

# GRACIE CONTE | Curriculum Vitae

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## EDUCATION

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**University of North Carolina, Chapel Hill** (expected) May 2022  
Ph.D. Applied Mathematics  
Adviser: **Dr. Jeremy Marzuola**

**California State University, Sacramento** May 2016  
M.A. Pure Mathematics  
Adviser: Dr. Tracy Hamilton

**California State University, Sacramento** May 2014  
B.A. Mathematics  
B.A. Physics  
Certificate: Scientific Computing and Simulation

## RESEARCH INTERESTS

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Partial Differential Equations • Quantum Mechanics • Fluid Dynamics • Continuum Mechanics

## DISSERTATION

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My dissertation research studies the cubic nonlinear Schrödinger equation (NLS) on quantum graphs from a dynamical perspective. In particular, I focus on how periodic solutions arise as a consequence of Hamilton-Hopf bifurcations. Analytically, I am working to prove that periodic solutions exist and find the necessary initial conditions. Numerically, I will use the initial conditions to find these periodic solutions with machine precision. To obtain machine precision, I have numerically defined the Laplacian operator on any given graph which gives our spatial component spectral accuracy. The time solver is complicated by the boundary conditions imposed by quantum graphs, but I can solve the NLS using an 8th order time solver. I am now implementing the Adjoint Continuation Method so we will be able to search for time periodic solutions. All these numerical components are being adapted into a software package jointly with **Roy Goodman**.

## PUBLICATIONS

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**Grace Conte**, Roy Goodman, Jeremy Marzuola, *QGLAB: a MATLAB package for computations on quantum graphs*, (in preparation)

Thomas Beck, Isabel Bors, **Grace Conte**, Graham Cox, Jeremy L. Marzuola, *Limiting eigenfunctions of Sturm–Liouville operators subject to a spectral flow*, Annales mathématiques du Québec (2020)

## GRANTS / AWARDS / SCHOLARSHIPS

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J. Burton Linker Award for Excellence in Undergraduate Teaching · UNC-CH	Spring 2019
Initiative for Minority Excellence · UNC-CH	Fall 2016 - Spring 2017
Faculty Endowment Award · CSU, Sacramento	Fall 2015
Royal Vanderburgh Scholarship · CSU, Sacramento	Fall 2014 - Spring 2015
James Clerk Maxwell Award · CSU, Sacramento	Spring 2012 - Fall 2013

## TECHNICAL SKILLS

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### Programming Languages:

MATLAB • Python • Mathematica • FreeFem++ • FORTRAN • C++

### Other:

L<sup>A</sup>T<sub>E</sub>X • **GitHub** • Labview

## TALKS AND PRESENTATIONS

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### Searching for Time Periodic Solutions to the Nonlinear Schrödinger Equation

- Triangle Area Graduate Mathematics Conference at UNC, Chapel Hill, 8 Dec. 2020 [Slides]

### Introduction to Bifurcation Theory and its Applications to the NLS Equation

- Mathematics Graduate Student Association Seminar at UNC, 29 Sept. 2020 [Slides]

### Discretizing Schrödinger Type Operators on Quantum Graphs with Spectral Accuracy

- Mathematics Graduate Student Applied Seminar at NCSU, 13 Mar. 2020 [Slides]
- Graduate Mathematics Association Seminar at UNC, Chapel Hill, 2 Mar. 2020
- Triangle Area Graduate Mathematics Conference at UNC, Chapel Hill, 9 Nov. 2019
- Graduate Mathematics Association Seminar at UNC, Chapel Hill, 25 Mar. 2019

### Applying to Graduate School

- Launch Point, 11 April 2021 [Slides]
- Diversity in Data Science and Machine Learning Conference by Samsi at Howard University, 17 Oct 2019

### Introduction to Quantum Mechanics

- Girls Talk Math at UNC, Chapel Hill, 12 July 2019 [Slides]
- Girls Talk Math at UNC, Chapel Hill, 10 July 2018
- Girls Talk Math at UNC, Chapel Hill, 14 July 2017

## MINI SCHOOLS

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Quantum Graphs and Their Spectra · Lake Como School of Advanced Studies Aug 2019

From Symplectic Geometry to Chaos · MSRI July 2018

## TEACHING AND ACADEMIC EXPERIENCE

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### Graduate Teaching Fellow

Aug. 2016 - Present

UNC, Chapel Hill

#### Senior Teaching Fellow:

2019/2020 Academic Year

Co-taught Math 920 which prepares incoming math graduate students to be successful course instructors. Checked syllabus, exams, and other class material of first-time instructors as well as observed their teaching during the semester. Assisted graduate students with creating class material on request. This position is awarded to a single graduate student each year.

#### Instructor of Record Class List:

Math 547	Linear Algebra	Summer 2020
Math 383	Differential Equations	Summer 2019
Math 381	Discrete Mathematics	Spring 2021, Fall 2020
Math 233	Calculus III (Recitation)	Fall 2016
Math 232	Calculus II (Recitation)	Fall 2018, Fall 2017
Math 231	Calculus I	Summer 2017
Math 130	Precalculus	Spring 2019, Spring 2017
Math 119	Mathematical Modeling	Fall 2018
Math 110	College Algebra	Spring 2018, Fall 2017

### Graduate Assistant

Aug. 2014 - July 2016

CSU, Sacramento

**Duties:** Taught classes. Proctored exams. Graded assignments. Taught review sessions for diagnostic testing. Tutored.

#### Instructor of Record Class List:

Math 11	Algebra for College Students	Spring 2016
Math 9	Essentials of Algebra and Trigonometry	Fall 2015, Spring 2015

### Curriculum Developer and Instructor

July 2015 - June 2016

Brookfield School

Taught math and physics summer camp classes for children ranging from 5th to 8th grade. Developed material that focused on experimentation and applied learning to teach students geometry, number theory, probability, and physics. Substituted for any teacher K-8th grade during regular school year.

## MENTORING

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### Undergraduate Research Mentor

Fall 2019 - Spring 2020

- Mentored an undergraduate student for her senior thesis by providing background on her problem and assisting her with the numerical analysis.

## PROGRAM CREATION

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### **Directed Reading Program** UNC, Chapel Hill

August 2018

- Founded a mentoring network where graduate students mentor undergraduate students.
- Designed a program to expose undergraduates to advanced level mathematics that is not found in a classroom setting to prepare them to think in an exploratory mindset rather than a regurgitative one.

### **Society of Industrial and Applied Mathematics - UNC Chapter** UNC, Chapel Hill

August 2017

- Founding member of the UNC-CH student chapter of SIAM.

## LEADERSHIP AND ADMINISTRATIVE EXPERIENCE

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### **Girls Talk Math** CO-DIRECTOR

August 2018 - Present

[\[Website\]](#)

- Annually organize a two-week day camp hosted in the Mathematics Department at the UNC-CH geared towards female and gender non-conforming high school students interested in mathematics.
- Obtain external funding so the program is free for all attendees.
- Guide students through high-level problem sets by helping them think critically about the material.
- Provide names of prominent female mathematicians in fields consistent with given problem sets for students to research for the purpose of writing blog posts.
- Coordinate activities to promote a sense of community, boosting collaboration amongst students.
- Adapted camp to a virtual environment for years 2020 and 2021.

### **Directed Reading Program - UNC Chapter** FOUNDING COMMITTEE MEMBER

August 2018 - Present

[\[Website\]](#)

- Organize the pairings of mentors and students each semester with special care taken to pair students from underrepresented minorities with graduate mentors who were sensitive to their unique backgrounds.
- Obtain funding for books so program is free mentors and mentees.
- Coordinate end-of-semester presentations.
- Sole author of [presentation guidelines](#) for students to successfully give technical talks.

### **American Mathematical Society - UNC Chapter** PRESIDENT

August 2019 - May 2020

- The AMS Student Chapters at UNC, NCSU and Duke created the Triangle Area Graduate Mathematics Conference ([TAGMaC](#)) and currently rotate hosting duties on a semesterly basis. As President of AMS Student Chapter at UNC, Chapel Hill, I hosted and organized TAGMaC in November 2019.

### **Graduate Mathematics Association** PRESIDENT

August 2019 - May 2020

- Fostered a sense of community amongst graduate students, faculty, staff, and postdoctoral students in the mathematics department by organizing a variety of social events including biannual picnics and a winter holiday party.
- Organized career panels that informed students of different career paths and how best to prepare for the transition out of graduate school.

### **Society of Industrial and Applied Mathematics - UNC Chapter** TREASURER

August 2017 - May 2019

[\[Website\]](#)

- The UNC-CH Student Chapter provides a forum where students can pursue mathematical research focused on applications in science and industry. Additionally, it facilitates interactions between students, faculty, and SIAM through official SIAM activities of the chapter.

## UNC Science Exposition

April 2017 - April 2019

### EXHIBIT LEADER

[\[Website\]](#)

- Managed an exhibit demonstrating how nature opts for minimizing surface area for a set volume with an interactive activity of making bubbles with a variety of shapes and sizes to share the magic of mathematics with young people.

## Graduate Student Advisory Council - CSUS

August 2015 - May 2016

### COUNCIL MEMBER

- Conceptualized and presented the idea of a private study space for graduate students to work apart from undergraduates that was accepted by the university.
- Coordinated a formal winter social event for graduate students from all departments.

## RESEARCH EXPERIENCE

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### Displacement Analysis of Neo-Hookean Elastic Materials • UNC, Chapel Hill

Derived and tested the behavior of finite element formulations for incompressible plastic materials at finite strains using Cook's Membrane and the Elasto-Plastic Strip using FreeFem++.

### Calculating the Stark Effect Energy Shift for the Hydrogen Atom • UNC, Chapel Hill

Found that the numerical eigenvalue methods produced very close estimates to the first-order perturbation theory corrections. However, the second-order estimates were slightly lower than the perturbation theory results. This was likely due to the fact that we truncated the Hamiltonian matrix and thus lost the effect of the higher level states on the eigenvalues.

### Heterojunction-Assisted Impact Ionization • University of Oregon REU

Experimentally determined the best method to deposit single crystal epitaxial sphalerite Zinc Sulfide on Silicon wafers. Such thin layers have the potential to increase solar cell photocurrent by promoting impact ionization at the junction between two absorber layers. Through this heterojunction-assisted impact ionization, two free electrons are produced by the absorption of a single high-energy photon.

## PROFESSIONAL SOCIETIES

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Pi Mu Epsilon (National Math Honor Society)

Pi Sigma Pi (National Physics Honor Society)

Society of Industrial and Applied Mathematics (SIAM)

American Mathematical Society (AMS)

## REFERENCES

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Jeremy Marzuola	UNC, Chapel Hill	marzuola@email.unc.edu	<i>Research Advisor</i>
Roy Goodman	NJIT	goodman@njit.edu	<i>Research Collaborator</i>
Linda Green	UNC, Chapel Hill	greenl@email.unc.edu	<i>Teaching Reference</i>