ALI LASEMI

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EDUCATION

Ph.D.	Mechanical Engineering	Stanford University, **NSF Fellow**	2022 – 2026 (expected)
M.S.	Mechanical Engineering	Stanford University	2020 – 2022
B.S.	Aerospace Engineering	University of Illinois at Urbana-Champaign	2016 – 2020

WORLD MODELING

World: GPU physics and a world model trained on it github.com/alilasemi/world

- Built a 3D CUDA physics simulation advancing over 30,000 contacting particles at 2x real time on one GPU, with an $O(n)$ neighbor search algorithm, spring-dashpot contact rule, and Coulomb friction
- Streamed simulation over WebSocket to a WebGL2 client, with spheres reconstructed in the fragment shader
- Measured what is predictable in this highly chaotic system: tiny changes in the initial particle positions amplify by 2000x, resulting in a predictability horizon of only 1.4 seconds, while the chosen latent representation stays reproducible throughout
- Trained an autoregressive world model in a reduced space, using per-channel proper orthogonal decomposition (POD) and one Gaussian process regression per latent coordinate, giving 0.15 held-out field error against a persistence baseline of 1.13

RESEARCH EXPERIENCE

Stanford University – Doctoral Researcher **2020 – Present**

- Raised the accuracy of AERO-F, a 3D distributed-memory C++/MPI fluid dynamics solver, by fitting the finite volume dual mesh onto fluid interfaces, resulting in convergence order 2.00 against 0.99 for the baseline method, reducing mass conservation error by 10x
- Enforced a discrete geometric conservation law as a constrained least-squares projection, eliminating unknowns to reduce an ill-conditioned system to a symmetric graph Laplacian with 6x fewer variables
- Augmented the level set reinitialization with a mass conservation constraint, and showed the resulting matrix has null space dimension equal to the number of connected graph components, reducing the system to a scalar
- Collaborated on a student development team to create Quail, a lightweight Python implementation of the discontinuous Galerkin method to enable teaching and prototyping, obtaining a 30x reduction in compute cost using NumPy tensor operations, and coauthored a journal paper in SoftwareX

NASA Ames Research Center – Aerothermodynamics Intern **Summers 2020, 2019, 2018**

- Implemented a simplified physics model into NASA fluid simulation software to reduce the dimensionality of a 3D model to 1D, reaching a 1000x reduction in total runtime
- Implemented grid coarsening and interpolation techniques into NASA aerothermodynamics software, leading to a 4x reduction in compute cost of coupled flow and radiation calculations

TECHNICAL SKILLS

C++, Python, CUDA, PyTorch, MPI, OpenMP, OpenGL, GoogleTest, Git, cloud (GCP, AWS), and Linux

PUBLICATIONS

- Lasemi, A., & Farhat, C. (in preparation). Higher-order multifluid interface representation with dual-mesh motion and DGCL-preserving numerical fluxes. *Journal of Computational Physics*.
- Lasemi, A., & Farhat, C. (2026). A local-length-scale-based mesh adaptation method for compressible multi-material flows. *International Journal of Multiphase Flow*, 198, 105667.
- Ching, E. J., Bornhoft, B., Lasemi, A., & Ihme, M. (2022). Quail: A lightweight open-source discontinuous Galerkin code in Python for teaching and prototyping. *SoftwareX*.