

# jacobdenson

## Research Interests

Harmonic Analysis and  
Geometric Measure  
Theory

## Contact Information

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## Education

### 2020-Present

PhD in Mathematics at  
the University of  
Wisconsin, Madison.

### 2017-2019

Masters in  
Mathematics at the  
University of British  
Columbia (Thesis:  
Cartesian Products  
Avoiding Patterns).

### 2013-2017

Bachelors in  
Computing Science at  
the University of  
Alberta.

## Research Projects

### 2021-Now **Radial Fourier Multipliers on Manifolds**

*Collaboration with Dr. Andreas Seeger.* The goal of this project is to use the technology of Fourier Integral Operators to extend results about Euclidean radial Fourier multiplier operators to obtain bounds for multipliers for the Laplace-Beltrami operators on compact Riemannian manifolds. Our current progress is detailed in notes linked [here](#).

### 2020-Now **Salem Sets Avoiding Patterns**

The goal of this project is to explore new tools which enable one to extend pattern avoidance methods in the Hausdorff dimension scheme to construct Salem sets avoiding patterns. I am currently exploring ways to improve probabilistic construction methods to construct optimal Salem sets avoiding general families of patterns, as well as exploring the use of extremizer theory to calculate the Fourier dimension of surfaces in Euclidean space with large codimension.

### 2018-2019 **Large Sets Avoiding Rough Patterns**

*Collaboration with Dr. Malabika Pramanik and Dr. Joshua Zahl.* In this project, we hope to find subsets of Euclidean space with large fractal dimension avoiding particular point configurations, which might be described as having a 'rough' character, such as those related to additive structure on fractals.

## Publications

### [Large Salem Sets Avoiding Nonlinear Configurations](#)

Jacob Denson

(Submitted 2021)

### [Cartesian Products Avoiding Patterns](#)

Jacob Denson

MSc Thesis (University of British Columbia) (2019)

### [Large Sets Avoiding Rough Patterns](#)

Jacob Denson, Malabika Pramanik, Joshua Zahl

Harmonic Analysis and Applications (2021) pp. 59–75. Springer International Publishing

### [Proofs in Three Bits or Less \(Expository Article\)](#)

Jacob Denson

CMS Notes from the Margin (2018) pp. 1–3

## Awards

2019

February Fourier Talks  
Poster Presentation  
Award (2nd Place)

2018

NSERC CGSM  
UBC Science Graduate  
Award  
(2nd Time)

2017

UBC Science Graduate  
Award  
U of A Dean's Silver  
Medal in Science  
NSERC USRA  
(2nd and 3rd Time)

2016

Jason Lang  
Scholarship  
(3rd Time)

2015

Jason Lang  
Scholarship  
(2nd Time)

2014

NSERC USRA  
Jason Lang  
Scholarship

2013

U of A Academic  
Excellence Scholarship  
U of A Science  
Academic Excellence  
Scholarship  
Alexander Rutherford  
Achievement  
Scholarship

## Teaching Assistantships

2019

Multivariate Calculus  
Graph Theory

2018

Introduction to Discrete  
Mathematics  
Introduction to  
Probability

2017

Calculus for Forestry  
Students  
Calculus for Business  
Students

2015

Tangible Introduction  
to Computer Science  
Undergraduate TA

## Conference Presentations

2022 **Nodal Domains via Diffusion Processes**

*Presented at the University of Bonn's 2022 Summer School on Nodal Domains and Landscape Functions.* An expository talk based on the work of Georgiev, Muchkherjee, and Steinerberger, discussing how the theory of stochastic flows can be used to determine geometric properties of the nodal sets of an eigenfunction to the Laplacian on a compact Riemannian manifold. A short summary of the talk can be found on the summer school's website [here](#).

2022 **Logarithmic Improvements to  $L_p$  Bounds for Eigenfunctions**

*Presented at the University of Madison Wisconsin's "Harmonic Analysis on Manifolds" Summer School.* A

2021 **Capacity of Rank Decreasing Operators**

*Presented at the University of Bonn's 2021 Summer School on Brascamp-Lieb Inequalities.* An expository talk based on the work of Garg, Gurvits, Oliveira, and Wigderson, which discusses how the method of *operator scaling* can be used to efficiently approximate Brascamp-Lieb inequalities, by connecting the theory to the study of the capacity of rank non-decreasing operators. A short summary of the talk can be found on the summer school's website [here](#).

2020-2021 **Salem Sets Avoiding Patterns**

*Presented at:*

- *The 2020 Ohio River Analysis Meeting.*
- *The University of Wisconsin Analysis Student Seminar.*

A talk discussing my work on constructing high dimensional Salem sets avoiding configurations. I emphasized the square root cancellation result necessary to extend previous results on Hausdorff dimension to constructing Salem sets, and the various concentration of measure results one can use to obtain this square root cancellation when using randomized constructions.

2018-2019 **Fractals Avoiding Fractal Sets**

*Presented at:*

- *The 2018 Mid-Atlantic Analysis Meeting.*
- *The 2018 CMS Winter Meeting.*
- *The 2019 Geometric and Harmonic Analysis (GAHA) Conference.*
- *Poster at the 2019 February Fourier Talks. Awarded Prize for 2nd Best Poster out of 19 participants.*
- *Poster at the 2019 Madison Lectures in Fourier Analysis.*

A talk discussing my work with Dr. Malabika Pramanik and Dr. Joshua Zahl on constructing high dimensional sets avoiding configurations. I emphasized the idea behind the discretization of a problem when working a single scale, as well as the phrasing of the discrete problem in terms of constructing independent sets in a hypergraph.

2016 **Molecular Gases and the Natural Numbers**

*Presented at the Canadian Undergraduate Mathematics Conference.* An expository talk introducing ergodic theory to undergraduate students, emphasizing its relation to a variety of problem in mathematics, especially number theory.