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

## **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<sub>++</sub>, Fortran, Bash, Git
- ML Libraries: TensorFlow, PyTorch
- Physics modeling tools: OpenFOAM, Paraview
- Languages: English (Fluent), French (Native), Spanish (Intermediate)

## EXPERIENCE

# National Renewable Energy Laboratory (NREL), USA

September 2019 - Current

- Researcher Computational Science and Machine Learning
  - o Scientific Machine Learning for augmenting or accelerating physics-based models and uncertainty quantification tasks.

# Maïa Eolis (now Engie Green), France

November 2012 - May 2013

- Physics Modeling Intern
  - Computational fluid dynamics modeling of wind turbine blades. I quantified the mechanical stress induced by a novel blade spoiler.

## RTE (French Electrical Grid), France

May 2012 - November 2012

- Software Development Intern
  - $\circ$  Developed of a generic gateway from a UML model to a C++ library used in a large-scale power grid code.

## Areva NP (now Orano), France

January 2010 - February 2010

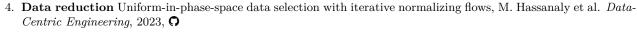
- Managing Solution Intern
  - Analysis of employees' perception of their workplace organization

#### **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, •







- 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 Deep-ONets, S. De, M. Reynolds, M. Hassanaly et al. *Computational Mechanics*, 2023





#### · Bayesian inverse modeling:







- - 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

9. Physics properties: PINN surrogate of Li-ion battery models for parameter inference, Part II: Regularization

10. Population balance modeling: Bayesian calibration of bubble size dynamics applied to CO2 gas fermenters, M.

#### • Adversarial ML:

- 12. Reinforcement learning + Variational autoencoder: 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, Under Review, 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, Under Review, 2025
- 15. 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

#### • Image processing:

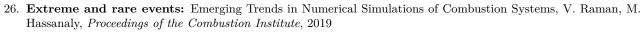
- 16. Data augmentation: Using Machine Learning to Construct Velocity Fields from OH-PLIF Images, S. Barwey, M. Hassanaly et al. Combustion Science and Technology, 2019
- 17. Cluster-reduced order modeling: Experimental Data Based Reduced Order Model for Analysis and Prediction of Flame Transition in Gas Turbine Combustors, S. Barwey, M. Hassanaly et al. Combustion Theory and Modelling, 2019
- 18. Discriminant analysis: Data-driven Analysis of Relight variability of Jet Fuels induced by Turbulence, M. Hassanaly et al. Combustion and Flame, 2021
- 19. 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

#### • Anomaly detection:



- 20. LSTM: Detection of False Data Injection (FDI) attacks on power dynamical systems with a state prediction method, A. Sahu, [...], M. Hassanaly IEEE Access, 2024
- 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 O
  - 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 O
  - 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 Open-FOAM, M. Hassanaly, Computer and Fluids, 2018.

#### Topical reviews:



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
- 2024: NREL Outstanding Mentor Award

















