

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: 3.98

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, 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

A. N. Diaz, Y. Choi, M. Heinkenschloss. *A fast and accurate domain-decomposition nonlinear manifold reduced order model.* arXiv preprint arXiv:2305.15163 (2023). <https://doi.org/10.48550/arXiv.2305.15163>

A. N. Diaz, M. Heinkenschloss. *Towards Data-Driven Model Reduction of the Navier-Stokes Equations using the Loewner Framework.* Active Flow and Combustion Control 2021, Notes on Numerical Fluid Mechanics and Multidisciplinary Design, vol 152.

Springer, Cham. 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), MATLAB, \LaTeX