

Zhuolin Qu

Curriculum Vitae

Tulane University
Department of Mathematics
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Research Interests

Dr. Qu is an Applied Mathematician, researching the mathematical modeling of infectious disease. She develops and analyzes mathematical and computational models for the spread and control of infectious diseases such as *Wolbachia*-based control for mosquito-borne diseases, non-typhi *Salmonella*, and sexually transmitted Chlamydia. Her studies have included population dynamics, stochastic agent-based models, uncertainty quantification, and optimization. She has also been working extensively on designing and analyzing numerical methods for nonlinear PDEs.

- Using mathematical modeling and simulations to help public health researchers better understand the spread of disease and optimizes mitigation resource
- Working on interdisciplinary team (public health, mathematics, statistics) with hands-on experience in developing models from large field datasets
- Modeling, forecasting, and visualizing infectious disease spread over population and networks

Education

2011–2016 **Doctor of Philosophy, Applied Mathematics**, *Tulane University*, 3.98/4.

Advisor: Dr. Alexander Kurganov

Thesis: Fast Operator Splitting Methods for Nonlinear PDEs

2012–2016 **Master of Science, Statistics**, *Tulane University*, 4/4.

Advisor: Dr. Michelle Lacey

2007–2011 **Bachelor of Science, Mathematics and Computational Science**, *University of Science and Technology of China*.

Advisor: Dr. Mengping Zhang

Academic Experience

2016–present **Postdoctoral Fellow**, *Tulane University*, Mentor: James (Mac) Hyman.

- Work in multi-disciplinary team (public health, mathematics, statistics) to develop model and simulation codes for infectious diseases, using nonlinear differential equations and stochastic agent-based network models
- Lead research on and submit manuscripts in mathematics and public health journals
- Develop and teach graduate-level numerical analysis classes and co-mentor senior undergraduat and graduate students

Summer 2017–2019 **Visiting Scholar**, *Los Alamos National Laboratory*, Host: Benjamin McMahon, Theoretical Biology and Biophysics (T-6).

- Performed epidemiological analysis on non-typhoidal *Salmonella* in sub-Saharan Africa
- Proposed compartmental and agent-based multi-scale model describing host-pathogen interactions, risk factors for host susceptibility, and family structure in disease transmission at different complexity level

2012–2016 **Graduate Research Assistant**, *Tulane University*.

- Addressed numerical challenges for fluid dynamic systems, including hyperbolic systems of conservation laws, phase-field models and the modified Buckley-Leverett equations
- Designed highly efficient and stable numerical algorithms using finite-difference/finite-volume methods, operator splitting methods and pseudo-spectral methods

- Summer 2015 **Summer Intern**, *Los Alamos National Laboratory*, Mentor: Carl Gable, Natalia Makedonska, Computational Earth Science (EES-16).
- Improved algorithms for calculating geometric coefficients of large unstructured mesh
 - Independently implemented the algorithms using highly efficient parallel programming (in PETSc and MPI) and object-oriented programming in Fortran
 - Codes are now part of dfnWorks, the software suit of flow and transport modeling in discrete fracture networks, used by the lab
- Summer 2012, 2013 **Visiting Fellow**, *Shanghai Jiao Tong University*.
Institute of Natural Sciences
- Summer 2010 **Summer Intern**, *Pohang University of Science and Technology, Korea*, Combinatorial and Computational Mathematics Centre Research Center.
Mentor: Kwang Ik Kim. Worked on the singular perturbation theory and its applications

Publications

(*authors in alphabetical order)

- **Qu, Zhuolin**, Hyman, J. M. Generating a Hierarchy of Reduced Models for a System of Differential Equations Modeling the Spread of *Wolbachia* in Mosquitoes, *SIAM Journal on Applied Mathematics*, 2019, 79(5):1675-1699.
- **Qu, Zhuolin**, Xue, L., Hyman, J. M. Modeling the Transmission of *Wolbachia* in Mosquitoes for Controlling Mosquito-Borne Diseases, *SIAM Journal on Applied Mathematics*, 2018, 78(2):826-852.
- Thongsripong, P., **Qu, Zhuolin**, Hyman, J. M. and Wesson, D. Quantification of Mosquito Biting Rates Using Surveys and Their Implication in Determining Dengue Viral Transmission Risk in the Greater New Orleans Region. In *The American Journal of Tropical Medicine and Hygiene*, 2018, 99(4)
- Cheng, Y. Z., Kurganov, A., **Qu, Zhuolin***, Tang, T. Fast and Stable Explicit Operator Splitting Methods for Phase-field Models, *Journal of Computational Physics*, 2015, 303:45-65.
- Kao, C. Y., Kurganov, A., **Qu, Zhuolin***, Wang, Y. A Fast Explicit Operator Splitting Method for Modified Buckley–Leverett Equations, *Journal of Scientific Computing*, 2015, 64(3):837-857.
- Chertock, A., Kurganov, A., **Qu, Zhuolin***, Wu, T. Three-Layer Approximation of Two-Layer Shallow Water Equations, *Mathematical Modelling and Analysis*, 2013, 18(5):675-693.
- Kurganov, A., Rozanova, O. S., **Qu, Zhuolin***, Wu, T. Adaptive Moving Mesh Central-Upwind Schemes for Hyperbolic System of PDEs. Applications to Compressible Euler Equations and Granular Hydrodynamics, submitted

Papers in Preparation

- Thongsripong, P., **Qu, Zhuolin**, Yukich, J., Hyman, J. M., Wesson, D. Quantification of Human-mosquito Contact Rate Using Surveys and its Application in Determining Dengue Viral Transmission Risk
- **Qu, Zhuolin**, Azizi, A., Schmidt, N., Craig-Kuh, M. C., Stoecker, C., Hyman, J. M., Kissinger, P., Network Modeling the Impact of Community-based Male-screening on the Chlamydia Trachomatis Prevalence in Women

- **Qu, Zhuolin**, Gulbudak, H., Hyman, J. M., Milner, F., Sensitivity Analysis in a Vector-Host Immuno-Epidemiological Model with Application to Rift Valley Fever

Funding Support and Awards

Grant submitted

- 2019 **NSF/MPS/DMS/Mathematical Biology**, “*Spatial Models for Enhancing the Effectiveness of Wolbachia to Control the Spread of Mosquito-borne Diseases*”, Role: PI, collaboration with Co-PI James (Mac) Hyman at Tulane, in review.

Research Support

- 2016–2019 **Joint DMS/NIGMS Initiative to Support Research at the Interface of the Biological and Mathematical Sciences**, “*Multiscale Models for Predicting the Effectiveness of Mitigation Efforts in Controlling Vector-Borne Epidemics*”.
- 2018–2019 **NIH NICHD**, “*A New Approach to Controlling Chlamydia Transmission in Young People*”.

Honors and Awards

- 2017–2019 **Postdoctoral Fellow Travel Fund**, Tulane University.
- 2017 **Health Sciences Research Days Award for Excellence in Research and Presentation by a Postdoctoral Fellow**, Tulane University.
Evaluated by a panel of judges in health science among the nearly 200 presentations
- 2015–2019 **Travel Awards**, Awarded 15 competitive grants for travel to conferences and workshops.
- 2012–2015 **Summer Research Fellowship**, Tulane University.

Conference and Talks

- 2019 ◦ **Epidemiology Seminar**, School of Public Health and Tropical Medicine, seminar talk, Tulane University, September
- **The Fifth International Conference on Computational and Mathematical Population Dynamics (CMPD5)**, invited talk, Fort Lauderdale, May
- **Workshop on Modeling the Spread of Infectious Diseases**, Tulane University, February
- **Scientific Computing around Louisiana**, contributed talk, Tulane University, February
- **NIMBioS tutorial: Network Modeling**, workshop, University of Tennessee, February
- 2018 ◦ **University of Louisiana at Lafayette**, Mathematics Department Colloquium, October
- **Biomathematics and Ecology: Education and Research (BEER)** conference, contributed talk, Arizona State University, October
- **SAMSI workshop**, Model Uncertainty: Mathematical and Statistical, poster presentation, Duke University, August
- **SIAM Annual Meeting 2018**, contributed talk, July
- **Los Alamos National Laboratory**, Brown bag meeting on disease transmission modeling and surveillance, seminar talk, July

- **Joint Research Conference on Statistics in Quality, Industry, and Technology**, participation, Santa Fe, June
- **MBI Emphasis Workshop on Multiscale Dynamics of Infections**, poster presentation, Ohio State University, April
- **NIH-MIDAS Network Meeting**, poster presentation, April
- **42nd SIAM SEAS Sectional Conference**, invited talk, UNC Chapel Hill, March
- **29th Annual Health Sciences Research Days**, poster presentation, Tulane University, February
- **Scientific Computing around Louisiana (SCALA)**, contributed talk, Louisiana State University, February
- 2017 ○ **Mathematical Biology Center**, Guangzhou University, invited talk, November
- **Mathematics and Science College**, Shanghai Normal University, invited talk, November
- **Tropical Medicine Seminar**, School of Public Health and Tropical Medicine, Tulane, seminar talk, September
- **Los Alamos National Laboratory**, Center for Nonlinear Studies, seminar talk, August
- **9th Annual Summer Institute in Statistics and Modeling in Infectious Diseases**, workshop, University of Washington, July
- **SMB Annual Meeting 2017**, poster presentation, July
- **SIAM Annual Meeting 2017**, contributed talk, July
- **NIMBioS Tutorial: Uncertainty Quantification for Biological Models**, workshop, June
- **NIH-MIDAS Network Meeting**, poster presentation, May
- **How Mathematical Models are helping Guide Mitigation Efforts to Control Epidemics**, guest lecture, Georgia State University, May
- **Scientific Computing around Louisiana (SCALA)**, contributed talk, Tulane University, March
- **SIAM Conference on Computational Science and Engineering**, poster presentation, March
- **28th Annual Health Sciences Research Days**, poster presentation, Tulane University, February
- 2016 ○ **SAMSI Optimization Program Summer School**, workshop, August
- 2015 ○ **KI-Net: Collective Dynamics in Biological and Social Systems**, poster presentation, November
- **Tulane Mathematics Department**, Graduate Student Colloquium, invited talk, September
- **Los Alamos National Laboratory**, SFT Brown Bag Seminar, invited talk, August
- **Student Symposium: “Championing Scientific Careers”**, poster presentation, Los Alamos National Laboratory, August
- **The Ninth IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena**, invited talk, April

- **Scientific Computing Around Louisiana (SCALA)**, poster presentation, March
- 2014 ○ **Tulane Mathematics Department**, applied mathematics seminar, invited talk, April
- **KI-Net Conference** on Modern Perspectives in Applied Mathematics: Theory and Numerics of PDEs, participation, April
- before ○ **Clifford Lectures Conference** on Numerical Methods for Convection Dominated Partial Differential Equations, participation, March 2013
- **American Mathematical Society Sectional Meeting**, participation, October 2012

Service

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| Journal Referee | Journal of Biological Dynamics, PLoS ONE, Journal of Theoretical Biology, Mathematical Biosciences, Letters in Biomathematics, Journal of Biological Systems |
| Organizer | New Orleans workshop on Modeling the Spread of Infectious Diseases, Tulane University, Spring 2019 |
| Co-organizer | Clifford Lectures, Tulane University, 2017 |
| Committee | <ul style="list-style-type: none"> ○ Graduate Oral exam and Dissertation Defense committee, Li Guan, Department of Mathematics, Tulane University, Spring 2018 ○ Prospectus Defense committee, Christian Geneus, Department of Biostatistics, Tulane University, Spring 2019 ○ Undergraduate Honors Thesis Prospectus, Rhea Kataria, Department of Mathematics, Tulane University, Fall 2019 |
| Media Coverage | <ul style="list-style-type: none"> ○ Math Horizons, Evelyn J. Lamb, “Fighting an Epidemic with an Epidemic”, <i>Math Horizons</i>, 2019, 26:4, 22-23, DOI: 10.1080/10724117.2019.1574148 ○ Forbes Magazine, Innovation-Science, “Math-Based Mosquito Control To Prevent Human Diseases”, January 14th, 2019 ○ Los Alamos Monitor, “Solving epidemics with math”, October 10th, 2018 ○ The Times-Picayune, “Tulane researchers use math to contain the spread of mosquito-borne illnesses”, August 30th, 2018 ○ SIAM News, Research Nugget on “Sustained bacterial outbreak in mosquitoes limits spread of life-threatening diseases”, March 20th, 2018 |
| Poster Judge | School of Science and Engineering Research Day, Tulane University, 2018, 2019 |
| Newcomb Fellow | Newcomb College Institute, 2016–present, voluntary association of faculty from all undergraduate colleges to support women’s leadership/gender equity and foster faculty-student interaction and research |

Teaching Experience

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| Instructor of Record | <ul style="list-style-type: none"> ○ MATH 758: Scientific Computation III (graduate), Spring 2018, Spring 2019 ○ MATH 221: Calculus III, Fall 2016 ○ MATH 122: Calculus II, Fall 2013 ○ MATH 116: Long Calculus II, Spring 2014 |
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| Teaching Assistant | <ul style="list-style-type: none"> ○ MATH 309/609: Linear Algebra, Fall 2012, Spring 2013 ○ MATH 224: Introduction to Applied Mathematics, Spring – Fall 2012, Spring 2015 ○ MATH 131: Consolidated Calculus, Fall 2014 ○ MATH 221: Calculus III, Spring 2012 ○ MATH 122: Calculus II, Spring 2016 ○ MATH 121: Calculus I, Fall 2011, Fall 2015 |
| Guest Teaching Lectures | <ul style="list-style-type: none"> ○ MATH 732: Applied Mathematics II (graduate), Spring 2017 ○ MATH 635: Optimization (graduate), Fall 2018 ○ MATH 424/624: Ordinary Differential Equation, Fall 2016 |

Mentoring Experience

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| Doctoral Dissertation | <ul style="list-style-type: none"> ○ Assist in mentoring doctoral dissertation, Mathematics student, on modeling epidemics with distribution parameters, committee member for Dissertation defense (Tulane, 2017-2019) ○ Assist in mentoring doctoral dissertation, Biostatistics student, on characterizing the spread of epidemics over networks (Tulane, 2018-2019) ○ Assist in mentoring doctoral dissertation, Public Health student, on quantifying human-mosquito contact rate, manuscript submitted. (Tulane, 2017-2018) |
| Master Thesis | <ul style="list-style-type: none"> ○ Assist in mentoring master thesis project, Computational Science student, on modeling chikungunya disease and quantifying model uncertainty (Tulane, 2018-2019) |
| Honor Thesis | <ul style="list-style-type: none"> ○ Assist in mentoring undergraduate honor thesis, Neuroscience student, on modeling Tuberculosis progression with treatment, Senior Scholar Award for undergraduate (Tulane, 2018-2019) ○ Assist in mentoring undergraduate honor thesis, Mathematics student, on characterizing the stochastic spread of epidemics over networks (Tulane, 2018-2019) ○ Assist in mentoring undergraduate project, Mathematics student, on modeling the Chagas disease in the New Orleans area and estimating human risk. (Tulane, 2018-2019) |
| Committee | Mentoring committee member for Society of Mathematical Biology mentoring program at the annual meeting 2017 |

Computer Skills

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| Script | Matlab, Octave, Fortran, Mathematica, C, R, Python, Maple, MySQL, NetLogo |
| Software | Latex, Git, Vim, Inkscape, Gephi, ParaView, Adobe Illustrator, Origin |
| Other | MPI, PETSc, LaGriT, PFLOTRAN |