

# Alejandro N. Diaz

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## EDUCATION

**Rice University** - Houston, TX

Ph.D., Computational and Applied Mathematics, May 2024 (expected)

M.A., Computational and Applied Mathematics, May 2022

Advisor: Prof. Matthias Heinkenschloss, GPA: 3.99

**University of Maryland, College Park** - College Park, MD

B.S., Mathematics with Departmental Honors, Minor Physics, May 2019, GPA 3.83

## RESEARCH AND WORK EXPERIENCE

**Rice University**, Dept. of Computational Applied Mathematics & Operations Research, 2020 - present.

*Interpolatory and nonlinear manifold reduced order models with domain decomposition.*

Advisor: Prof. Matthias Heinkenschloss

**Microsoft**, Data Science Internship, Summer 2023.

*Implemented differential privacy auditing algorithm with  $170\times$  speedup.*

**Lawrence Livermore National Laboratory**, Defense Science and Technology Internship - Graduate Summer Student, Summer 2022.

*Domain-decomposition nonlinear manifold reduced order models using sparse autoencoders.*

Advisor: Dr. Youngsoo Choi

**University of California, Los Angeles**, UCLA Applied Mathematics REU,

Summer 2018. *Data-driven approaches for microfluidic device design.*

Advisors: Prof. Marcus Roper, Dr. Hangjie Ji

**Williams College**, SMALL NSF REU, Summer 2017.

*Tetrahedral tilings, isoperimetric surfaces in spaces with density.*

Advisor: Prof. Frank Morgan

**University of Maryland, College Park**, Summer Student Theoretical Physics Research Session, Summer 2016.

*Tensor computations in supersymmetry.*

Advisor: Prof. S. James Gates Jr.

## PUBLICATIONS AND PREPRINTS

A. N. Diaz, Y. Choi, M. Heinkenschloss. *A fast and accurate domain-decomposition nonlinear manifold reduced order model.* Computer Methods in Applied Mechanics and Engineering, Vol. 425, pages 116943 (2024). <https://doi.org/10.1016/j.cma.2024.116943>.

A. N. Diaz, I. V. Gosea, M. Heinkenschloss, A. C. Antoulas. *Interpolation-based model reduction of quadratic-bilinear dynamical systems with quadratic-bilinear outputs.* Adv Comput Math 49, 95 (2023). <https://doi.org/10.1007/s10444-023-10096-2>

A. N. Diaz, Y. Choi, M. Heinkenschloss. *Nonlinear-manifold reduced order models with domain decomposition.* Machine Learning and the Physical Sciences Workshop, NeurIPS (2023). [https://ml4physicalsciences.github.io/2023/files/NeurIPS\\_ML4PS\\_2023\\_30.pdf](https://ml4physicalsciences.github.io/2023/files/NeurIPS_ML4PS_2023_30.pdf)

A. N. Diaz, M. Heinkenschloss. *Towards Data-Driven Model Reduction of the Navier-Stokes Equations using the Loewner Framework.* Active Flow and Combustion Con-

trol 2021, Notes on Numerical Fluid Mechanics and Multidisciplinary Design, vol 152. Springer, Cham. [https://doi.org/10.1007/978-3-030-90727-3\\_14](https://doi.org/10.1007/978-3-030-90727-3_14)

E. Bongiovanni, A. N. Diaz, A. Kakkar, *et al.* *The Least-Area Tetrahedral Tile of Space*. Geom Dedicata 205, 51–93 (2020). <https://doi.org/10.1007/s10711-019-00465-x>

E. Bongiovanni, A. N. Diaz, A. Kakkar, N. Sothanaphan. *Isoperimetry in Surfaces of Revolution with Density*. Missouri J. Math. Sci. 30 (2018), no. 2, 150–165. <https://doi.org/10.35834/mjms/1544151692>

E. Bongiovanni, L. Di Giosia, A. N. Diaz, *et al.* (2018). *Double Bubbles on the Real Line with Log-Convex Density*. Analysis and Geometry in Metric Spaces, 6(1), pp. 64–88. <https://doi.org/10.1515/agms-2018-0004>

W. Caldwell, A. N. Diaz, I. Friend, *et al.*, *On the Four Dimensional Holonomy of the 4D, N=1 Complex Linear Supermultiplet*, International Journal of Modern Physics A 33 (2018), 1850072. <https://doi.org/10.1142/S0217751X18500720>

## TALKS AND PRESENTATIONS

A. N. Diaz, Y. Choi, M. Heinkenschloss. *Nonlinear manifold reduced order models with domain decomposition*. Poster, Machine Learning and the Physical Sciences Workshop, NeurIPS 2023, 15 Dec. 2023, New Orleans, LA.

A. N. Diaz, Y. Choi, M. Heinkenschloss. *Nonlinear manifold reduced order models with domain decomposition*. Poster, Mathematical Opportunities in Digital Twins, 11 Dec. 2023, Arlington, VA.

A. N. Diaz, *Neural network-based reduced-order models with domain decomposition*. Seminar at the U.S. Army Research Laboratory, Aberdeen, MD.

A. N. Diaz, *Nonlinear manifold reduced order models with domain decomposition*. Presentation, 6th Annual Meeting of the SIAM Texas-Louisiana Section, 4 Nov. 2023, Lafayette, LA.

A. N. Diaz, *Neural network-based reduced-order models with domain decomposition*. Presentation, Research Training Group in Numerical Mathematics and Scientific Computing at Rice University Annual Workshop, 13 Oct. 2023, Houston, TX.

A. N. Diaz, *Nonlinear Manifold Reduced Order Models with Domain Decomposition*. Poster presentation, NDSEG Fellowship Program 4th Annual Conference, 1 Aug. 2023, San Antonio, TX.

A. N. Diaz, *A fast and accurate domain-decomposition nonlinear reduced order model using shallow masked autoencoders*. Presentation, 2023 SIAM Conference on Computational Science and Engineering (CSE23), 27 Feb. 2023, Amsterdam, The Netherlands.

A. N. Diaz, *A fast and accurate domain-decomposition nonlinear reduced order model using shallow masked autoencoders*. Presentation, 5th Annual Meeting of the SIAM Texas-Louisiana Section, 4–6 Nov. 2022, Houston, TX.

A. N. Diaz, *Impact of the Convergence of Series Expansions on Model Reduction of Quadratic-Bilinear Systems*. Presentation, 2022 Model Reduction and Surrogate Modeling Conference, 21 Sept. 2022, Berlin, Germany.

A. N. Diaz, *Data-Driven Model Reduction using the Loewner Framework*. Poster, 2021 Oil and Gas HPC Conference, 5 Mar. 2021, Houston, TX (virtual).

A. N. Diaz, *Data-Driven Model Reduction using the Loewner Framework*. Presentation, Model Order Reduction for Large-Scale Problems Minisymposium, SIAM Conference

on Computational Science and Engineering, 4 Mar. 2021, Fort Worth, TX (virtual).

A. N. Diaz A. Kakkar, *The Least-Area Tetrahedral Tile of Space*. Poster, MAA Undergraduate Student Poster Session, Joint Mathematics Meetings, 12 Jan. 2018, San Diego, CA.

A. N. Diaz *Existence and Boundedness of Isoperimetric Regions in Surfaces of Revolution with Density*, Informal Geometric Analysis Seminar, 14 Nov. 2017, Math Department, University of Maryland, College Park. Seminar.

A. N. Diaz *The Log-Convex Density Conjecture in Hyperbolic Space*. MAA Student Paper Sessions, MathFest. 28 Jul. 2017, Hilton Hotel, Chicago, IL. Student Presentation.

## AWARDS

**Honorable Mention for Poster Presentation in Mathematics**, NDSEG Fellowship Program 4th Annual Conference, Aug. 2023

**Global Young Scientists Summit 2022 Attendee**, Oct. 2021

**DoD National Defense Science and Engineering Graduate (NDSEG) Fellowship**, Mar. 2021,  
Sponsoring Agency: Air Force Office of Scientific Research.

**NSF Graduate Research Fellowship Program Honorable Mention**, Mar. 2021.

**K2I 2020/21 BP Graduate Fellowship**, Rice University, Dec. 2020.

**K2I Computational Science and Engineering Fellowship**, Rice University, May 2019.

**Departmental Honors**, Department of Mathematics, University of Maryland, College Park, May 2019.

**Strauss Teaching Assistantship**, Department of Mathematics, University of Maryland, College Park, Fall 2018 – Spring 2019.

**University Honors Citation**, University of Maryland, College Park, Apr. 2018.

**Outstanding Poster**, Joint Mathematics Meeting, Jan. 2018.

**Banneker-Key Scholarship**, University of Maryland, College Park, May 2015.

## SERVICE

**Fellowship Application Writing Coach**, Office of Graduate and Postdoctoral Studies, Rice University, Aug. 2023 - Present

**SIAM Student Chapter**, Rice University,  
President, Aug. 2022 - Aug. 2023  
Graduate Student Association Representative, Aug. 2021 - Aug. 2022  
Treasurer, Aug. 2020 - Aug. 2021

**Graduate Student Mentor**, Department of Computational and Applied Mathematics, Rice University, Aug. 2021 - Aug. 2022

**Graduate Student Advisory Committee**, Rice University, Member, Aug. 2020 - May 2023

**Freshmen Math Mentorship Program**, Rice University, Graduate Student Mentor,  
Aug. 2020 - Dec. 2020

**TEACHING**

**Rice University**, Department of Computational and Applied Mathematics  
Grader, CAAM 336, Fall 2019, Spring 2020  
Grader, CAAM 453/550, Fall 2020  
Grader, CAAM 554, Spring 2021

**University of Maryland, College Park**, Department of Mathematics  
Teaching assistant, Calculus II, Spring 2019  
Teaching assistant, Calculus I, Fall 2018

**COMPUTER  
SKILLS**

**Programming languages:** Python (incl. PyTorch, TensorFlow, Scikit-Learn), MAT-  
LAB, L<sup>A</sup>T<sub>E</sub>X