Malik Hassanaly

https://malihass.github.io
https://github.com/malihass

malik[dot]hassanaly[at]gmail!dot!com
+1-123-456-7899

Education

- **PhD University of Michigan, USA**
  Aerospace Engineering - Dissertation:"Extreme Events in Turbulent Combustion" *August 2019*
- **MSE University of Texas at Austin, USA**
  Aerospace Engineering - Master Thesis:"Large-eddy simulations of boundary layer flashback" *January 2015*
- **MSE Ecole Centrale de Lille, France**
  General Engineering - Thesis project:"Design and testing of a new tidal turbine" *January 2015*

Skills

- **Programming**: Python, C++, Fortran, Bash, Git
- **ML Libraries**: TensorFlow, PyTorch
- **Physics modeling tools**: OpenFOAM, Paraview
- **Languages**: English (Fluent), French (Native), Spanish (Intermediate)

Professional Experience

- **National Renewable Energy Laboratory (NREL), USA** September 2019 - Current
  Staff Researcher (since 2022) - Computational Science and Machine Learning
  Postdoctoral Researcher (until 2022) - Combustion Modeling and Scientific Machine Learning
- **Maïa Eolis (now Engie Green), France** November 2012 - May 2013
  Physics Modeling Intern
- **RTE (French Transmission Grid), France** May 2012 - November 2012
  Software Development Intern
- **Areva NP (now Orano), France** January 2010 - February 2010
  Managing Solution Intern

Publications

- **Generative Machine Learning**:
  1. **Super resolution with generative adversarial nets**: Adversarial sampling of unknown and high-dimensional conditional distributions, M. Hassanaly et al. *Journal of Computational Physics*, 2022
  2. **Inpainting with diffusion models**: Ensemble flow reconstruction in the atmospheric boundary layer from spatially limited measurements through latent diffusion models, A. Rybchuk, M. Hassanaly et al. *Physics of Fluids*, 2023
  3. **Extreme event generation**: GANISP: a GAN-assisted Importance Splitting Probability Estimator, M. Hassanaly et al. *AAAI-ADAM*, 2022,
  4. **Data reduction** Uniform-in-phase-space data selection with iterative normalizing flows, M. Hassanaly et al. *Data-Centric Engineering*, 2023,
- **Predictive surrogate modeling**:
  5. **Physics-informed neural networks**: PINN surrogate of Li-ion battery models for parameter inference, Part I: Implementation and multi-fidelity hierarchies for the single-particle model, M. Hassanaly et al. *Journal of Energy Storage*, 2024
  6. **Bayesian neural networks**: A Priori Uncertainty Quantification of Reacting Turbulence Closure Models using Bayesian Neural Networks, G. Pash, M. Hassanaly et al. *Engineering Applications of Artificial Intelligence*, 2025
  7. **Mixture of experts**: Data-driven Classification and Modeling of Combustion Regimes in Detonation Waves, S. Barwey, S. Prakash, M. Hassanaly et al. *Flow Turbulence and Combustion*, 2020
  8. **Multifidelity neural operators**: Bi-fidelity Modeling of Uncertain and Partially Unknown Systems using DeepONets, S. De, M. Reynolds, M. Hassanaly et al. *Computational Mechanics*, 2023
- **Bayesian inverse modeling**:
  9. **Physics properties:** PINN surrogate of Li-ion battery models for parameter inference, Part II: Regularization and application of the pseudo-2D model, M. Hassanaly et al. *Journal of Energy Storage*, 2024
  10. **Population balance modeling:** Bayesian calibration of bubble size dynamics applied to CO2 gas fermenters, M. Hassanaly et al. *Chemical Engineering Research and Design*, 2025
  11. **Reaction kinetics:** Surface chemistry models for GaAs epitaxial growth and hydride cracking using reacting flow simulations, M. Hassanaly et al. *Journal of Applied Physics*, 2021

- **Adversarial Machine Learning**:
    12. **Self-supervised learning:** Swift Hydra: Self-Reinforcing Generative Framework for Anomaly Detection with Multiple Mamba Models, N. H. K. Do, T. Nguyen, M. Hassanaly et al. *ICLR*, 2025
    13. **Multi Agent Reinforcement learning:** Adversarial Multi-Agent Reinforcement Learning for Proactive False Data Injection Detection, K. Chen, T. Nguyen, M. Hassanaly, *In preparation*, 2025
    14. **Reinforcement learning + continual learning:** Continual Adversarial Reinforcement Learning (CARL) of False Data Injection detection: forgetting and explainability, P. Aslami, K. Chen, T. Hansen, M. Hassanaly, *IEEE PowerTech*, 2025
    15. **LSTM:** Detection of False Data Injection (FDI) attacks on power dynamical systems with a state prediction method, A. Sahu, [...], M. Hassanaly *IEEE Access*, 2024
    16. **Reinforcement learning:** Discovery of False Data Injection Attacks on Power Grid Frequency Controllers with Reinforcement Learning, R. Prasad, M. Hassanaly et al. *IEEE PES GM*, 2024
- **Scientific Image Analysis**:
    17. **Data augmentation:** Using Machine Learning to Construct Velocity Fields from OH-PLIF Images, S. Barwey, M. Hassanaly et al. *Combustion Science and Technology*, 2019
    18. **Cluster-reduced order modeling:** Experimental Data Based Reduced Order Model for Analysis and Prediction of Flame Transition in Gas Turbine Combustors, S. Barwey, M. Hassanaly et al. *Combustion Theory and Modelling*, 2019
    19. **Discriminant analysis:** Data-driven Analysis of Relight variability of Jet Fuels induced by Turbulence, M. Hassanaly et al. *Combustion and Flame*, 2021
    20. **Cluster-reduced order modeling:** Data-based analysis of multimodal partial cavity shedding dynamics, S. Barwey, H. Ganesh, M. Hassanaly et al. *Experiments in Fluids*, 2020
- **Numerical methods for high-performance computing**:
    21. **Chemistry integration:** SUNDIALS Time Integrators for Exascale Applications with Many Independent ODE Systems, C. Balos., [...], M. Hassanaly et al. *International Journal of High Performance Computing Applications*, 2024
    22. **Symbolic computations:** Symbolic construction of the chemical Jacobian of quasi-steady state (QSS) chemistries for Exascale computing platforms, M. Hassanaly et al. *Combustion and Flame*, 2024
    23. **Exascale computing methods:** The Pele Simulation Suite for Reacting Flows at Exascale, M. Henry de Frahan, [...], M. Hassanaly et al. *SIAM Conference on Parallel Processing for Scientific Computing*, 2024
    24. **Exascale computing demo:** Visualizations of a methane/diesel RCCI engine using PeleC and PeleLMeX, N. T. Wimer, [...], M. Hassanaly et al., *Physical Review Fluids*, 2023
    25. **Secondary conservation:** A minimally-dissipative low-Mach number solver for complex reacting flows in OpenFOAM, M. Hassanaly et al., *Computer and Fluids*, 2018.
- **Topical reviews**:
    26. **Extreme and rare events:** Emerging Trends in Numerical Simulations of Combustion Systems, V. Raman, M. Hassanaly, *Proceedings of the Combustion Institute*, 2019
    27. **Combustion modeling:** Classification and Computation of Extreme Events in Turbulent Combustion, M. Hassanaly et al. *Progress in Energy and Combustion Science*, 2021

- **Turbulence modeling**:
    28. **Ignition:** Probabilistic Modeling of Forced Ignition of Alternative Jet Fuels, Y. Tang, M. Hassanaly et al. *Proceedings of the Combustion Institute*, 2021
    29. **Ignition:** Simulation of gas turbine ignition using large eddy simulation approach, Y. Tang, M. Hassanaly et al., *ASME Turbo Expo*, 2020
    30. **Ignition:** A Comprehensive Modeling Procedure for Estimating Statistical Properties of Forced Ignition, Y. Tang, M. Hassanaly et al. *Combustion and Flame*, 2019
    31. **Soot:** Large Eddy Simulation of Pressure and Dilution Jet Effects on Soot Formation in a Model Aircraft Swirl Combustor, S. T. Chong, M. Hassanaly et al. *Combustion and Flame*, 2018
    32. **Soot:** Large Eddy Simulation of Soot Formation in a Model Gas Turbine Combustor, H. Koo, M. Hassanaly et al. *Journal of Engineering for Gas Turbines and Power*, 2017
    33. **Flashback:** Large eddy simulation of flame stabilization in a multi-jet burner using a non-adiabatic flamelet approach, Y. Tang, M. Hassanaly et al., *54th AIAA Aerospace Sciences Meeting*, 2016
    34. **Boundary layer flashback:** Large Eddy Simulation of Flame Flashback in Swirling Premixed CH4/H2-Air Flames, C. F. Lietz, M. Hassanaly et al., *53rd AIAA Aerospace Sciences Meeting*, 2015
    35. **Stratified combustion:** Influence of Fuel Stratification on Turbulent Flame Propagation, M. Hassanaly et al., *53rd AIAA Aerospace Sciences Meeting*, 2015
    36. **Boundary layer flashback:** LES of Premixed Flame Flashback in a Turbulent Channel, C. F. Lietz, M. Hassanaly et al., *52nd AIAA Aerospace Sciences Meeting*, 2014
    37. **Inertial manifolds:** An Approximate Inertial Manifold (AIM) Based Closure for Turbulent Flows, M. Akram, M. Hassanaly et al. *AIP Advances*, 2022
    38. **Inertial manifolds:** A priori analysis of reduced description of dynamical systems using approximate inertial manifolds, M. Akram, M. Hassanaly et al. *Journal of Computational Physics*, 2020
- **Chaotic dynamics and rare event modeling**:
    39. **Lyapunov spectrum calulcation:** Numerical convergence of the Lyapunov spectrum computed using low Mach number solvers, M. Hassanaly et al. *Journal of Computational Physics*, 2019
    40. **Rare event probability:** A self-similarity principle for the computation of rare event probability, M. Hassanaly et al. *Journal of Physics A: Mathematical and Theoretical*, 2019
    41. **Lyapunov spectrum of non-reacting flows:** Lyapunov spectrum of forced homogeneous isotropic turbulent flows, M. Hassanaly et al. *Physics Review Fluids*, 2019
    42. **Lyapunov spectrum of reacting flows:**Ensemble-LES Analysis of Perturbation Response of Turbulent Partially-Premixed Flames, M. Hassanaly et al. *Proceedings of the Combustion Institute*, 2019

Honors and Awards

- 2019: Richard and Eleanor Towner Prize for Distinguished Academic Achievement
- 2022: Milton Van Dyke Video Award,"Simulation of an RCCI Engine Using the Pele Suite of Exascale Codes"
- 2024: R&D 100 Finalist (Pele)
- 2024: NREL President's Award for Exceptional Achievement
- 2024: NREL Outstanding Mentor Award