Jamal Shabani PhD

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https://github.com/jamalshabani

RESEARCH INTEREST

Topology Optimization, Applied Mathematics, Scientific Computing, Numerical Analysis, Partial Differential Equations, Machine Learning, Artificial Intelligence.

EDUCATION

McMaster University, Hamilton, ON. *September 2021 - September 2024*
PhD in Applied Mathematics. **PhD by Research (100%)**

Louisiana State University, Baton Rouge, LA. *August 2019 - May 2021*
Master of Science in Mathematics. **GPA: 4.00/4.00 (100%)**

University of North Florida, Jacksonville, FL. *August 2017 - May 2019*
Master of Science in Mathematics. **GPA: 4.00/4.00 (100%)**

Middle East Technical University, Ankara, Turkey. *September 2012 - June 2016*
Bachelor of Science in Mathematics. **GPA: 3.65/4.00 (91%)**

PROFESSIONAL SUMMARY

- 5 years' university teaching experience as Assistant Lecturer.
- 4 years' experience using Python to solve Partial Differential Equations with Finite Elements Methods(FEM)
- 4 years' experience in Optimal Control, Optimal Design, and Topology Optimization.
- Strong mathematical background especially in Numerical Analysis, Optimization and Numerical PDEs.
- Strong programming background in Python and C++.
- Strong background in Machine Learning, AI and Deep Neural Networks tools such as PyTorch and TensorFlow.

WORK EXPERIENCE

Postdoctoral Researcher Fellow September 2024 - Present
University of Wisconsin - Madison *Madison, WI*

- Technical Skills: Python, C++.
- Working on 3D multimaterials Advanced Topology Optimization with materials selection.
- Employing Machine Learning techniques such as Variational Auto Encoders (VAE) into 3D Topology Optimization.

Graduate Research Assistant September 2021 - September 2024
MEF90 Lab *Hamilton, ON*

- Technical Skills: Python, C++.

- Creating all mathematical frameworks for our Optimization problems including the appropriate adjoint computations necessary for sensitivity analysis.
- Implementing the Optimization problems using Python, PETSs (Portable Extensible Toolkit for Scientific Computations and TAO (Toolkit for Advanced Optimization).
- Running the simulations and analyzing results using PARAVIEW.

Web Developer June 2017 - Present
Freelancer *Hamilton, ON*

- Technical Skills: HTML5, CSS3, JavaScript, PHP, MySQL.
- Using HTML5, CSS3 and JavaScript to create responsive front-end design of the web apps.
- Utilizing MySQL and PHP to create databases and back-end design of the web apps.

Argonne National Laboratory Summer 2021
MCS Given Associate Intern *Lemont, Illinois*

- Technical Skills: Fortran 90, C++.
- Developed Fortran programs for generating profiles comparisons of different constrained and unconstrained TAO (Toolkit for Advanced Optimization) solvers.
- Ran simulations for different TAO solvers to compare their efficient runtime and CPU usage.

TEACHING EXPERIENCE

McMaster University September 2021 - September 2024
Hamilton, ON *Canada*

(1) Instructor for **MATH 1MP3** - Introduction to Mathematical Scientific Computation in Spring 2023.

(2) Instructor for **MATH 1MP3** - Introduction to Mathematical Scientific Computation in Spring 2022.

(3) Teaching Assistant for **MATH 1LS3** - Calculus for the Life Sciences I

(4) Teaching Assistant for **MATH 1ZC3** - Engineering Mathematics II

(5) Teaching Assistant for **MATH 2C03** - Differential Equations

(6) Teaching Assistant for **MATH 2ZZ3** - Engineering Mathematics IV

(7) Teaching Assistant for **MATH 3MB3** - Introduction to Modelling

Louisiana State University September 2019 - August 2021
Baton Rouge, LA *United States*

(8) Instructor for **MATH 7210** - Abstract Algebra I in Summer 2021.

(9) Instructor for **MATH 1550** - Differential and Integral Calculus in Fall 2020.

(10) Instructor for **MATH 1022** - Plane Trigonometry in Fall 2020.

(11) Instructor for **MATH 1500** - Calculus in Spring 2020.

(12) Instructor for **MATH 2070** - Mathematical Methods in Engineering in Fall 2019.

University of North Florida September 2017 - May 2019
Jacksonville, FL *United States*

(13) Instructor for **MGF 1106** - Finite Mathematics in Spring 2019.

(14) Instructor for **MAC 1105** College Algebras in Fall 2018.

(15) Teaching Assistant for **MAA 4211** - Advanced Calculus I

(16) Teaching Assistant for **MAA 4402** - Complex Analysis

Feza Boys High School July 2016 - July 2017
Dar Es Salaam *Tanzania*

(17) High school math teacher.

(18) High school physics teacher.

RELEVANT COURSEWORK

MAS 6145 - Advanced Linear Algebra Fall 2017
Grade A *University of North Florida*

MAP 6385 - Scientific Computing Spring 2018
Grade A *University of North Florida*

MAA 6417 - Complex Analysis Spring 2019
Grade A *University of North Florida*

MAD 6405 - Numerical Analysis Spring 2019
Grade A *University of North Florida*

MATH 7210 - Algebra I Fall 2019
Grade A *Louisiana State University*

MATH 7311 - Real Analysis I Fall 2019
Grade A *Louisiana State University*

MATH 7320 - Ordinary Differential Equations Spring 2020
Grade A+ *Louisiana State University*

MATH 7330 - Functional Analysis Spring 2020
Grade A- *Louisiana State University*

MATH 7710 - Advanced Numerical Linear Algebra I Spring 2020
Grade A *Louisiana State University*

MATH 7386 - Theory of PDE Fall 2021
Grade A *Louisiana State University*

MATH 7384 - Topics in Material Science Fall 2021
Grade A *Louisiana State University*

PUBLICATIONS

1. **J. Shabani,** K. Bhattacharya and B. Bourdin, *"Systematic Design of Compliant Morphing Structures: A Phase-Field Approach."* **Applied Mathematics and Optimization** 91, 41(2025)**https://doi.org/10.1007/s00245-025-10237-7**
2. **J. Shabani**, *"Systematic design of compliant morphing structures with stimulus as design and state variable."* (**Thesis**) **LINK TO ACCESS THESIS**

WORKS IN PROGRESS

1. **J. Shabani** and B. Bourdin, *"Optimal design of a responsive trajectory path."*(**In preparation. Manuscript available upon request**)
2. S. Sridhara, **J. Shabani** and K. Suresh, *Topology optimization with material selection*
3. **J. Shabani**, *FireTop: 150 lines python code for 2D and 3D multi materials topology optimization with Firedrake and phase-field approach.*
4. **J. Shabani**, *On systematic design of time-dependent compliant morphing structures.*
5. **J. Shabani**, *Multi-phase fields topology optimization in 2D and 3D with material selection.*

TALKS GIVEN

1. **Applied and Industrial Mathematical Sciences (AIMS)**, *"Optimal design for Linear Elasticity problems."* - June 2023
2. **Applied and Industrial Mathematical Sciences (AIMS)**, *"Optimal design of responsive structures."* - January 2024
3. **The Mathematics of Modern Sciences webinar**, *"Topology Optimization with Variational Auto Encoders (VAE)."* - April 2025

COMPUTER SKILLS

Programming Languages	Python, SQL, C/C++, MATLAB, Java, C#
Python Packages	Pandas, Matplotlib, Numpy, BeautifulSoup, Jupyter
Software & Tools	FEniCS, Firedrake, LaTeX, Github, PETSc/TAO
Frontend Web Development	HTML5, CSS3, Javascript, NodeJs, VueJS, JQuery, Django
Backend Web Development	PHP, MVC (Model View Controller) Frameworks (Laravel)
Machine Learning Tools	Pytorch, TensorFlow

REFERENCES

1. Prof. Blaise Bourdin - McMaster University - bourdin@mcmaster.c - 905-525-9140 ext 27243
2. Prof. Nicholas Kevlahan - McMaster University - kevlahan@mcmaster.ca - 905-525-9140 ext 23412