

# Arun Suresh

*PhD candidate - University of Missouri*

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## Education

- 2021 – Now **PhD in Mathematics**  
*University of Missouri, Columbia, MO, United States*  
**Dissertation:** *The Geometry of Second Moments: Signal recovery estimates for Phase Retrieval and MRA problems (Tentative title)*  
**Advisor:** Dr. Dan Edidin
- 2020 – 2021 **Dual B.S. (Honors) + M.S. in Mathematics - Summa cum Laude**  
*Georgia State University, Atlanta, GA, United States*  
**Thesis:** *The Generators, Relations and Type of the Backelin Semigroup*  
**Advisor:** Dr. Florian Enescu

## Research Interests

**Applied Mathematics:** Applied algebraic geometry and representation theory for inverse problems.  
**Data Science:** Computational Imaging, Topological Data Analysis, Invariant Machine Learning.  
**Applied Data Science:** Dynamic, Spatio-temporal modeling and ML for Biology/Epidemiology.

**Exploring:** AG in Computer Vision, Polynomial/Semialgebraic n.nets, Markov/Stochastic modeling.

## Research Positions

- Summer 2025 **Graduate Research Assistant, MU department of mathematics.**  
**Project:** Recovering 3D protein structure from cryo-electron microscopy measurements
- Spring 2025 **Project Lead (volunteer), MU Institute of Data Science and Informatics.**  
**Project:** Dynamic Spatiotemporal model to predict CWD infection spread in Kansas.
- Summer 2023 **Graduate research assistant, MU department of mathematics.**  
**Project:** The generic crystallographic phase retrieval problem.
- Summer 2020 **Graduate research assistant, GSU department of mathematics and statistics.**  
**Project:** Parameter estimation models and neural ODEs.
- Fa+Sp 2019 **University assistant, GSU department of mathematics and statistics.**  
**Project:** (Minimal) generators of the presentation ideal of the Backelin semigroup ring.

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## Publications

- [Prep.] Dan Edidin, **Arun Suresh**. 2025.  $O(n)$  Beltway problem with applications to cryo-EM and Euclidean Distance Geometry. *In preparation*
- [Prep.] **Arun Suresh**, Zoe Shanley, Ram K. Raghavan, et al. 2025. The Direction and Rate of Spread of Chronic Wasting Disease via Spatiotemporal modeling. *In preparation*
- JoFoCM Tamir Bendory, Nadav Dym, Dan Edidin, **Arun Suresh**. 2024. A transversality theorem for semi-algebraic sets with application to signal recovery from the second moment and cryo-EM. *Journal of Foundations of Computational Mathematics*
- SIMODS Tamir Bendory, Nadav Dym, Dan Edidin, **Arun Suresh**. 2023. Phase retrieval with semi-algebraic and ReLU neural network priors. *SIAM journal on mathematics of data science*
- Submitted Dan Edidin, **Arun Suresh**. 2023. The generic crystallographic phase retrieval problem. *Journal of Applied and Computational Harmonic Analysis*.
- CiA 2021 Florian Enescu, **Arun Suresh**. 2021. The generators relations and type of the Backelin semigroup. *Communications in Algebra*

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## Awards and achievements

- Spring 2023 **Huckaba Scholarship in algebra**, *University of Missouri*.  
This award entailed a \$1,200 scholarship prize
- Spring 2023 **Excellence in graduate teaching**, *University of Missouri*.  
This award entailed a \$300 scholarship.
- Fall 2021 **Excellence in qualifying exams - Algebra, Analysis**, *University of Missouri*.  
This award entailed a \$600 scholarship prize
- Spring 2021 **V.V.Lavroff award for exceptional graduate achievements**, *GSU*.  
This award entailed a \$600 scholarship prize.
- Spring 2019 **V.V.Lavroff award for exceptional undergraduate achievements**, *GSU*.  
This award entailed a \$300 scholarship prize.
- Fall 2017 **Kirkland Sattlemeyer Scholarship**, *Georgia State Honors College*.  
Waived \$2000 off the yearly tuition fees for my Junior and Senior years.
- Fall 2016 **Campus Atlanta Scholarship**, *Georgia State University*.  
Waived the out of state portion of my yearly tuition ( $\sim$ \$18000) during my undergraduate enrollment.

## Talks and Presentations

### Research talks

- Fall 2025 **Math and Data Seminar**, *U. of Missouri*.  
Title: Recovery of point configuration from unlabeled inter-point distances.
- Fall 2025 **AMS Fall Sectional Conference**, *St. Louis University*.  
Title:  $O(n)$  beltway problem with one isolated point.
- Summer 2025 **SIAM conference on Applied Algebraic Geometry**, *U. of Wisconsin (Madison)*.  
Title: Phase Retrieval for Signals that are Sparse Under a Generic Orthonormal Basis
- Summer 2023 **Codes and Expansion (CodEx)**, *Online*.  
Title: The generic crystallographic phase retrieval problem
- Spring 2023 **Commutative Algebra Regional Expository Seminar (CARES)**, *Online*.  
Title: Betti numbers of the Backelin semigroup
- Spring 2023 **Pre-print seminar**, *MU department of mathematics*.  
Title: Exploring the Backelin semigroup
- Spring 2020 **MathNexus - student body at ISI**, *Online*.  
Title: The generators, relations and type of the Backelin semigroup
- Fall 2019 **Georgia Undergraduate Research Conference**, *University of North Georgia*.  
Title: The minimal generating set for the presentation ideal of the Backelin semigroup ring.
- Spring 2018 **GSU algebra seminar**, *Georgia State University*.  
Title: On the number of generators for the presentation ideal of a semigroup ring.

### Co-curricular and outreach talks

- Fall 2025 **Graduate Student Seminar**, *MU Department of Mathematics*.  
A primer on Euclidean Distance Geometry with unlabeled distances
- Summer 2023 **GSU-MathPath workshop for undergraduates**, *Online*.  
A workshop on the peer-review process
- Fall 2022 **Graduate student seminar**, *MU department of mathematics*.  
Title: All the money in the world cannot buy me 151 chicken McNuggets\*
- Fall 2022 **Pre-print seminar**, *MU department of mathematics*.  
Title: Every algebraic set in  $n$ -space is the intersection of  $n$ -hypersurfaces
- Spring 2022 **GSU Mathematics and Statistics Undergraduate research conference**, *Online*.  
Title: The art of reasoning: why it is meaningful to pursue a graduate degree in mathematics
- Spring 2020 **Mathematical music composition workshop**, *Perimeter college*.  
Title: La-Pendu: An exploration of neo-Riemannian transformations and Euclidean rhythms.  
Original music composition: La-Pendu
- Spring 2019 **Mathematical music composition workshop**, *Georgia State University*.  
Title: Neo-Riemannian transformations and Sierpinski-like walks across the Tonnetz.  
Original music composition: Spring

## Posters

- Fall 2023 **Western Algebraic Geometry Symposium**, *Washington University*.  
Title: Second moment of dihedral actions, incidence varieties and ensuring signal recovery
- Summer 2020 **eCARs conference**, *Online*.  
Betti-sequence for the Backelin semigroup
- Spring 2019 **Georgia State Undergraduate Research Conference**, *Georgia State University*.  
Title: Numerical semigroup rings and the Frobenius coin exchange problem
- Fall 2018 **Georgia Undergraduate Research Conference**, *University of North Georgia*.  
Title: On the existence of arbitrarily large number of generators for the presentation ideal of semigroup rings
- Fall 2018 **Undergraduate Math Symposium**, *University of Illinois, Chicago*.  
Title: On the minimal number of relations among the generators of the Backelin semigroup

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## Mentorship

2023 - Now **Directed Readings Program at MU**, *Founder, Coordinator, Mentor*.

**Fall 2025:** *Principal Component Analysis with appl. to epidemiology (CWD prediction)*  
—**Mentee:** Sevara Pulatova (Sophomore at Mizzou)

**Spring 2025:** *Linear, Logistic and Generalized regression models*  
—**Mentee:** Catriana Boul (Junior at Mizzou)

**Fall 2024:** *Stochastic Processes and Markov Chains (with appl. in biology)*  
—**Mentee:** Zoe Shanley (applying to grad schools.)

**Spring 2024:** *ML for ODE parameter estimation via the genetic algorithm*  
—**Mentee:** Vaso Micheas (now applied math PhD student at Texas A & M)

**Spring 2024:** *Neural networks and the universal approximation theorem.*  
—**Mentee:** Jake Parmentier (now applied math PhD student at CU Boulder)

**Fall 2023:** *Understanding fiber bundles by visualizing  $\text{Spec}(\mathbb{Z})$*   
—**Mentee:** Logan Chambers (now Physics PhD student at Montana State)

**Spring 2023:** *Picturing rings - exploring the marriage b/w algebra and geom.*  
—**Mentee:** James Mc. Millen (now Physics PhD student at Northeastern)

Spring 2025 **MU Institute of Data Science and Informatics**, *Project Lead (Volunteer)*.  
Modelling the spatio-temporal spread of Chronic Wasting Disease in Kansas using data using data-driven parameter estimation for a spatially augmented dynamical system.  
— **Mentee:** Zoe Shanley.

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## Teaching

2021 - Now **University of Missouri, Graduate Teaching Assistant.**

**Teaching:**

**Fall 2024 - Fall 2025:** Math 1700, Calculus and analytic geometry 2 (Recitations)

**Fall 2023 - Fall 2024:** Math 1500, Calculus and analytic geometry 1 (Recitations)

**Fall 2023:** Math 1500H, Calculus and analytic geometry 1 - Honors (Recitations)

**Spring 2023:** Math 1400, Calculus for social and life sciences

**Fall 2022:** Math 1300, Finite mathematics

**Fall 2021 - Summer 2022:** Math 1100, College algebra

**Grading:**

**Fall 2021 - Spring 2023:** Math 3000, Introduction to advanced mathematics.

2020-2021 **Georgia State University, Graduate teaching assistant.**

**Teaching:**

**Fall 2020 - Spring 2021:** Math 1111, College algebra

2017-2020 **Mathematics Assistance complex (MAC) at GSU, Graduate lab assistant.**

**Positions:**

**Spring 2020:** Graduate Lab Assistant

**2018-2019:** University Assistant

**2017:** Undergraduate student assistant

**Classes tutored:**

All undergraduate math courses offered (MATH 1001-6752), barring those that required a statistics or bio-informatics concentration.

Summer 2017 **IIT-Buds Private Ltd., RMO coach.**

Prepared students towards regional mathematics olympiad.

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## Extra Curricular

2023 - Now **Directed Readings Program (DRP) at MU, Founder, mentor.**

2022 - 2024 **American mathematical society - MU graduate student chapter, President.**

2022 - 2023 **(Student led) MU algebraic geometry reading group, Coordinator, presenter.**

2022 - Now **MU mathematics graduate student seminar, Co-coordinator.**

2018 - 2021 **GSU Continuum group (Putnam team), Founder, member.**

2018 - 2021 **Mathematics and Statistics club at GSU, President.**

Summer 2016 **Org. for the promotion of science (Chennai, TN, India), Speaker, member.**

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## Skills

Programming: Python, Matlab, Julia, Macaulay2, R, C++, Haskell (beginner).

Languages: English, Tamil,  $\text{\LaTeX}$ .

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## Certificates

- Spring 2024 Advanced Google Data Analytics certificate, *Google (via Coursera) online*.  
Spring 2023 Google Data Analytics certificate, *Google (via Coursera) online*.  
Fall 2023 Advanced Learning Algorithms, *DeepLearning.ai, Stanford online*.

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## Selected Personal Projects

- Spring 2025 **Modelling the spatio-temporal spread of Chronic Wasting Disease in Kansas**, *University of Missouri*.  
Mentored undergraduate student research project to address the spatio-temporal inconsistencies in CWD prevalence data using parameter estimation for a spatially augmented dynamical system. Built a predictive **mathematical model** with **87.4% accuracy** using geospatial+ML tools. Applied PCA to infection co-variate data, training a random forest classifier that **improved classification accuracy to 93%**
- Fall 2024 **Topological Machine Learning Pipeline for Dimension Reduction**, *University of Missouri*.  
Built an ML pipeline in Python (Torch, Giotto) using persistent homology data of point clouds to **downscale input feature size by 90%**. Trained a **random forest classifier** with topological features for regression and classification tasks, achieving comparable performance to industry standard, with an **out-of-bag score of 100% on synthetic data** and **82.5% on real-world data**.
- Spring 2024 **Simultaneous Robust Subspace Recovery via Quiver representation Theory**, *University of Missouri*.  
Implemented a python package that employs simultaneous robust subspace recovery for dimension reduction. The SRSR scheme effectively extracts a dominant low-dimensional linear subspace contained in a high-dimensional point cloud while minimizing the loss of statistical properties of the original point-cloud.
- Spring 2024 **Optimizing Solar Practicality Across the U.S.**, *Google - Data Analytics Certificate*.  
Built a solar feasibility model on **1M+ records**, identifying 3 key metrics to evaluate solar potential across 40K+ ZIP codes. Developed an **R-based ETL pipeline** to integrate geospatial, cost, and energy data, reducing noise by ~60% and identifying solar hot-spots at state/zip levels - suggesting avenues **sustainable environmental developments**. Launched a **Tableau dashboard** with dynamic parameter tuning, visualizing ROI trade-offs and demonstrating **> 15K metric tons CO<sub>2</sub> offset** and **\$6M+ annual savings** in electricity per zip-locality.
- Fall 2020 **Numerical analysis research group (Mentor: Dr. Xiaojing Ye)**, *Georgia State University*.  
Built a compressed sensing pipeline in Julia with **accelerated proximal gradient optimizer** to improve reception and transmission of **sparse signals**. Implemented a sparsification layer utilizing **Wavelet transforms** (FFT, Wavelets.jl) to handle non-sparse signals. **Delivered a 4× speed-up** to traditional CS methods, while also maintaining the **average error rate below 1%**.

Spring 2020 **Numeripy**, *Online*.

Developed a Python package that offers a comprehensive suite of **20+ numerical methods** including 12 robust differential equation solvers and 9 advanced matrix algebra tools. Garnered significant adoption with an average of **60 downloads per month** and over **6,035 total downloads** to date.

Spring 2019 **Identifying financial bubbles via Nucleation Theory**, *Georgia State University*.

Built a model to **detect market bubbles across 4 financial sectors** by adapting Avrami-JMAK equations from physical nucleation theory. Fitted the adapted model using non-linear LS regression to the 2007 housing bubble data, and **identified scale-invariant indicators** predicting the formation of market bubbles **with 88% accuracy** across four economic sectors.

Fall 2018 **Physics4500 - Computational fluid dynamics**, *Georgia State University*.

Simulated the gravitational collapse of a Spherical Magnetic Molecular Cloud Core With ENZO AMR MHD Code. Used GSU's supercomputer cluster "Harlow" for **parallel computing support**.

References available upon request.