Curriculum Vitae – Qingguang Guan

Address:	School of Mathematics and Natural Sciences University of Southern Mississippi 118 College Drive Hattiesburg, MS 39406
Phone:	+1-850-228-6284
E-mail:	qingguang.guan@usm.edu
Website:	https://sites.google.com/site/qingguangguan
Google Scholar:	link to my google scholar

Employment

07/01/2022 – now	Assistant Professor at School of Mathematics and Natural Sciences University of Southern Mississippi
07/01/2019 – 06/30/2022	Research Assistant Professor at Department of Mathematics Temple University
08/13/2018 – 06/31/2019	Visiting Assistant Professor at Department of Mathematics and Statistics Missouri University of Science and Techonology
12/01/2016 – 07/31/2018	Postdoc Fellow at Center for Computation and Technology Louisiana State University
06/09/2014 – 08/15/2014	Summer Intern at Oak Ridge National laboratory

Education

08/11/2011 – 12/01/2016	Ph.D. in Computational Science, Florida State University Advisor: Professor Max Gunzburger
09/01/2009 – 07/01/2011	M.S. in Computational Mathematics, Jilin University Advisor: Professor Yongkui Zou
09/01/2005 – 07/01/2009	B.S. in Computational Mathematics, Jilin University

Research Interests

- Computational Neuroscience and High Performance Computing
- Deep Learning with Neural Networks
- FEM, Weak Galerkin FEM, VEM, and Collocation Method
- Numerical Analysis of Nonlocal PDEs
- Stochastic PDEs

Publications

Published

1. Qingguang Guan, How Can Deep Neural Networks Fail Even With Global Optima? *International Journal of Numerical Analysis and Modeling*, 21 (5), 674-696 (2024)
2. Abel Gurung and Qingguang Guan, Hybrid PDE-Deep Neural Network Model for Calcium Dynamics in Neurons. *Journal of Machine Learning for Modeling and Computing*, 6 (1), 1-21 (2024)
3. Qingguang Guan, Xu Guo, and Wenju Zhao, Efficient numerical method for shape optimization problem constrained by stochastic elliptic interface equation. *Communications on Analysis and Computation* 1 (4), 321-346 (2023).

4. Qingguang Guan, Gillian Queisser, and Wenju Zhao, Weak Galerkin finite element method for second order problems on curvilinear polytopal meshes with Lipschitz continuous edges or faces, *Computers and Mathematics with Applications*, Volume 148, 15 October 2023, Pages 282-292.

5. Wenju Zhao and Qingguang Guan, Numerical analysis of energy stable weak Galerkin schemes for the Cahn-Hilliard equation, *Communications in Nonlinear Science and Numerical Simulation*, Volume 118, 2023, 106999.

6. Qingguang Guan and Gillian Queisser, Modeling calcium dynamics in neurons with endoplasmic reticulum: existence, uniqueness and an implicit-explicit finite element scheme, *Communications in Nonlinear Science and Numerical Simulation*, Volume 109, 2022, 106354.

7. Qingguang Guan, Max Gunzburger, and Xiaoping Zhang, Collocation method for one dimensional nonlocal diffusion equations, *Numerical Methods for Partial Differential Equations*, 2021, (published online).

8. Qingguang Guan, Some estimates of Virtual Element Methods for fourth order problem, *Electronic Research Archive*, 2021, (published online).

9. Qingguang Guan, Weak Galerkin finite element method for Poisson's equation on polytopal meshes with small edges or faces, *Journal of Computational and Applied Mathematics*, Volume **368**, 2020: 112584.

10. Qingguang Guan, Max Gunzburger, and Wenju Zhao, Weak Galerkin finite element methods for a second-order elliptic variational inequality, *Computer Methods in Applied Mechanics and Engineering*, Volume **337**, 2018, Pages 677-688.

11. Susanne C. Brenner, Qingguang Guan, and Li-Yeng Sung, Some estimates for Virtual Element Methods, *Computational Methods in Applied Mathematics*, Volume **4**, 2017, Pages:553 - 574.

12. Qingguang Guan, Max Gunzburger, Clayton Webster, and Guannan Zhang, Reduced basis methods for nonlocal diffusion problems with random input data, *Computer Methods in Applied Mechanics and Engineering*, Volume **317**, 2017, Pages: 746-770.

13. Qingguang Guan and Max Gunzburger, Analysis and approximation of a nonlocal obstacle problem, *Journal of Computational and Applied Mathematics*, Volume **313**, 2017, Pages: 102-118.

14. Qingguang Guan and Max Gunzburger, Θ schemes for finite element methods for space-time fractional diffusion equation, *Journal of Computational and Applied Mathematics*, Volume **288**, November 2015, Pages: 264–273.

15. Qingguang Guan and Max Gunzburger, Stability and accuracy of time-stepping schemes and dispersion relations for a nonlocal wave equation, *Numerical Methods for Partial Differential Equations*, Volume **31**, Issue 2, March 2015, Pages: 500–516.

16. Qingguang Guan and Max Gunzburger, Stability and convergence of time-stepping methods for a nonlocal model for diffusion, *Discrete and Continuous Dynamical Systems - Series B*, Volume **20**, Issue 5, July 2015, Pages: 1315–1335.

17. Qingguang Guan, Ran Zhang, and Yongkui Zou, Analysis of collocation solutions for nonstandard Volterra integral equations, *IMA J. Numer. Anal.* **32**, No.4, 2012, Pages: 1755–1785

18. Qingguang Guan and Lin Zang, Numerical computation of periodic solutions generated by the generalized Hopf bifurcation of a three-dimensional piecewise smooth Filippov-type equation, (Chinese. English summary) *J. Jilin Univ., Sci.* **48**, No.3, 2010, Pages: 371–374.

Teaching

- **Deep Learning Seminar** 2023 Fall, University of Southern Mississippi
  Topics: Deep Neural Network, Convolutional Neural Network, Recurrent Neural Network, Transformer, Generative Adversarial Network and their applications.
- Cal I With An Geom, 2023 Fall, University of Southern Mississippi
- Ordinary Differential Equation (graduate), 2023 Fall, University of Southern Mississippi
- Cal IV With An Geom, 2023 Spring, University of Southern Mississippi
- Introduction to PDE, 2023 Spring, University of Southern Mississippi
- Cal I With An Geom (two sections), 2022 Fall, University of Southern Mississippi
- Numerical Analysis II, 2022 Spring, Temple University
- Numerical Analysis I, 2021 Fall, Temple University
- Calculus I, 2021 Spring, Temple University
- Calculus I, 2020 Fall, Temple University
- ODE, 2020 Spring, Temple University
- Calculus III, 2019 Fall, Temple University
- ODE, 2019 Spring, Missouri University S&T
- Trigonometric, 2018 Fall, Missouri University S&T
- College Algebra, 2018 Fall, Missouri University S&T

Conferences and Workshops

- May 20 - 21, 2024 - International Workshop: Exploring Brain Dynamics through Modelling, Numerics, and Experiments, University of Glasgow, UK., talk: " Calcium Dynamics in Neurons with ER: From Differential Equations to Hybrid Differential Equation and Deep Neural Network Models".
- March 23, 2024. 2024 Spring Southeastern Sectional Meeting. American Mathematical Society, Tallahassee, FL, United States.

  Invited talk: "Modeling the Open Probability of Ion Channels on Cell/Organelle Membranes using Deep Neural Networks."
- Nov 3 - 5, 2023 - 6th Annual Meeting of the SIAM Texas-Louisiana Section (TXLA23), University of Louisiana at Lafayette, Lafayette, Louisiana, U.S., talk: "Modelling Open Probability of Ion Channels by Deep Neural Network".
- October 1 - 2, 2022 - The 7th Annual Meeting of SIAM Central States Section, Oklahoma State University, Stillwater, OK, U.S., talk: "Modeling Calcium Dynamics in Neurons with Endoplasmic Reticulum: Well-Posedness and Numerical Methods".

- July 11 - 15, 2022 – SIAM Annual Meeting, David L. Lawrence Convention Center, Pittsburgh, Pennsylvania, U.S., talk: "Weak Galerkin Method for Second Order Problems on Curvilinear Polytopal Meshes".
- Feb 12 - Feb 13, 2020 – SIAM Conference on Parallel Processing for Scientific Computing, Seattle, USA, talk:"A Dimension Switching Multigrid Method and its Applications."
- Oct 5 - Oct 7, 2018 – 4th Annual Meeting of SIAM Central States Section, University of Oklahoma, Norman, OK, talk: "Weak Galerkin finite element method for Poisson's equation on polytopal meshes with small edges or faces".
- March 17 - March 18, 2017 – SCALA 2017: Scientific Computing around Louisiana, Tulane University, New Orleans, LA.
- April 15 - April 16, 2016 – Finite Element Circus, University of Maryland, College Park, Talk: " Weak Galerkin finite element methods for a second-order elliptic variational inequality".
- Oct 26 - Oct 28, 2015 – Workshop for Nonlocal Models in Mathematics, Computation, Science, and Engineering, Oak Ridge National laboratory, USA, Poster: "Θ schemes for finite element methods for space-time fractional diffusion equation".
- March 29 - 30, 2014 – 38th Annual SIAM Southeastern Atlantic Section Conference, Melbourne, Florida Institute of Technology, USA, Talk: "Numerical Analysis of Nonlocal Obstacle Problem".
- Dec 7 - 10, 2013 – SIAM Conference on Analysis of Partial Differential Equations (PD13), Orlando, USA. Presentation: "Stability and Convergence Analysis for Nonlocal Diffusion and Nonlocal Wave Equations"
- Feb 08 - 09, 2013 – Fifth Annual SIAM Student Conference, Clemson University, USA. Presentation: "Timestepping for a Nonlocal Diffusion Process".
- Jun 25 - 29, 2012 – SAMSI Workshop on Nonlocal Continuum Models for Diffusion, Mechanics, and Other Applications, Research Triangle Park, NC, USA.

Mentoring

1. Luke Fontan (Undergraduate). August 20, 2024 - May 2025.

   Luke worked on a cutting-edge, innovative project entitled "Model Order Reduction by Deep Neural Networks for the Continuous-Time Markov Chain Model."

   The Continuous-Time Markov Chain (CTMC) model is a framework for understanding the probability of ion channels being open by modeling their random transitions between open, closed, and other possible states over time. This approach captures the kinetics of ion channels by assigning transition rates between states, influenced by factors like voltage or ligand concentration, to predict how often a channel will be open. We start with a CTMC model with five states, which is an ODE system, and try to reduce it to a smaller two-state CTMC model. Luke and I have developed a method to preserve the structure of the CTMC model, using sufficient data from the larger model and a deep neural network to successfully reduce its size while maintaining acceptable accuracy.

   He joined the **PhD program in Mathematics at University of Florida** after graduation.

2. Maddie Miller (Undergraduate). August 20, 2024 - May 2025.

   Maddie worked on developing a novel SIR model, which is widely used for predicting infectious diseases.

The new model has a similar structure but incorporates a Deep Neural Network component. This enhanced model is more general and can fit real-world data more accurately.

3. Hayden Reed (Undergraduate). May 1, 2024 - May 2025.

   Hayden worked on "Sliding Window Method for Simulating Action Potentials on Infinitely Long Axons", which is his Honor thesis.

   He joined the **PhD program in Computational Science at the University of Southern Mississippi** after graduation.

4. Dwayne Prosperie (Undergraduate). February 2023 - May 1, 2024.

   Dwayne Prosperie won McNair Scholarship and worked on the project "Predicting Forest Fire Propagation by Machine Learning."

   He presented the results at McNair Symposium held at USM, on November 2nd, 2023, and then finished his thesis.

   He joined the **PhD program in Physics at Vanderbilt University** after graduation.

5. Abel Gurung (Undergraduate). September 2022 - May 1, 2024.

   Abel Gurung worked on Modeling the Open Probability of Ion Channels on Cell's Membranes by Deep Neural Network.

   Through the research project, Abel won first place in the Undergraduate Research Symposium at the University of Southern Mississippi in the category of computational science.

   He also won first place for the research abstract at the 3rd Annual VJ Canizaro, MD Health Summit Research Abstract competition.

   In Summer 2023, Abel got an internship at Chan Zuckerberg Biohub in California, USA.

   Abel successfully obtained the highly competitive Eagle SPUR grant for undergraduate researchers at USM, entitling him to a $1,000 stipend for project completion in Spring, 2024.

   Our paper "Hybrid PDE-Deep Neural Network Model for Calcium Dynamics in Neurons" based on this project was published in a peer-reviewed journal - Journal of Machine Learning for Modeling and Computing.

   He joined the **PhD program in Computer Science at Purdue University** after graduation.