Mykhaylo M. Malakhov

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Education

University of Minnesota **Minneapolis, MN**
PhD in Biostatistics *2020–present*

- Expected to defend in the spring of 2025
- Advised by Wei Pan
- Member of the Interdisciplinary Biostatistics Training in Genetics and Genomics program

Andrews University **Berrien Springs, MI**
BS in Mathematics *2016–2020*

- Minor in Computing
- *Summa Cum Laude* and J. N. Andrews Honors Scholar
- Thesis: "Managing White-nose Syndrome in Bats: A Spatially Dynamic Modelling Approach"

Budapest Semesters in Mathematics **Budapest, Hungary**
Study abroad *Fall 2019*
Selective study abroad program focusing on advanced mathematics

Experience

Research

University of Minnesota School of Public Health **Minneapolis, MN**
Graduate Research Assistant *2023–present*

- Introduced the co-expression-wide association study (COWAS) method for identifying genes or proteins whose genetically regulated co-expression is associated with complex traits
- Contributed to a study showing that imputation of Alzheimer's disease can enhance the performance of nonlinear transcriptome- and proteome-wide association studies (TWAS/PWAS)
- Contributed to the development of Mendelian randomization methods for causal inference with multiple correlated exposures (MVMR-cML-SuSiE) and multiple related outcomes (MR2-cML-SuSiE)

Denali Therapeutics **South San Francisco, CA**
Human Genetics Intern *Summer 2023*
Was part of the Discovery Genomics Group

- Built cloud-based infrastructure that enabled scientists across the company to easily clean, store, and access genome-wide association study (GWAS) data
- Leveraged public GWAS data to better understand the molecular mechanisms of genetic variants associated with neurodegenerative diseases

University of Minnesota School of Public Health **Minneapolis, MN**
Predoctoral Trainee *2020–2023*
Was funded by a T32 Training Grant from the National Institutes of Health (NIH)
- Proposed and implemented the differential regulation analysis by bootstrapping (DRAB) framework, a statistical approach for identifying genes with context-specific patterns of local genetic regulation
- Contributed to the first study demonstrating nonlinear effects of gene expression on complex traits

Institute for Pure and Applied Mathematics **Los Angeles, CA**
Researcher and Project Manager *Summer 2019*
Was part of the Air Force Research Laboratory (AFRL) team at the Research in Industrial Projects for Students (RIPS) program
- Proposed novel attractor reconstruction and model calibration methods
- Inferred reaction rate coefficients for hydrogen-oxygen combustion from a time series of one observable

Williams College **Williamstown, MA**
Student Researcher *Summer 2018*
Was part of the SMALL REU program
- Project 1: demonstrated how to improve management outcomes for white-nose syndrome in bats by considering metapopulation dynamics
- Project 2: established guidelines for transboundary infectious disease management when multiple administrative jurisdictions set different objectives

Andrews University **Berrien Springs, MI**
Undergraduate Research Fellow *Summer 2017*
Was part of the Seabird Ecology Research Group
- Modeled the effects of climate change on seabird behavior and population dynamics
- Proved that egg cannibalism and egg-laying synchrony can yield strong Allee effects, which allow gull colonies to survive at higher sea surface temperatures than otherwise possible

Teaching

Andrews University **Berrien Springs, MI**
Teaching Assistant *2017–2020*
- Tutored students of all levels in the Mathematics Center
- Led a short course on LaTeX
- Graded for Foundations of Advanced Mathematics
- Served as a substitute teacher for Calculus I and II

Honors and awards

National

- Williams Award Finalist, International Genetic Epidemiology Society (IGES) Annual Meeting (2024)
- Reviewers' Choice Award, American Society of Human Genetics (ASHG) Annual Meeting (2024)
- Conference Travel Grant from the American Mathematical Society (2019)
- Goldwater Scholarship (2018)

University of Minnesota

- People's Choice Poster Award at the School of Public Health Research Day (2022)
- 2nd place, Best Poster Award at the School of Public Health Research Day (2022)

- 3rd place in the Interdisciplinary Health Data Competition (2022)
- Dean's PhD Scholars Award (2020)
- Jean Roberts Biostatistics Fellowship (2020)

Andrews University

- Excellence awards for 12 mathematics courses (2016–2020)
- Dean's List (every semester)
- Putnam Competition team member (2017, 2018, 2019) and highest scorer at AU (2018, 2019)
- Harold T. Jones Scholarship for highest excellence in mathematics (2018)
- Louis Ulloth Scholarship for most significant leadership contributions (2018)
- Four-year full tuition ACT/SAT scholarship (2016)

Publications

Working papers

1. Chan, L. S., Malakhov, M. M. & Pan, W. Identifying shared and distinct causes of multiple related traits: A robust multi-response Mendelian randomization framework for highly correlated exposures. In preparation.
2. Malakhov, M. M. & Pan, W. Co-expression-wide association studies implicate protein–protein interactions in complex disease risk. Submitted to *The American Journal of Human Genetics*. https://www.medrxiv.org/content/10.1101/2024.10.02.24314813.
3. He, R., Ren, J., Malakhov, M. M. & Pan, W. Enhancing nonlinear transcriptome- and proteome-wide association studies via trait imputation with applications to Alzheimer's disease. In revision at *PLOS Genetics*.

Journal articles

4. Malakhov, M. M., Dai, B., Shen, X. T. & Pan, W. A bootstrap model comparison test for identifying genes with context-specific patterns of genetic regulation. *The Annals of Applied Statistics* **18,** 1840–1857. https://doi.org/10.1214/23-AOAS1859 (Sept. 2024).
5. Chan, L. S., Malakhov, M. M. & Pan, W. A novel multivariable Mendelian randomization framework to disentangle highly correlated exposures with application to metabolomics. *The American Journal of Human Genetics* **111,** 1834–1847. https://doi.org/10.1016/j.ajhg.2024.07.007 (Sept. 2024).
6. Lin, Z., Xue, H., Malakhov, M. M., Knutson, K. A. & Pan, W. Accounting for nonlinear effects of gene expression identifies additional associated genes in transcriptome-wide association studies. *Human Molecular Genetics* **31,** 2462–2470. https://doi.org/10.1093/hmg/ddac015 (July 2022).
7. Blackwood, J. C., Malakhov, M. M., Duan, J., Pellett, J. J., Phadke, I. S., Lenhart, S., Sims, C. & Shea, K. Governance structure affects transboundary disease management under alternative objectives. *BMC Public Health* **21,** 1782. https://doi.org/10.1186/s12889-021-11797-3 (Oct. 2021).

8. Duan, J., Malakhov, M. M., Pellett, J. J., Phadke, I. S., Barber, J. & Blackwood, J. C. Management efficacy in a metapopulation model of white-nose syndrome. *Natural Resource Modeling* **34,** e12304. https://doi.org/10.1111/nrm.12304 (Aug. 2021).

Reports and theses

9. Malakhov, M. M., Fitzpatrick, B. R., Lopez, R. A. & Shivkumar, A. *Attractor Reconstruction and Empirical Parameter Inference for Hydrogen-Oxygen Chemistry.* Technical Report AD1098889 (Air Force Research Laboratory, Aug. 2019). https://apps.dtic.mil/sti/citations/AD1098889.
10. Malakhov, M. M. *Managing White-nose Syndrome in Bats: A Spatially Dynamic Modelling Approach.* Honors Thesis (Andrews University, Apr. 2019). https://doi.org/10.32597/honors/216.

Presentations

Conference talks

1. "Co-expression-Wide Association Studies Implicate Protein-Protein Interactions in Complex Disease Risk." Platform Presentation; International Genetic Epidemiology Society (IGES) Annual Meeting; Denver, CO. (Nov. 2024)
2. "A bootstrap model comparison test for identifying genes with context-specific patterns of genetic regulation." Session on Mediation and Interaction in Genomics; Joint Statistical Meetings (JSM); Toronto, ON, Canada. (August 2023)
3. "Accounting for nonlinear effects of gene expression in transcriptome-wide association studies." Andrews Research Conference (ARC); Andrews University; Berrien Springs, MI. (May 2022)
4. "Modeling the impact of bat dispersal on white-nose syndrome control strategies." Mathematics Section; Michigan Academy of Science, Arts, and Letters (MASAL); Alma College; Alma, MI. (March 2019)
5. "Federalism in Epidemic Modeling: Multi-objective Management of Interconnected Populations." AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs; Joint Mathematics Meetings (JMM); Baltimore, MD. Jointly with Ishan Phadke. (Jan. 2019)
6. "Cannibalism and synchrony in a periodic matrix seabird population model." Mathematics Section; Michigan Academy of Science, Arts, and Letters (MASAL); Central Michigan University; Mount Pleasant, MI. (March 2018)
7. "Backward Bifurcations in a Periodic Matrix Model of Seabird Population Dynamics." MAA General Contributed Paper Session on Modeling and Applications; Joint Mathematics Meetings (JMM); San Diego, CA. (Jan. 2018)

Symposia and other talks

1. "How to find differentially regulated genes." School of Public Health 3-Minute Thesis (3MT®) Competition; University of Minnesota; Minneapolis, MN. (April 2023)
2. "Identifying genes with tissue-specific patterns of genetic regulation." Genomic Data Science Mini-Symposium; Masonic Institute for the Developing Brain (MIDB); Minneapolis, MN. (Oct. 2022)

3. "Attractor Reconstruction and Empirical Parameter Inference for Hydrogen-Oxygen Chemistry." Projects Day; Institute for Pure and Applied Mathematics (IPAM); Los Angeles, CA. Jointly with Brianna Fitzpatrick, Rebecca Lopez, and Abhishek Shivkumar. (Aug. 2019)
4. "Application of Convergent Cross Mapping to Chemical Reactions." Edwards Air Force Base; Boron, CA. Jointly with Brianna Fitzpatrick, Rebecca Lopez, and Abhishek Shivkumar. (Aug. 2019)
5. "Managing White-nose Syndrome in Bats: A Spatially Dynamic Modelling Approach." Honors Thesis Symposium; Andrews University; Berrien Springs, MI. (April 2019)

Poster presentations

1. "Co-expression-wide association studies implicate protein-protein interactions in complex disease risk." Statistical Genetics and Genetic Epidemiology Poster Session; American Society of Human Genetics (ASHG) Annual Meeting; Denver, CO. (Nov. 2024)
2. "Leveraging Public GWAS Data to Inform Discovery." Summer Research Symposium; Denali Therapeutics; South San Francisco, CA. (August 2023)
3. "Identifying genes with tissue-specific patterns of genetic regulation." School of Public Health Research Day; University of Minnesota; Minneapolis, MN. (April 2023)
4. "Governance structure affects transboundary disease management under alternative objectives." School of Public Health Research Day; University of Minnesota; Minneapolis, MN. (April 2022)
5. "Data-driven Attractor Reconstruction and Parameter Inference for Hydrogen-Oxygen Chemistry." MAA Student Poster Session; Joint Mathematics Meetings (JMM); Denver, CO. (Jan. 2020)
6. "Managing White-nose Syndrome in Bats: A Spatially Dynamic Modeling Approach." Honors Scholars and Undergraduate Research Poster Symposium; Andrews University; Berrien Springs, MI. (March 2019)
7. "Efficacy of Control in a Spatially Dynamic Model of White-nose Syndrome." Summer Science Poster Session; Williams College; Williamstown, MA. Jointly with Ishan Phadke. (Aug. 2018)
8. "A Periodic Matrix Model of Seabird Behavior and Population Dynamics." Honors Scholars and Undergraduate Research Poster Symposium; Andrews University; Berrien Springs, MI. (March 2018)

Volunteering and academic service

Ad-hoc peer reviewing:

- *Ecology and Evolution* (`https://onlinelibrary.wiley.com/journal/20457758`)

University of Minnesota School of Public Health **Minneapolis, MN**

BCOE Member *2022–2024*

As a member of the Biostatistics Community Outreach and Engagement Committee (BCOE), I mentored high school students in clinical trial design and data analysis. I also participated in and helped coordinate a wide range of volunteering opportunities for students, faculty, and staff in the Division of Biostatistics and Health Data Science.

Pi Mu Epsilon: The National Mathematics Honor Society **Berrien Springs, MI**

President, Michigan Gamma Chapter *2018–2020*

I organized Pi Day festivities, game nights, and our chapter's induction ceremonies. After one year as President I was reelected for a second term.

Engineers Without Borders USA **Berrien Springs, MI**

Vice President, Andrews University Chapter *2018–2019*

I coordinated outreach activities, assisted with engineering design, and planned travel itineraries for a solar energy project at a remote school in Madagascar. The summer of 2018 I traveled to Madagascar to help conduct the assessment phase of our project.

eigen* (Andrews University math/physics club) **Berrien Springs, MI**

Mathematics President *2017–2018*

I planned colloquia, weekend retreats, and other events for the math/physics community. I also helped organize the first-ever Putnam Competition preparation course and team at Andrews University.

Engineers Without Borders USA **Berrien Springs, MI**

Treasurer, Andrews University Chapter *2017–2018*

I oversaw chapter and project finances, wrote grant applications, and organized fundraising efforts. During my time as Treasurer we raised about $20,000.

Graduate courses

Core:

- Honors Real Analysis I & II
- Theory of Statistics I & II
- Biostatistics: Regression
- Advanced Regression and Design
- Linear Models
- Probability Models for Biostatistics
- Advanced Statistical Inference
- Bayesian Decision Theory and Data Analysis
- Survival Analysis

Electives:

- Statistics for Human Genetics and Molecular Biology
- Advanced Statistical Genetics and Genomics
- GIS and Spatial Analysis for Public Health
- Statistical Learning and Data Mining
- Seminar: Transethnic Association Studies
- Seminar: Imaging Genetics
- Seminar: Bioinformatics Methods

Other:

- Research Skills in Biostatistics
- Foundations of Public Health
- Biomedical Ethics