

# Mufutau Ajani Rufai

## Curriculum Vitae

### Profile

I am a proactive and committed teaching/research associate in applied mathematics. I have experience in teaching and academic support of students through the delivery of modules. I have trained many undergraduate and graduate students in mathematics and engineering on how software Engineers and Scientists use math to solve real-world problems in applied sciences and engineering. I am interested in science, technology, engineering, and mathematics (STEM), and I wish to improve in a career combining teaching and research in STEM. I am determined to conduct worthwhile research in STEM to achieve an impact that will make a visible difference.

### Education

- June 2022** **PhD in Computer Science and Mathematics**, *University of Bari, Aldo Moro, Italy.*
- Aug. 2015** **Masters in Mathematical Sciences**, *African Institute for Mathematical Sciences, Tanzania.*
- Nov. 2012** **Bachelor Degree in Industrial Mathematics**, *Federal University of Technology, Akure, Nigeria.*

### Teaching Skills

I am an engaging teacher with over five years of experience in teaching various modules in applied and computational mathematics, statistics, and mathematical programming software such as Python, Matlab, Mathematica, R, Maple, Scientific-Workplace, and  $\text{\LaTeX}$ .

### Experience

- May 2025- Today** **Full Time Postdoctoral Researcher**, *FREE UNIVERSITY OF BOZEN-BOLZANO, ITALY.*  
I am working on the PNRR - Mission 4 project at the Faculty of Engineering. I focus on providing efficient numerical solutions to differential equations in complex physical models in different disciplines, including physics, fluid mechanics and dynamics, astrophysics, biology, and other applied sciences and engineering fields.
- Feb.-May, 2025** **Full Time Postdoctoral Researcher**, *UNIVERSITY OF ROME TOR VERGATA, ITALY.*  
I worked in the Department of Computer Engineering on the Horizon European project EoCoE-III (Energy-oriented Centre of Excellence for Exascale HPC Applications). I used innovative numerical methods to provide efficient numerical solutions to elliptic partial differential equations. I also worked on mathematical software libraries for physics-driven computational models of lighthouse codes and data processing during and after simulations. This experience significantly improved my understanding of high-performance computing, especially since most computations in the libraries I worked on were executed in parallel.
- Jan. 2023- Dec. 2024** **Full Time Postdoctoral Researcher**, *FREE UNIVERSITY OF BOZEN-BOLZANO, ITALY.*  
My work on the IN200Z SmartPrint and FH2ASTE European projects at the Faculty of Engineering was funded by the European Regional Development and Cohesion Funds. I focused on numerical solutions of differential equations. I applied innovative numerical methods to solve real-life model differential problems in physics, astrophysics, biology, chemistry, and related disciplines in applied sciences and engineering.
- Aug.-Sept., 2024** **Research Collaboration Visit**, *UNIVERSITY OF NEW SOUTH WALES, AUSTRALIA.*  
I worked on the IN200Z SmartPrint project at the School of Mathematics and Statistics. This project focused on developing suitable error estimation techniques and step variation strategies using collocation methods to solve singular real-life model differential problems in multidisciplinary fields, including chemical engineering, fluid mechanics, physics, astrophysics, and other applied sciences and engineering.
- Nov. 2018- June 2022** **Research Associate**, *UNIVERSITY OF BARI, ALDO MORO, ITALY.*  
At the Department of Computer Science and Mathematics, I worked on numerical methods for solving ordinary and partial differential equations. I wrote and published research papers in top-rated applied and computational mathematics journals and reviewed articles for many applied mathematics journals.

- Jan.-Sept., **Research Collaboration Visit**, UNIVERSITY OF SALAMANCA, SPAIN.  
 2020 I worked on research activities on numerical solutions to differential equations using hybrid block methods at the Department of Applied Mathematics. I published the results I obtained in referred journals and presented them at international conferences.
- Jan. 2015 - **Teaching Assistant**, FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE, NIGERIA.  
 Oct. 2018 At the Department of Mathematical Sciences, I lectured, led class discussions, supervised a laboratory group, graded assignments and exams, and counseled undergraduate students. Some of the courses I taught were MTS 101 (Introductory Mathematics I), MTS 102 (Introductory Mathematics II), MTS 203 (Linear Algebra I), MTS 204 (Linear Algebra II), MTS 201 (Mathematical Methods I), MTS 202 (Numerical Analysis I), MTS 209 (Differential Equation I), MTS 309 (Differential Equation II), and MTS 345 (Numerical Analysis II). I taught Mathematics, Statistics, and Engineering students how to use programming software like  $\text{\LaTeX}$ , Matlab, Python, and Mathematica. I assisted some professors in supervising various BSc and MSc dissertations in Numerical Analysis.
- Jan. 2013 - **Lecturer II**, FEDERAL POLYTECHNICS EDE, NIGERIA, Department of Mathematics and Statistics.  
 July 2014 My responsibilities included lecturing and counseling National Diploma and Higher National Diploma students, supervising examinations, and marking assignments and examination scripts. The courses taught at the Polytechnics were STA 122 (Statistics for Physical Sciences and Engineering), STA221 (Probability Theory I), STA 222 (Statistical Inference I), and STA 326 (Operations Research).
- May-October, **Industrial Training**, BUDGET, PLANNING, RESEARCH AND STATISTICS DEPARTMENT, IWO LOCAL  
 2011 GOVERNMENT, OSUN STATE, Nigeria.  
 I acquired knowledge of data collection by verifying the basic data collection form, entering data, analyzing data, and writing reports. This training developed my skills in data collection, analysis, and interpretation.

## Research Interests

I am highly interested in Applied and Computational Mathematics and am keen to learn more about Mathematical Modelling, Numerical Analysis, Mathematical Physics, Differential Equations and Applications, Artificial Intelligence, Machine Learning, Applied Fluid Mechanics and Dynamics, Optimization, High Performance Computing, Parallel Computing Programming Environment, and Data Science.

## Selected Publications

1. **M.A. Rufai**, B. Carpentieri, H. Ramos, An efficient fifth-order block method for solving third-order BVPs. The Elsevier Journal of Mathematics and Computers in Simulation 223, (2024) 307-321. (Q1, Ranked 19/128 in Computer Science and Software Engineering, Impact Factor 2024: 4.4).
2. **M.A. Rufai**, B. Carpentieri, H. Ramos, A new pair of block techniques for direct integration of third-order singular IVPs. The Elsevier Journal of Applied Numerical Mathematics 204, (2024) 222-231. (Q1, Ranked 43/343 in Applied Mathematics, Impact Factor 2024: 2.4).
3. **M.A. Rufai**, T. Tran, B. Carpentieri, H. Ramos, Application of Variable Step-Size Hybrid Methods for Solving Third-Order Lane-Emden Equations. The Wiley Journal of Mathematical Methods in the Applied Sciences, 48(14), (2025) 13854-13863 (Q1, Ranked 78/343 in Applied Mathematics, Impact Factor 2024: 1.8).
4. **M.A. Rufai**, Numerical integration of third-order BVPs using a fourth-order hybrid block method. The Elsevier Journal of Computational Science, 81 (2024) 102338. (Q1, Ranked 34/147 in Computer Science, Theory & Method, Impact Factor 2024: 3.7).
5. **M.A. Rufai**, B. Carpentieri, A.A. Alimi, M.A. Babalola, A New Collocation Method for Solving Some First-order Differential Models of Biological Systems. The Elsevier Journal of Scientific African 28, (2025) e02735. (Q1, Ranked 32/135 in Multidisciplinary Sciences, Impact Factor 2024: 3.3).
6. **M.A. Rufai**, B. Carpentieri, H. Ramos, A new block method with variable stepsize implementation for solving third-order differential systems. The Wiley Journal of Mathematical Methods in the Applied Sciences, 47(12) (2024) 9987-9999. (Q1, Ranked 78/343 in Applied Mathematics, Impact Factor 2024: 1.8).
7. **M.A. Rufai**, H. Ramos, B. Carpentieri, A variable stepsize hybrid block optimized technique for integrating a class of singularly perturbed parabolic problems. The Elsevier Journal of Results in Applied Mathematics, 21, (2024), 100417. (Q2, Ranked 126/343 in Applied Mathematics, Impact Factor 2024: 1.3).
8. **M.A. Rufai**, B. Carpentieri, A variable step-size implementation of a new one-step block method for integrating Burgers' model equation. The Alexandria Engineering Journal, Elsevier 83, (2023), 355-366. (Q1, Ranked 9/175 in Engineering, Multidisciplinary, Impact Factor 2024: 6.8).
9. **M.A. Rufai**, B. Carpentieri, H. Ramos, A new hybrid block method for solving first-order differential system models in applied sciences and engineering. The MDPI Journal of Fractal and Fractional (2023), 7(10), 703. (Q1, Ranked 22/136 in Mathematics, Interdisciplinary Applications, Impact Factor 2024: 3.3).
10. **M.A. Rufai**, F. Mazzia, H. Ramos, An adaptive optimized Nyström method for second-order IVPs. The Wiley

- Journal of Mathematical Methods in the Applied Sciences, 46(6), (2023), 7543-7556. (Q1, Ranked 78/343 in Applied Mathematics, Impact Factor 2024: 1.8).
11. **M.A. Rufai**, T. Tran, Z. Anastassi, A variable step-size implementation of the hybrid Nyström method for integrating Hamiltonian and stiff differential systems. The Springer Journal of Computational and Applied Mathematics, 42, 156 (2023). (Q1, Ranked 39/343 in Applied Mathematics, Impact Factor 2024: 2.5).
  12. **M.A. Rufai**, H. Ramos, Solving SIVPs of Lane–Emden–Fowler type using a pair of optimized Nyström methods with a variable stepsize. The MDPI Journal of Mathematics (2023), 11(6), 1535. (Q1, Ranked 29/483 in Mathematics, Impact Factor 2024: 2.2).
  13. **M.A. Rufai**, A.A. Kosti, Z.A. Anastassi, B. Carpentieri, A new two-step hybrid block method for the FitzHugh–Nagumo model equation, The MDPI Journal of Mathematics, 12(1), (2023), 51. (Q1, Ranked 29/483 in Mathematics, Impact Factor 2024: 2.2).
  14. Z.A. Anastassi, A.A. Kosti, **M.A. Rufai**, A parametric method optimised for the solution of the  $(2+1)$ -dimensional nonlinear Schrödinger equation. The MDPI Journal of Mathematics, 11(3), (2023) 609. (Q1, Ranked 29/483 in Mathematics, Impact Factor 2024: 2.2).
  15. **M.A. Rufai**, A. Shokri, E.A. Omole, A one-point third-derivative hybrid multistep technique for solving second-order oscillatory and periodic problems. The Journal of Mathematics (2023), 2343215. (Q1, Ranked 71/483 in Mathematics, Impact Factor 2024: 1.3).
  16. H. Ramos, **M.A. Rufai**, A new one-step method with three intermediate points in a variable step-size mode for stiff differential systems. The Springer Journal of Mathematical Chemistry, 61(4), (2023) 673–688. (Q2, Ranked 49/136 in Mathematics, Interdisciplinary Applications, Impact Factor 2024: 2.0).
  17. **M.A. Rufai**, An efficient third derivative hybrid block technique for the solution of second-order BVPs. The MDPI Journal of Mathematics 10, (2022) 3692. (Q1, Ranked 29/483 in Mathematics, Impact Factor 2024: 2.2).
  18. **M.A. Rufai**, H. Ramos, Solving third-order Lane-Emden-Fowler equations using a variable step-size formulation of a pair of block methods. The Elsevier Journal of Computational and Applied Mathematics, 420, (2023), 114776. (Q1, Ranked 35/343 in Applied Mathematics, Impact Factor 2024: 2.6).
  19. **M.A. Rufai**, H. Ramos, Numerical integration of third-order singular boundary-value problems of Emden–Fowler type using hybrid block techniques. The Elsevier Journal of Communications in Nonlinear Science and Numerical Simulation, 105, (2022), 106069. (Q1, Ranked 7/343 in Applied Mathematics, Impact Factor 2024: 3.8).
  20. H. Ramos, **M.A. Rufai**, A two-step hybrid block method with fourth derivatives for solving third-order boundary value problems. The Elsevier Journal of Computational and Applied Mathematics 404, (2022), 113419. (Q1, Ranked 35/343 in Applied Mathematics, Impact Factor 2024: 2.6).
  21. H. Ramos, **M.A. Rufai**, An adaptive pair of one-step hybrid block Nyström methods for singular initial-value problems of Lane-Emden-Fowler type. The Elsevier Journal of Mathematics and Computers in Simulation 193, (2022) 497-508. (Q1, Ranked 19/128 in Computer Science and Software Engineering, Impact Factor 2024: 4.4).
  22. H. Ramos, **M.A. Rufai**, An adaptive one-point second-derivative Lobatto-type method for solving efficiently differential systems. The Taylor and Francis International Journal of Computer Mathematics 99(8), (2022) 1687-1705. (Q2, Ranked 126/343 in Applied Mathematics, Impact Factor 2024: 1.3).
  23. **M.A. Rufai**, H. Ramos, A variable step-size fourth-derivative hybrid block strategy for integrating third-order IVPs, with applications. The Taylor and Francis International Journal of Computer Mathematics 99(2) (2022) 292-308. (Q2, Ranked 126/343 in Applied Mathematics, Impact Factor 2024: 1.3).
  24. **M.A. Rufai**, H. Ramos, Numerical Solution for Singular Boundary Value Problems Using a Pair of Hybrid Nyström Techniques. Axioms 10, (2021) 202. (Q1, Ranked 98/343 in Applied Mathematics, Impact Factor 2024: 1.6).
  25. **M.A. Rufai**, H. Ramos, Numerical solution of Bratu's and related problems using a third derivative hybrid block method. The Springer Journal of Computational and Applied Mathematics 39, 322 (2020). (Q1, Ranked 39/343 in Applied Mathematics, Impact Factor 2024: 2.5).
  26. **M.A. Rufai**, H. Ramos, One-step hybrid block method containing third-derivatives and improving strategies for solving Bratu's and Troesch's problems. Numerical Mathematics-Theory Methods and Applications, 13(4), (2020) 946-972. (Q1, Ranked 41/483 in Mathematics, Impact Factor 2024: 1.8).
  27. H. Ramos, **M.A. Rufai**, Numerical solution of boundary value problems by using an optimized two-step block method. The Springer Journal of Numerical Algorithms 84, (2020) 229–251. (Q1, Ranked 65/343 in Applied Mathematics, Impact Factor 2024: 2.0).
  28. H. Ramos, **M.A. Rufai**, A third-derivative two-step block Falkner-type method for solving general second-order boundary-value systems. The Elsevier Journal of Mathematics and Computers in Simulation 165 (2019) 139–155. (Q1, Ranked 19/128 in Computer Science and Software Engineering, Impact Factor 2024: 4.4).
  29. H. Ramos, **M.A. Rufai**, Third derivative modification of k-step block Falkner methods for the numerical solution of second order initial-value problems. The Elsevier Journal of Applied Mathematics and Computation, 333 (2018) 231-245. (Q1, Ranked 11/343 in Applied Mathematics, Impact Factor 2024: 3.4).

## Proceedings

- (a) **M.A. Rufai**, F. Mazzia, F. Iavernaro, H. Ramos, Solving second-order IVPs using an adaptive optimized Runge-Kutta-Nyström method, AIP Conf. Proc. 2849 (2023) 450012.
- (b) M.K. Duromola, A.L. Momoh, **M.A. Rufai**, I.L. Animasaun, Insight into 2-step continuous block method for solving mixture model and SIR model, International Journal of Computing Science and Mathematics, 14(4) (2022) 347-356.
- (c) **M.A. Rufai**, H. Ramos, Numerical solution of third-order boundary value problems by using a two-step hybrid block method with a fourth derivative, Computational and Mathematical Methods 3(6) (2021) e1166.
- (d) **M.A. Rufai**, H. Ramos, Numerical solution of second-order singular problems arising in astrophysics by combining a pair of one-step hybrid block Nystrom methods. Astrophysics and Space Science 365, 96 (2020).

## Selected Conferences and Workshops Attended with Presentations

- 1. Oral Presentation at International Conference on Computational and Mathematical Methods in Science and Engineering (CMMSE) Spain (Cadiz) 2-8, July 2024.
- 2. Oral Presentation at IMACS World Congress and Interdisciplinary International Conference, Sapienza University of Rome, Italy, 11-15, September 2023.
- 3. Oral Presentation at International Conference on Numerical Analysis in the 21st Century, University of Oxford, UK, 14-17, August 2023.
- 4. Oral Presentation at ANODE 2023, International Conference in honour of John Butcher's 90th birthday, University of Auckland, New Zealand, 20-24 February 2023.
- 5. Invited Plenary Speaker at the International Conference on Evolution in Pure and Applied Mathematics, Punjab, India, 16-18 November 2022.
- 6. Oral Presentation at International Conference of Numerical Analysis and Applied Mathematics (ICNAAM), Rhodes, Greece, 20-26 September 2021.
- 7. Oral Presentation at International Conference on the Numerical Solution of Differential and Differential-Algebraic Equations (NUMDIFF-16), Germany, 6-10 September 2021.
- 8. Oral Presentation at International Conference on Computational and Mathematical Methods in Science and Engineering (CMMSE) Spain (Cadiz) 26-30, July 2020.
- 9. Oral Presentation at X-Maths Workshop, Department of Mathematics, University of Bari, Italy, 19-20 Dec. 2019.
- 10. HA-LU 2019, International Conference in honour of Ernst Hairer and Christian Lubich, Gran Sasso Science Institute, L'Aquila, Italy 17-21 June 2019.
- 11. Nigerian Mathematician Society (NMS 2016) 35th Annual Conference Held at the University Auditorium, Federal University of Technology, Minna, Nigeria, 3-6 May 2016.

## Review for Journals

Some selected Journals that I have acted as a reviewer include the Elsevier Journal of Mathematics and Computers in Simulation, the Elsevier Journal of Applied Mathematics and Computation, the Alexandria Engineering Journal, Elsevier, the Elsevier Journal of Computational Science, the Elsevier Journal of Applied Numerical Mathematics, the Elsevier Journal of Results in Applied Mathematics, the Elsevier Journal of Scientific African, the Wiley Journal of Mathematical Methods in the Applied Sciences, the Springer Journal of Applied Mathematics and Computing, the Springer Journal of Computational and Applied Mathematics, the Springer Journal of Numerical Algorithms, the Springer Journal of Supercomputing, the Springer Journal of Scientific Reports, the Springer Journal of Soft Computing, the Journal of Applied and Computational Mechanics, the MDPI Journals of Symmetry, Mathematics, Fractal Fractional, Entropy, and Axioms.

## Editorial of Special Issues of Journal

- 1. Z.A Anastassi, A.A. Kosti, **M.A. Rufai**, Special Issue on "Numerical Solution of Differential Equations and their Applications", Mathematics, MDPI (Ongoing).
- 2. **M.A. Rufai**, M. Shams, Special Issue on "Innovative Developments in Collocation, Block, and Iterative Methods: Theory and Applications", AIMS Mathematics (Ongoing).

## Membership in Professional Bodies

- 1. International Association for Mathematics and Computers in Simulation (IMACS).
- 2. Istituto Nazionale di Alta Matematica (INDAM) Francesco Severi.
- 3. African Institute for Mathematical Sciences (AIMS).
- 4. Nigerian Mathematical Society (NMS).

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## Grants and Awards

- 2023 I AM AN INTEGRAL PART OF THE IN200Z SMARTPRINT AND FH2ASTE PROJECT GRANTS.
- 2019 JUNIOR SCIENTIST GRANTS FOR CONFERENCE AT GRAN SASSO SCIENCE INSTITUTE, L'AQUILA.
- 2018 WINNER OF UNIVERSITY OF BARI ALDO MORO PhD FELLOWSHIP FOR FOREIGN STUDENTS.
- 2015 POSTGRADUATE SCHOLARSHIP AT AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES.

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## Computer skills

Proficient in using Linux (Ubuntu) and Microsoft Windows and numerous computer software applications such as; Microsoft Office Applications, Python, MATLAB, Mathematica, R, Maple, Scientific-Workplace, and  $\LaTeX$ . I can use data science and numerical libraries such as Pandas, Numpy, Scipy, SymPy, OpenFOAM, and GNU Octave.

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## Hobbies

Travelling, Reading, Researching, Writing, Playing and Watching Football and Networking.