Jonas A. Actor

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Education

PhD, Rice University — *Houston, TX*
Department of Computational and Applied Mathematics — *May 2021*
Advisers: Beatrice Riviere and David Fuentes
Thesis: Physics-Based Machine Learning for Image Segmentation

MA, Rice University — *Houston, TX*
Department of Computational and Applied Mathematics — *August 2018*
Adviser: Matthew Knepley
Thesis: Computation of the Kolmogorov Superposition Theorem

BS, University of Chicago — *Chicago, IL*
Department of Mathematics — *June 2016*
Direct Enrollment Program at University of Edinburgh 2014-2015

Research

Senior Member of the Technical Staff, **Sandia National Laboratories**, Center for Computing Research — *Albuquerque, NM*
Structure preservation in scientific machine learning — *August 2023 - Current*
Multimodal learning and causal discovery — *August 2023 - Current*
Property characterization for materials science and microelectronics — *August 2023 - Current*

Postdoctoral Researcher, **Sandia National Laboratories**, Center for Computing Research — *Albuquerque, NM*
Structure preservation in scientific machine learning — *June 2021 - August 2023*
PI: Nat Trask

Graduate Researcher, **Rice University**, Department of Computational and Applied Mathematics — *Houston, TX*
NIH NLM **Predoctoral Fellow,** Biomedical Informatics and Data Science, Gulf Coast Consortia
PDEs and neural networks in image segmentation for hepatocellular carcinoma — *August 2018 - May 2021*
PI: Lydia Kavraki

Graduate Consultant, **Rice University**, Center for Academic and Professional Communication — *Houston, TX*
Consultant and instructor for written, oral, and visual communication — *August 2018 - May 2021*

Summer Researcher, **Lawrence Berkeley National Laboratory**, Computational Research Division — *Berkeley, CA*
Computation of inertia for hierarchical semi-separable matrices — *May 2018 - August 2018*
PI: Xiaoye Li

Graduate Researcher, **Rice University**, Department of Computational and Applied Mathematics — *Houston, TX*
Computation of Kolmogorov Representation for multivariate continuous functions — *August 2016 - May 2018*
PI: Matthew Knepley

Research Consultant, **NanoEar** — *Houston, TX*
Modeling vibration of tympanic membrane to develop new hearing aid technology — *September 2017 - May 2018*

Moncrief Summer Intern, **University of Texas**, Institute for Computational Engineering and Sciences — *Austin, TX*

Modeling of $CaCO_3$ fouling in heat exchangers — *June 2015 - August 2015*

PI: Ivo Babuska

Publications

Papers

Actor, J. A., Walker, E., Trask, N., Propp, A., Tartakovsky, D., Pegolotti, L., & Owhadi, H. (2023). Learning Dirichlet-to-Neumann Maps on Graphs via Gaussian Processes [In Preparation].

Walker, E., Trask, N., Martinez, C., Lee, K., Actor, J. A., Saha, S., Shilt, T., & Boyce, B. (2023). Unsupervised physics-informed disentanglement of multimodal data [In Preparation]. *SIAM Journal of Mathematics of Data Science*.

Walker, E., Actor, J. A., Martinez, C., & Trask, N. (2024). Causal Disentanglement of Multimodal Data [Submitted]. *Conference on Causal Learning and Reasoning*.

Actor, J. A., Huang, A., Hu, X., & Trask, N. (2023). Machine-Learned Drift-Diffusion Models for Compact Circuit Analysis with Structure Preservation Guarantees [In Preparation]. *IEEE*.

Shuai, J., Actor, J. A., Roberts, S., & Trask, N. (2023). A Structure-Preserving Domain Decomposition Method for Data-Driven Modeling [Submitted]. *SIAM Journal on Mathematics of Data Science*.

Actor, J. A., Hu, X., Huang, A., Roberts, S. A., & Trask, N. (2023). Data-Driven Whitney Forms for Structure-Preserving Control Volume Analysis. *Journal of Computational Physics*.

Celaya, A., Actor, J. A., Muthusivarajan, R., Gates, E., Chung, C., Schellingerhout, D., Riviere, B., & Fuentes, D. (2022). PocketNet: A Smaller Neural Network For Medical Image Analysis. *IEEE Transactions on Medical Imaging*.

Actor, Jonas A and Huang, Andy and Trask, Nat. (2022). Polynomial-Spline Networks with Exact Integrals and Convergence Rates. *2022 IEEE Symposium Series on Computational Intelligence (SSCI)*, 1156–1163.

Actor, J., & Knepley, M. G. (2019). An algorithm for computing Lipschitz Inner Functions in Kolmogorov's Superposition Theorem., *In preparation*.

Knepley, M. G., Actor, J. A., Bauman, P., & Adams, M. (2018). *The Kolmogorov Superposition Theorem for Machine Learning* (tech. rep.) [Scientific Machine Learning Workshop]. Department of Energy.

Babuška, I., Silva, R. S., & Actor, J. A. (2018). Break-off model for CaCO 3 fouling in heat exchangers. *International Journal of Heat and Mass Transfer*, *116*, 104–114.

Actor, J. A. (2018). Computation for the Kolmogorov Superposition Theorem [Thesis for degree of Masters of Arts; Rice University].

Actor, J. A. (2021). Physics-Based Machine Learning for Image Segmentation [Thesis for degree of Doctor of Philosophy; Rice University].

Posters

Walker, E., Actor, J. A., Martinez, C., & Trask, N. (2023). Causal Disentanglement of Multimodal Data [Poster]. *4th Annual Conference on Mathematics of Scientific Machine Learning*.

Actor, J. A., Trask, N., Patel, R., Hu, X., Gao, X., & Huang, A. (2022). Data Driven Whitney Forms for Structure-Preserving Control Volume Analysis [Poster]. *SIAM Mathematics of Data Science 2022*.

Actor, J. A., Riviere, B., & Fuentes, D. (2019-a). Kernel Analysis of a Neural Network for Liver Segmentation [Poster]. *29th Annual Keck Center Research Conference : Precision Environmental Health*.

McCollum, E., Gates, E., Actor, J. A., & Fuentes, D. (2019). Opening the Black Box of a Convolutional Neural Network Used for Brain Tumor Segmentation [Poster]. *2019 CPRIT CURE Summer Undergraduate Research Program*.

Actor, J. A., Riviere, B., & Fuentes, D. (2019-b). A Comparison of Image Segmentation Methods [Poster]. *SIAM Gene Golub Student Summer School 2019 Poster Session*.

Actor, J. A., Riviere, B., & Fuentes, D. (2019-c). A Comparison of Image Segmentation Methods [Poster]. *Ken Kennedy Institute Rice Oil and Gas High Performance Computing Conference 2019*.

Actor, J. A., Riviere, B., & Fuentes, D. (2019-d). Efficient and Robust CT Image Segmentation with a Level Set Network [Poster]. *AMIA Annual Symposium*.

Actor, J. A., Riviere, B., & Fuentes, D. (2018). Liver Segmentation via Unrolled Mumford-Shah Neural Network [Poster]. *28th Annual Keck Center Research Conference : Data Science and Machine Learning for Bioinformatics*.

Actor, J. A., Ghysels, P., & Li, X. (2018). Inertia of HSS Matrices using STRUMPACK [CSSSP Poster Session, Lawrence Berkeley National Laboratory].

Actor, J., & Knepley, M. G. (2017). Kolmogorov Superposition Theorem: Univariate Encodings for Multivariate Functions [Poster]. *Ken Kennedy Institute Rice Data Science Conference*.

Babuška, I., Silva, R. S., & Actor, J. (2016). Modeling $CaCO_3$ Fouling in Heat Exchangers [Poster]. *Advances in Mathematics of Finite Elements Conference*.

Actor, J. A., Hwang, S.-A., Monroe, W., Morado, D., Paredes, A., Liu, J., & Actor, J. K. (2014). Serial Block Face SEM Visualization of Tuberculosis-Infected Macrophages [Poster]. *Fall Meeting of the American Society of Microbiology, Texas Branch*.

Conference Talks and Invited Presentations

Actor, J. A., Huang, A., & Trask, N. (2023a). Machine-Learned Whitney Forms for Structure Preservation [Invited Presentation]. *10th International Conference on Industrial and Applied Mathematics*.

Actor, J. A. (2023). Data-Driven Structure Preservation for Scientific Machine Learning. *3rd Sandia Machine Learning and Deep Learning Conference*.

Rodriguez, A., Actor, J. A., Perego, M., Kumar, V., & Trask, N. (2023). Unsupervised physics-informed domain identification with PINNs and mixtures of experts. *IACM MMLDE-CSET*.

Actor, J. A., Huang, A., & Trask, N. (2023b). Machine-Learned Finite Element Exterior Calculus for Linear and Nonlinear Problems. *4th Annual Conference on Mathematics of Scientific Machine Learning*.

Actor, J. A., Huang, A., & Trask, N. (2022). Polynomial-Spline Networks with Exact Integrals and Convergence Rates [Presentation]. *2022 IEEE Symposium Series on Computational Intelligence (SSCI)*.

Actor, J. A., Fuentes, D., & Riviere, B. (2020-b). Identification of Kernels in a Convolutional Neural Network: Connections Between Level Set Equation and Deep Learning for Image Segmentation. *SPIE Medical Imaging Conference 2020*.

Actor, J. A. (2019-a). Neural Networks for Image Segmentation of Liver [Presentation]. *SIAM Texas-Louisiana Sectional Meeting*.

Actor, J. A., Fuentes, D., & Riviere, B. (2019). Identification of Kernels in a Convolutional Neural Network: Connections Between Level Set Equation and Deep Learning for Image Segmentation [Presentation]. *Ken Kennedy Institute Rice Data Science Conference*.

Actor, J. A. (2019-b). Upwind Schemes and Deep Learning for Image Segmentation [Lightning Talk]. *SIAM Gene Golub Student Summer School 2019 Student Panel*.

Actor, J., & Knepley, M. G. (2018). Exploiting Lipschitz Continuity for the Kolmogorov Superposition Theorem [Presentation]. *Sparse Grids and their Applications*.

Seminars

Actor, J. A. (2022). Enforcing Exact Physics in Machine Learning via Chain Complexes [Sandia Deep Learning Monthly Seminar Series].

Actor, J. A. (2023). Structure-Preserving Machine Learning via Whitney Forms [UTEP S. Scott Collis Advanced Modeling and Simulations Seminar].

Actor, J. A. (2019-c). Good Models for Real-World Problems [Rice Data Science REU].

Actor, J. A. (2019-d). Fast Marching Methods [Rice University SIAM Student Chapter Journal Club].

Actor, J. (2019-a). Level Set Networks for Medical Image Segmentation [Departmental Graduate Student Seminar].

Actor, J. (2019-b). A Series of Lightnight Talks on CAAM Summer Experiences [Departmental Graduate Student Seminar].

Actor, J. (2019-c). Understanding Neural Networks for Image Segmentation [Departmental Graduate Student Seminar].

Actor, J. (2018-a). A Primer on Image Segmentation [Departmental Graduate Student Seminar].

Actor, J. (2018-b). Finding the Inertia of HSS Matrices [Departmental Graduate Student Seminar].

Actor, J. (2017). Lipschitz Inner Functions in Kolmogorov Superposition Theorem [Departmental Graduate Student Seminar].

Awards and Honors

November 2020	**Graduate Teaching Award for Course Support** (nominated), Center for Teaching Excellence, Rice University
November 2020	**Graduate Teaching Award for Independent Instruction** (nominated), Center for Teaching Excellence, Rice University
July 2020	**Student Travel Award**, SIAM Imaging Sciences 2020
Summer 2019	**SIAM Gene Golub Summer School**, SIAM
August 2018	**Predoctoral Fellow**, National Library of Medicine, Training Grant in Biomedical Informatics and Data Science
April 2018	**Honorable Mention**, NSF GRFP
July 2018	**Alan Weiser Memorial Travel Award**, Rice University
August 2016	**Ken Kennedy Institute Graduate Enhancement Fellowship**, Rice University

Teaching

Summer 2020	UNIV 105, Instructor, **Introduction to Coding in Python**, Rice Emerging Scholars Program, Rice University
Summer 2019	UNIV 105, Instructor, **Introduction to Coding in Python**, Rice Emerging Scholars Program, Rice University
Fall 2020	UNIV 600, Guest Lecturer, **Academic Reading and Writing**, Program in Writing and Communication, Rice University
Fall 2019	COMP 543, Guest Lecturer, **Graduate Tools and Models Data Science**, Rice University
Spring 2020	CAAM 520, Grader, **Computational Science II**, Rice University
Fall 2019	CAAM 519, Grader, **Computational Science I**, Rice University
Spring 2019	CAAM 336, Grader, **Differential Equations in Science and Engineering**, Rice University
Fall 2018	CAAM 336, Grader, **Differential Equations in Science and Engineering**, Rice University
Spring 2018	CAAM 536, Course Assistant, **Numerical Methods for PDEs**, Rice University
Fall 2017	CAAM 453, Grader, **Numerical Analysis I**, Rice University
Spring 2017	CAAM 335, Grader, **Matrix Analysis**, Rice University
Fall 2016	CAAM 355, Grader, **Matrix Analysis**, Rice University

Service

MMLDE-CSET Minisymposium co-organizer — *El Paso, TX*
AI/ML algorithms for accelerating material discovery, design, and manufacturing processes — *September 2023*
With Elise Walker and Troy Shilt

USNCCM Minisymposium co-organizer — *Albuquerque, NM*
Beyond Fingerprinting: AI Approaches to Unearthing Property Correlations in Additive Manufacturing — *July 2023*
With Elise Walker

AI4SS Advanced Research Directions on AI for Science and Security Workshop Series — *Davis, CA*
Participant and Scribe, Workshop # 2 — *July 2022*

SIAM Student Chapter, Rice University
President — *Fall 2017 - Fall 2018*
Secretary — *Fall 2016 - Fall 2017*

Center for Teaching Excellence, Rice University
Graduate Liaison — *Fall 2019 - Spring 2021*

Department of Computational and Applied Mathematics, Rice University
Graduate Student Advisory Committee — *Summer 2020 - Winter 2020*
Graduate Seminar Coordinator — *Fall 2019 - Spring 2020*

Gulf Coast Consortia
NLM Fellows Seminar Coordinator — *Fall 2019 - Spring 2021*

Technical

Programming Python, Matlab, TensorFlow, Keras, PyTorch, LaTeX, FEniCS, PETSc
Memberships SIAM, IEEE; formerly AMIA, ASA
Languages English (Native), Hebrew (Conversant)