

# Rujeko Chinomona

Temple Department of Mathematics (038-16) ♦ 1805 N. Broad St. ♦ Philadelphia, PA, 19122  
rchinomona@temple.edu ♦ <https://rujekoc.github.io/>

## EDUCATION

### Southern Methodist University (SMU)

May 2021

Ph.D. in Computational & Applied Mathematics

(Advisor: Daniel Reynolds)

Thesis title: High-Order, Flexible Multirate Integrators for Multiphysics Applications

### Rice University

May 2016

M.A. in Computational & Applied Mathematics

(Advisor: Beatrice Riviere)

Thesis title: Black-oil Simulation Utilizing a Central Finite Volume Scheme

### Georgia College & State University (GCSU)

May 2014

B.S. in Mathematics & Physics

## TECHNICAL SKILLS

**Programming languages:** Proficient in MATLAB, C. Experience with Python, C++, C#, Fortran 90

**High performance computing:** Experience with MPI, OpenMP, CUDA, Unity

**Computational mathematics:** In-depth expertise in numerical analysis, with a specialized focus on developing robust methods for ordinary differential equations and differential algebraic equations

**Scientific software development:** Experience with designing, implementing, and deploying scientific software for applications in radiation transport and computational neuroscience

## RESEARCH EXPERIENCE

### Dept. of Mathematics, Temple University

Philadelphia, PA

Research Assistant Professor (Postdoctoral Researcher)

July 2021 - Present

*Areas: numerical differential equations, moment methods, digital twins*

(Advisor: Benjamin Seibold)

- ♦ Collaborate on constructing and implementing new stable and computationally efficient implicit-explicit multistep time stepping schemes
- ♦ Co-designed and applied computationally efficient moment method algorithms for advective systems in a network
- ♦ Design, develop and integrate new numerical methods into the StaRMAP software for the solution to spherical harmonic moment method systems with applications in radiative transfer
- ♦ Investigate and analyze performance of numerical algorithms best suited for real-time computing with user interaction for computational neuroscience simulations
- ♦ Train and co-supervise a dynamic team of undergraduate research students (approx. 4 students per semester)
- ♦ Conduct virtual reality demonstrations to experts and lay audiences

### Dept. of Mathematics, SMU

Dallas, TX

Graduate Research Assistant

Jan 2018 - May 2021

*Areas: high-order time-stepping methods, multi-scale methods*

(Advisor: Daniel Reynolds)

- ♦ Developed innovative flexible, implicit-explicit, high-order numerical algorithms for multirate time integration specifically designed for multiphysics applications
- ♦ Demonstrated improved accuracy (up to 100K times) and efficiency (up to 100 times) compared to typically used operator splitting approaches
- ♦ Collaborated on developing new classes of multirate exponential integrators, constructing test cases, and performing convergence and efficiency studies

### CASC Division, Lawrence Livermore National Laboratory

Remote

Computing Intern

June 2020 - Aug 2020

*Areas: scientific computing, parallel computing, large-scale simulation*

(Advisor: David Gardner)

- ◇ Implemented new multirate time integration algorithms in ARKODE, an open-source award winning solver library distributed as part of the SUNDIALS software package
- ◇ Designed and implemented test problems to assess method performance on spatially serial and parallel cases

#### **CASC Division, Lawrence Livermore National Laboratory**

Livermore, CA

##### **Computing Intern**

June 2019 - Aug 2019

*Areas: large-scale multiphysics simulation, climate simulation*

(Advisor: Carol Woodward)

- ◇ Investigated the applicability of multirate time stepping in cloud microphysics simulations
- ◇ Performed verification studies to match Matlab and Fortran 90 implementations

#### **Dept. Computational and Applied Mathematics, Rice University**

Houston, TX

##### **Graduate Research Assistant**

May 2015 - May 2016

*Areas: reservoir simulation, numerical PDEs, conservation laws*

(Advisor: Beatrice Riviere)

- ◇ Utilized finite volume methods for solving the black-oil system of PDEs for multi-phase fluid flow, and validated the application and results through comparison with existing research

#### **Dept. of Physics, GCSU**

Milledgeville, GA

##### **Undergrad Research Assistant**

Aug 2012 - May 2014

*Areas: atomic molecular optics, experimental physics*

(Advisor: Hauke Busch)

- ◇ Designed and constructed components of a cost effective setup for laser cooling with a magneto-optical trap
- ◇ Gained valuable basic experience in experimental designs, data acquisition techniques, working with high precision optical equipment, building electronics, and working in a machine shop

#### **Dept. of Mathematics, University of Wisconsin-Madison**

Madison, WI

##### **NSF REU Intern**

May 2013 - July 2013

*Areas: mathematical modeling, fluid dynamics*

(Advisor: Saverio Spagnolie)

- ◇ Participated in a National Science Foundation funded Research Experience for Undergraduates in Analysis and Differential Equations
- ◇ Modeled, simulated, and analyzed the stability of self-assembled ferro-magnetic swimmers

## **SIGNIFICANT SOFTWARE CONTRIBUTIONS**

### **StaRMAP** *Staggered-grid Radiation Moment Approximation*

- ◇ Implemented a flexible solver that works with 1D-3D test problems
- ◇ Maintain the StaRMAP codebase and spearhead initiatives to enhance functionality

### **Neuro-VISOR** *Neuroscience Virtual Simulation of Reality*

- ◇ Key in implementing robust numerical methods and incorporating interactive features for synapses
- ◇ Build and maintain Neuro-VISOR codebase

### **SUNDIALS** *Suite of Nonlinear and Differential/Algebraic Equation Solvers*

- ◇ Implemented IMEX-MRI-GARK methods and corresponding test problems in the MRISolver module

## **RECOGNITIONS & ACCOMPLISHMENTS**

### **Winner of SIAM Student Paper Prize**

2023

One of three selected recipients by Society for Industrial and Applied Mathematics

### **Attended Rising Stars in Computational and Data Science Workshop**

Apr 2023

Selected to attend workshop sponsored by Oden Institute, Sandia National Laboratory, Lawrence Livermore National Laboratory

### **Team-Based Inquiry Learning Fellow**

2023-2024

Completed certification workshop to implement Team-Based Inquiry Learning in undergraduate courses

### **Postdoctoral Teaching Award**

2022

Temple University Dept. of Mathematics

### **Honored Guest Speaker**

Apr 2022

Georgia College Dept. of Mathematics Award Ceremony <b>Dean's Dissertation Fellowship</b> Southern Methodist University	2020 - 2021
<b>Haberman Fellowship</b> Southern Methodist University Dept. of Mathematics	2020 - 2021
<b>University Ph.D. Fellowship</b> Southern Methodist University	2017 - 2021
<b>Outstanding graduating senior in STEM majors</b> Georgia College & State University	May 2014
<b>Outstanding graduating physics major</b> Georgia College & State University	May 2014
<b>Recipient of Grace Scholarship</b> Philanthropic Ventures Foundation	2010 - 2014

## PUBLICATIONS

1. **R. Chinomona**, K. Kean, B. Seibold, and J. Woods. Moment Methods for Advection on Networks and an Application to Forest Pest Life Cycle Models, 2023 (preprint - arxiv 2308.06940)
2. D. R. Reynolds, D. J. Gardner, C. S. Woodward, and **R. Chinomona**. ARKODE: A flexible IVP solver infrastructure for one-step methods. *ACM Transactions on Mathematical Software*, 49(2):1–26, 2023. doi: 10.1145/3594632
3. **R. Chinomona** and D. R. Reynolds. Implicit–explicit multirate infinitesimal GARK methods. *SIAM Journal on Scientific Computing*, 43(5):A3082–A3113, 2021. doi: 10.1137/20M1354349
4. V. T. Luan, **R. Chinomona**, and D. R. Reynolds. Multirate exponential Rosenbrock methods. *SIAM Journal on Scientific Computing*, 44(5):A3265–A3289, 2022. doi: 10.1137/21M1439481
5. V. T. Luan, **R. Chinomona**, and D. R. Reynolds. A new class of high-order methods for multirate differential equations. *SIAM Journal on Scientific Computing*, 42(2):A1245–A1268, 2020. doi: 10.1137/19M125621X
6. **R. Chinomona**, J. Lajeunesse, W. H. Mitchell, Y. Yao, and S. E. Spagnolie. Stability and dynamics of magnetocapillary interactions. *Soft Matter*, 11(9):1828–1838, 2015. doi: 10.1039/C4SM02189D

## PRESENTATIONS

[D = demonstration, P = poster, T = talk]

<b>Mathematical Opportunities in Digital Twins</b> , George Mason University Real-time interactive simulation of reality with neuroscience applications [P,D]	Dec 2023
<b>Computational Applied Mathematics &amp; Operations Research Colloquium</b> , Rice University Improving Time Integration for Multiphysics Simulation and Advancing State-of-the-Art Numerical Methods in Practical Applications [T]	Nov 2023
<b>Mid-Atlantic Numerical Analysis Day</b> , Temple University StaRMAP: Simple, efficient, and flexible simulation software for radiation transport [T]	Nov 2023
<b>Rising Stars in Computational and Data Science Workshop</b> , University of Texas at Austin Bridging the gap between numerical analysis and application [T]	Apr 2023
<b>Mid-Atlantic Numerical Analysis Day</b> , Temple University Demonstration of the Neuro-VISOR project [D]	Oct 2022
<b>Int'l. Conference on Computational Methods &amp; Applications in Engineering</b> , Virtual Derivation of stability optimized IMEX-MRI-GARK methods [T]	May 2022
<b>ICERM Topical Workshop: Holistic Design of Time-Dependent PDE Discretizations</b> , Virtual Multirate IMEX Integrators for PDEs [T]	Jan 2022
<b>Applied Mathematics and Scientific Computing Seminar</b> , Temple University Flexible and accurate multirate time-stepping methods for differential equations [T]	Sep 2021
<b>SIAM Annual Meeting</b> , Virtual Highly Accurate and Flexible Multirate Time-Stepping Methods for Multiphysics Applications [T]	July 2021
<b>SIAM Conference on Computational Science and Engineering</b> , Virtual High-Order Implicit–Explicit Multirate Infinitesimal Methods for Multiphysics Applications [T]	Mar 2021

<b>SIAM Conference on Parallel Processing for Scientific Computing</b> , Seattle, WA	Feb 2020
Construction of High-Order Multirate IMEX Integrators for Large-Scale Complex Multiphysics Applications [P]	
<b>SIAM TX-LA Section Meeting</b> , Southern Methodist University	Nov 2019
Comparison of High-Order Multirate Integrators [P]	
<b>LLNL Summer Student poster session</b> , Livermore, CA	Aug 2019
Multirate Time Integration for Cloud Microphysics [P]	
<b>SMU Research Day</b> , Southern Methodist University	Mar 2019
A New Class of High-Order Multirate Integrators for Multiphysics Applications [P]	
<b>SIAM Conference on Computational Science and Engineering</b> , Spokane, WA	Feb 2019
A New Class of High-order, Flexible, IMEX Multirate Integrators for Multiphysics Applications [T]	

## TEACHING EXPERIENCE

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### Instructor of Record (*Temple University*)

MATH 3044 Numerical Analysis II	Spring 2023
MATH 3043 Numerical Analysis I	Fall 2023, Fall 2022
MATH 2121 Mathematical Modeling and Simulation	Spring 2023, Spring 2022
MATH 1042 Calculus II	Fall 2021

### Teaching Assistant

[SMU] MATH 3315 Introduction to Scientific Computing	Fall 2017 - Spring 2018
[GCSU] MATH 1113 Precalculus	Spring 2014
[GCSU] MATH 1111 College Algebra	Fall 2011 - Spring 2012

### Tutoring

[Varsity Tutors - Houston TX] High school algebra and calculus	Nov 2016 - Apr 2017
[Terrific Tutors - Katy, TX] High school algebra and calculus	Feb 2017 - Apr 2017

### Grader (*Rice University*)

CAAM 536 Numerical Methods for PDEs	Spring 2016
CAAM 335 Matrix Analysis	Fall 2014 - Fall 2015

## OTHER EXPERIENCES

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### Dept. of Mathematics, Temple University

Philadelphia, PA

#### Research Assistant Professor

July 2021 - Present

#### Curriculum Development and Mentorship

- ◇ Organized class materials, created video lectures and taught the department's first course in Mathematical Modeling and Simulation
- ◇ Supervised 2 undergraduate students on honors projects in Numerical Analysis and Mathematical Modeling and Simulation

### Dept. of Physics, GCSU

Milledgeville, GA

#### Laboratory Assistant

Feb 2012 - Dec 2013

- ◇ Taught and facilitated introductory physics labs
- ◇ Set-up and documented detailed experiment layouts, streamlining the training process for laboratory assistants

### Payroll Services, GCSU

Milledgeville, GA

#### Student Assistant

Aug 2011 - May 2014

- ◇ Executed receptionist duties, including the warm welcoming of customers, handling incoming phone calls, and organizing payroll data filing

### Alumni Records, GCSU

Milledgeville, GA

#### Student Assistant

Mar 2011 - July 2011

- ◇ Interacted with Georgia College alumni, ensuring the accuracy of their records and gathering details about their current professional positions

- ◇ Conducted outreach calls to secure contributions for the school's scholarship funds

## SERVICE & LEADERSHIP

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<b>Judge</b> , COMAP Interdisciplinary Contest in Modeling	Mar 2022
<b>Organizer</b> , SMU Math Graduate Student Seminar	Jan 2020 - Dec 2020
<b>Dept. Representative</b> , SMU Graduate Student Assembly	Jan 2020 - May 2021
<b>Volunteer</b> , Green Careers Dallas	Nov 2019 - Mar 2020
<b>Advisory Committee Member</b> , SMU Graduate Student Health Insurance Advisory Panel	Mar 2019
<b>Judge</b> , Dallas Regional Science & Engineering Fair	Feb 2019, Feb 2020
<b>Treasurer</b> , Rice University SIAM Student Chapter	Aug 2015 - May 2016
<b>Participant</b> , GCSU Georgia Education Mentorship Program	Aug 2013 - May 2014
<b>Participant</b> , GCSU Leadership Certificate Program	Jan 2011 - May 2014
<b>Secretary</b> , GCSU International Club	Aug 2012 - May 2013
<b>Secretary</b> , GCSU Mathematics Club	Aug 2012 - May 2013

## PROFESSIONAL MEMBERSHIPS

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Society for Industrial and Applied Mathematics (SIAM)  
Association for Computing Machinery (ACM)  
Association for Women in Mathematics (AWM)