BIALA, TOHEEB AYINDE
Murfreesboro, TN37130
Mobile: 615-892-6941
Email: tab7v@mtmail.mtsu.edu

Research Statement

I am interested in developing fast numerical algorithms for the simulation of mathematical models involving partial differential equations (PDEs). Presently, I work on the development of fast numerical algorithms for fractional PDEs (non-integer order PDEs) using the shared and distributed memory systems (OpenMP and MPI). During one of the workshops I attended, I got excited with the use of data analytics and data-driven modeling methods for the simulation of PDEs. I have since then been working on developing data-driven modeling algorithms for fractional PDEs. I intend to pursue this research area in the near future.

Education

2016 - May 2020 **PhD** in Computational Science, Middle Tennessee State Univ. Murfreesboro, TN
Advisor: Dr. Abdul Q.M. Khaliq

2016 - 2019 **M.S.** Computer Science, Middle Tennessee State University.

2012 - 2014 **M.S** in Mathematics, University of Ilorin, Nigeria

2007 – 2011 **B. S.** in Mathematics, University of Ilorin, Nigeria

Research Interest

- Data-driven modeling algorithms
- Data analytics
- Numerical methods of fractional PDEs with applications
- Parallel algorithms for large scale computing
- High performance computing/ Parallel computing

Publications

- **T. A. Biala,** Second-order predictor-corrector schemes for nonlinear distributed-order space-fractional differential equations with non-smooth initial data, International Journal of Computer Mathematics, 96 (9) (2019), 1861-1878.
- S. S. Alzahrani, A. Q. M. Khaliq, **T. A. Biala,** K. M. Furati, Fourth-order time-stepping methods with matrix transfer technique for space-fractional reaction-diffusion equations, Applied Numerical Mathematics, 146 (2019) 123 – 144.
- **T. A. Biala,** A. Q. M. Khaliq, Parallel algorithms for nonlinear time-space fractional parabolic PDEs, Journal of Computational Physics, 375 (2018) 135 - 154
- A.Q.M. Khaliq, **T. A. Biala,** S.S. Alzahrani, K. M. Furati, Linearly implicit predictor-corrector methods for space-fractional reaction-diffusion equations with

non-smooth initial data, Computer Mathematics with Applications 75 (8) (2018) 2629 – 2657

- S. N. Jator, T. Okunlola, **T. A. Biala,** R. B. Adeniyi, Direct Integrators for the General Third-Order Differential Equations with an application to the Korteweg-de Vries equation, International Journal of Applied and Computational Mathematics, (2018) 4:110
- P. L. Ndukum, **T. A. Biala,** S. N. Jator and R. B. Adeniyi, On a family of trigonometrically fitted extended backward differentiation formulas for stiff and oscillatory initial value problems, Numerical Algorithms, 74, (2017) 267-287
- **T. A. Biala** and S. N. Jator, A family of boundary value methods for systems of second-order boundary value problems, International Journal of Differential Equations, Volume 2017, Article ID 2464759, 12 pages.
- **T. A. Biala** , A computational study of the boundary value methods and the block unification methods for y'' = f(x, y , y'), Abstract and Applied Analysis, Volume 2016, Article ID 8465103, 14 pages,
- **T. A. Biala** and S. N. Jator, Block implicit Adams methods for fractional differential equations, Chaos, Solitons and Fractals, 81, (2015) 365-377.
- **T. A. Biala** and S. N. Jator, A boundary value approach for solving three-dimensional elliptic and hyperbolic partial differential equations, SpringerPlus Journals, 2015, 4:588,

Submitted Papers

- **T. A. Biala** and A. Q. M. Khaliq, Second-order accurate schemes with Gaussian quadrature points for nonlinear space-fractional PDEs with time-dependent boundary conditions.

Works in Progress

- **T. A. Biala** and A. Q. M. Khaliq, Data-driven modeling algorithms for fractional PDEs
- **T. A. Biala** and A. Q. M. Khaliq, A fractional ODE/PDE model for α-synuclein production, transport and aggregation in neurons: A factor that prompts the onset of the Parkin's disease

Conference Presentations

- **Parallel Algorithms for nonlinear time-space fractional PDEs,** SIAM Conference on Computational Science and Engineering (Portland, Oregon), February 25 – March 1, 2019.
- **Anomalous sub and super-diffusion in image processing, (Poster),** SIAM Conference on Computational Science and Engineering (Portland, Oregon), February 25 – March 1, 2019.
- **Parallel Algorithms for nonlinear time-space fractional PDEs,** SIAM Annual Meeting (Portland, Oregon), July 9 – 13, 2018
- **Fractional linear multistep methods for fractional differential equations**,

The 35th Annual Conference of the Nigerian Mathematical Society, 3rd -6th May 2016.

Participation in Scientific Workshops

- ➢ SIAM Conference on Computational Science and Engineering, (CSE19), Spokane Convention Center, Spokane, Washington, February 25-March 1, 2019.
- ➢ ICERM Scientific Machine learning workshop, Brown University, Providence, Rhode Island, January 28-30, 2019.
- ➢ SIAM Annual Meeting, Oregon Convention Center (OCC) Portland, Oregon, July 9-13, 2018.
- ➢ Nonlocal Dynamics: Theory and Applications, Department of Applied Mathematics, Illinois Institute of Technology, Chicago, Illinois, June 4 - 9 2017.
- ➢ Workshop on Mathematical analysis and Optimization: Theory and Applications, Faculty of Science, University of Lagos, Nigeria.

Research Experience

- ➢ Developed novel numerical algorithms for time-space fractional PDEs as well as fractional PDEs with time-dependent boundary conditions
- ➢ Improved performance of algorithms using the shared and distributed memory systems
- ➢ Improved performance by implementing algorithms using GPU.
- ➢ Developed a parallel sorting algorithm used in an orthogonal recursive bisection of large datasets.
- ➢ Developed and analyzed schemes for the production, transport and aggregation of α-synuclein in neurons
- ➢ Conducted extensive data analysis using Python, TensorFlow, MATLAB etc
- ➢ Gave minisymposium talks and presentations at national conferences.

Work Experience

- ➢ Graduate Teaching Assistant, Middle Tennessee State University, (2016 till date)
    1. Assisted in grading undergraduate and graduate courses: COMS 7300 (Numerical Methods for PDEs), MATH 3110 (Calculus III)
    2. Taught and grade different sections of Calculus I with student sizes ranging from 25 – 30.
    3. Assisted in teaching other undergraduate courses ranging in sizes from 25-40. Topics included: algebra, Financial mathematics etc.
    4. Prepared course materials including PowerPoints, tests, homework, quizzes and exams.
    5. Supervised students in projects, graded exams and weekly quizzes.
    6. Wrote primer on integrating by parts functions whose nth derivative varnishes
    7. Graded assigned homework, test and exams.
    8. Held weekly office hours for students requiring assistance.
    9. Assisted faculty with administrative tasks and curriculum development

Programming Skills

C\C++, Python, Bash Scripting, Mathematica, MATLAB , SQL, TensorFlow, OpenMP, MPI, GPU, Fortran.

Projects

- ➢ <u>Parallel algorithms for nonlinear time-space fractional PDEs</u>: This project deals with the numerical simulation of time-space fractional PDEs. Due to the nonlocality and memory dependencies of the fractional operators, schemes developed from such operators are dependent on all time histories making it difficult to compute the solution at any given time interval. We develop parallel algorithms to increase speed, efficiency and performance of the algorithms. A complete discussion of the algorithms can be found on https://github.com/bialatoheeb/ParallelAlgorithms

- ➢ <u>A simulation of α-synuclein production, transport and aggregation in neurons:</u> The accumulation or aggregation of infectious α-synuclein in neurons is the hallmark of the onset of the Parkinson's disease. This project discusses a modified minimalistic model which simulates the conditions under which α-synuclein aggregates in three compartments (soma, axon, synapse) of the cell body with the axon acting as a transport channel between the other two compartments. The effect of axonal transport is modeled by an interplay between an advection and a fractional diffusion term. The effect of entry of infectious α-synuclein is also discussed. Also, we simulate a slower rate of change of the proteins using a fractional time-derivative.

- ➢ <u>A parallel orthogonal recursive bisection of data sets along N-dimensions:</u> This is a joint project that deals with a data decomposition strategy to distribute a large data set consisting of coordinate points (3 coordinates) to a distributed memory system. The main goal is to show that searching for data points (within a circle centered at a given point with a given radius) is faster and more efficient than searching the whole data set. The algorithm depends on the distribution of the datapoints in the data set. A full length paper, power point presentation and the algorithms can be found on https://github.com/bialatoheeb/Parallel-Pros/tree/FinalBranch

- ➢ <u>Design of a novel web utility that provides multi-lingual word definitions for Child E-Book applications:</u> This is a joint project that intends to help children understand the meaning of words (used in a certain different context) in an e-book application by requesting the definition of an unfamiliar word. The user specifies the word as well as relevant information such as the word context and language. Queries are then sent to a server application via an HTTP/POST requests using a JSON-serialized objects and the server responds with structured JSON object containing query results. https://link.springer.com/chapter/10.1007/978-3-030-21817-1_1

Editorial Responsibilities

- ➢ Referee of Journal of Computational Physics
- ➢ Applied Mathematics and Computation
- ➢ Referee of International Journal of Computer Mathematics
- ➢ Referee of Ain Shams Engineering Journal
- ➢ Referee of Cogent Mathematics

Professional Links

- ➢ Website: https://bialatoheeb.github.io/
- ➢ Google scholar:
  https://scholar.google.com/citations?user=ostnD1UAAAAJ&hl=en
- ➢ LinkedIn: https://www.linkedin.com/in/biala-toheeb-12371a67
- ➢ Orcid: https://orcid.org/0000-0001-8116-9278
- ➢ Github: https://github.com/bialatoheeb/