.

The talk should be accessible to people without much PDE background. (But, for those with more PDE background, I'll try to include some more subtle issues about the delicacies of proving well-posedness in more difficult cases.)

Seminar & Events Bulletin: Student Analysis

09-01-2012 to 06-30-2013

Student Analysis
Thursday, February 28, 2013, 5:10pm-6:00pm
3096 East Hall
Joe Roberts (University of Michigan)
Ill Posed Problems

In PDE, a problem consists of one or more partial differential equations along with boundary and/or initial data. A well posed problem has a unique solution that depends continuously on the data in some suitable topology. An ill posed problem is then a problem in which at least one of existence, uniqueness, or continuous dependence fails to hold. Obtaining existence and uniqueness usually means finding the right number of conditions to impose, while obtaining continuous dependence usually means finding the right kinds of conditions to impose. I'll go over some classical examples of ill posed problems demonstrating some different ways things can go badly. The talk will be accessible to those without much knowledge of PDE's.

Student Analysis
Thursday, March 07, 2013, 5:10pm-6:00pm
3096 East Hall
()
No Talk (Spring Break)

Seminar & Events Bulletin: Student Analysis

09-01-2012 to 06-30-2013

Student Analysis
Thursday, March 28, 2013, 5:10pm-6:00pm
3096 East Hall
Jeff Calder (University of Michigan)
A Hamilton-Jacobi equation for the continuum limit of non-dominated sorting

Given a finite partially ordered set, one can arrange the points in the set into layers in the following way. The first layer is the set of minimal elements with respect to the partial order. The second layer is obtained by removing the first layer, and finding the minimal elements in what remains. Further layers are obtained recursively by repeatedly removing the set of minimal elements. When applied to points in Euclidean space with the usual partial order this algorithm is called non-dominated sorting. It is a fundamental algorithm in multi-objective optimization and has connections to many important problems in combinatorics and probability. In this talk I will sketch the proof of a new result which shows that the layers obtained by non-dominated sorting of random points in Euclidean space converge almost surely, in the large sample size limit, to the level sets of a function which satisfies a Hamilton-Jacobi equation in the viscosity sense. The talk will be at a basic level and will be accessible to all graduate students.

Student Analysis
Thursday, April 11, 2013, 5:10pm-6:00pm
3096 East Hall
Jeremy Hoskins (University of Michigan)
TBA