Shelvean Kapita

CONTACT INFORMATION

Department of Mathematics & Computational Sciences
University of Zimbabwe
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RESEARCH INTERESTS

Numerical analysis and scientific computing, high-order finite element methods, adaptive mesh refinement, absorbing boundary conditions, multivariate splines and Bernstein-Bézier polynomials, applications in acoustic and electromagnetic scattering, and variational inequalities, implementation of numerical methods in Python and in MATLAB.

EMPLOYMENT

Texas A&M University, College Station, TX, United States

- Department of Mathematics
  Instructional Assistant Professor, Aug 2023 -

University of Zimbabwe, Harare, Zimbabwe

- Department of Mathematics & Computational Sciences
  Lecturer, May 2022 - Aug 2023

University of Georgia, Athens, GA, United States

- Limited Term Assistant Professor, Aug 2017 - May 2020

Institute for Mathematics and Its Applications, University of Minnesota, Minneapolis, MN, United States

- Postdoctoral Fellow, Mathematics and Optics , Aug 2016 - Aug 2017.

University of Delaware, Newark, DE, United States

- Research and Teaching Assistant, Aug 2010 - Aug 2016

EDUCATION

University of Delaware, Newark, DE, United States

Ph.D., Applied Mathematics, Aug 2016

- Thesis Topic: *Plane Wave Discontinuous Galerkin Methods for Acoustic Scattering*
- Advisor: Peter B. Monk

M.S., Applied Mathematics, Aug 2012

Lafayette College, Easton, PA, United States

- B.S. in Mathematics, A.B. in Physics, May 2010
  - *Cum Laude, Honors in Mathematics*
  - *Minor in Philosophy*

Prince Edward School, Harare, Zimbabwe

- University of Cambridge GCE A-levels, 2004

Mhangura Secondary School, Mhangura, Zimbabwe

- ZIMSEC GCSE O-levels, 2002

Publications

1. **Kapita, S.**, A Bernstein-Bézier Spline Element Method for Solving the Elliptic Obstacle Problem, under preparation.
2. **Kapita, S.**, Lai, M.-J. A Bivariate Spline Solution to the Exterior Helmholtz Equation and Its Applications. , pre-print.
3. **Kapita, S.**, Monk, P., Selgas, V. 'A Trefftz Discontinuous Galerkin Method for Time Harmonic Waves with Generalized Impedance Boundary Conditions. *Applicable Analysis*, 2018.
4. **Kapita, S.**, Monk, P., A Plane Wave Discontinuous Galerkin Method with a Dirichlet-to-Neumann Boundary Condition for a Scattering Problem in Acoustics. *Journal of Computational and Applied Mathematics*, 327, 208–225, 2018.
5. **Kapita, S.**, Plane Wave Discontinuous Galerkin Methods for Acoustic Scattering, *Ph.D. Thesis, University of Delaware*, 2016.
6. **Kapita, S.**, Monk, P., Warburton, T., Residual based Adaptivity and PWDG Methods for the Helmholtz Equation. *SIAM Journal on Scientific Computing*, 37(3): A1525–A1553, 2015.
7. Abedin, F., Corvino, J., **Kapita, S.**, and Wu, H., On Isoperimetric Surfaces in General Relativity II. *Journal of Geometry and Physics*, 59(11):1453–1460, 2009.

Teaching

University of Zimbabwe
Lecturer:

- MTSCS515 (Numerical Linear Algebra and Optimization), Block C, Semester 2 2023
- MTSCS546 (Numerical Methods for Partial Differential Equations), Block C, Semester 1 2022
- HMTH407, HFM307 (Partial Differential Equations), Block B, Semester 2 2022
- MTE201 (Engineering Mathematics 2), Block A, Semester 2 2022
- HMTHCS212, HFM213 (Numerical Methods), Block D, Semester 1 2022

University of Georgia
Instructor:

- MATH 4500/6500 (Numerical Analysis 1), Spring 2019
- MATH 2700 (Elementary Differential Equations), Spring 2019
- MATH 2250 (Calculus I for Science and Engineering), Fall 2019, Fall 2018, Spring 2018, Fall 2017
- MATH 1113 (PreCalculus), Fall 2017

University of Delaware
Instructor:

- MATH 243 (Analytic Geometry and Calculus C), Winter 2015
- MATH 221 (Calculus I for Business and Economics), Winter 2012, Winter 2013, Winter 2014

Teaching assistant:

- MATH 243 (Analytic Geometry and Calculus C Lab), Spring 2015, Fall 2012
- MATH 241 (Analytic Geometry and Calculus A), Fall 2010, Spring 2011, Fall 2011
- MATH 242 (Analytic Geometry and Calculus B), Spring 2012

Undergraduate Thesis Supervision

University of Zimbabwe

- Gerald Munetsi '23, BSc Hons in Applied Mathematics and Economics
- Talent Maramba '23, BSc Hons in Applied Mathematics and Economics
- Cosmas T. Nyazika '23, BSc Hons in Applied Mathematics and Economics
- Clemeo Gwezere '23, BSc Hons in Applied Mathematics and Economics

Awards and Honors

- UNIDEL Fellowship, University of Delaware, Spring 2014
- McKelvy Scholar, Lafayette College, 2007-2008
- Sigma Pi Sigma, Pi Mu Epsilon, Sigma Xi
- EXCEL Scholar, Lafayette College in mathematics and physics

Computer Languages

- Scientific programming: MATLAB, R,
  Python (NumPy, SciPy, MatPlotLib, Pandas, Mayavi)
- Web programming: HTML, CSS, JavaScript, KaTeX, Sphinx.
- I have implemented a bivariate spline code using Bernstein-Bézier polynomials to solve elliptic PDE constrained problems by an inexact primal-dual active set method in Python 3.9.7 and in MATLAB for arbitrary polynomial order and smoothness.
- Sample codes on GitHub.

Service

- Level 2 (sophomore) course coordinator, Mathematics Department, University of Zimbabwe
- Head of the Computer Laboratory and Library Committee, Mathematics Department, University of Zimbabwe
- Referee for Inverse Problems in Science and Engineering
- Referee for the Journal of Applied and Computational Mathematics
- Referee for Applied Numerical Mathematics

Presentations

- Seminar (online): *A Finite Element Method for Solving the Elliptic Obstacle Problem*, Applied Mathematics & Statistics Seminar, The Johns Hopkins University, Baltimore, MD. Jan 31, 2023.
- Seminar: *A Bivariate Spline PML Approximation of the Exterior Helmholtz Equation*, Applied Math Seminar, Auburn University, Auburn, AL. Feb 8, 2019.
- Seminar: *A Bivariate Spline PML Approximation of the Exterior Helmholtz Equation*, Applied Math Seminar, University of Georgia, Athens, GA. Feb 6, 2019.
- Seminar: *An Adaptive PML Technique for Time Harmonic Scattering*, Applied Math Seminar, University of Georgia, Athens, GA. April 30, 2018

- Mini-symposium: *A Trefftz Discontinuous Galerkin Method for Time-Harmonic Waves with Generalized Impedance Boundary Conditions*, SIAM Conference on Analysis of Partial Differential Equations, Hyatt Regency Baltimore Inner Harbor, Baltimore, MD. Dec 9-12, 2017.
- Mini-symposium: *A Trefftz Discontinuous Galerkin Method for Time-Harmonic Waves with Generalized Impedance Boundary Conditions*, SIAM Central States Section, Colorado State University, Fort Collins, CO. Sept 30, 2017.
- Seminar: *A Trefftz Discontinuous Galerkin Method for Time-Harmonic Waves with Generalized Impedance Boundary Conditions*, Applied Math Seminar, University of Georgia, Athens, GA. Sept 5, 2017.
- Seminar: *Plane Wave Discontinuous Galerkin Methods for Acoustic Scattering*, CCMA PDE's and Numerical Methods Seminar, Pennsylvania State University, PA. Jan 19, 2017.
- Seminar: *Plane Wave Approximation of Homogeneous Helmholtz Solutions*, Cockburn's Seminar, University of Minnesota, Minneapolis, MN. Dec 2016
- Seminar: *Plane Wave Discontinuous Galerkin Methods for Acoustic Scattering*, IMA Postdoc Seminar, University of Minnesota, Nov 22, 2016.
- Workshop: *Plane Wave Discontinuous Galerkin Methods for Acoustic Scattering*, NSF Mathematics Institutes' Modern Math Workshop at SACNAS, Long Beach CA. Oct 12-13, 2016.
- Conference: *Plane Wave Discontinuous Galerkin Methods for Acoustic Scattering*, International Conference on Computational Mathematics and Inverse Problems, On the occasion of the 60th birthday of Prof. Peter Monk, Michigan Technological University. Aug 19, 2016.
- Workshop: *A Plane Wave Discontinuous Galerkin Method with Dirichlet-to-Neumann Boundary Conditions*, DelMar Numerics Day, George Mason University, Fairfax VA. May 2016.
- Symposium: *Residual based Adaptivity and PWDG Methods for the Helmholtz Equation*, Joint Mathematics Meetings, Seattle WA. Jan 2016.
- Poster: *Adaptive Plane Wave Discontinuous Galerkin Methods for the Helmholtz Equation*, Franco-German Summer School, Inverse Problems for Waves, École Polytechnique, Palaiseau France. August 2015.
- Symposium: *Residual based Adaptivity and PWDG Methods for the Helmholtz Equation*, Winter Research Symposium, University of Delaware. February 2015.
- Workshop: *Plane Wave Discontinuous Galerkin Methods for the Helmholtz Equation*, DelMar Numerics Day, University of Maryland, Baltimore County. May 2014.
- Seminar: *Convergence of an Interior Penalty Adaptive Discontinuous Galerkin Method,* Hallenbeck Graduate Student Seminar, University of Delaware. April 2013.

Professional Activities and Workshops

- Georgia Scientific Computing Symposium, Georgia Institute of Technology, Atlanta, GA. Feb 16, 2019.
- SIAM Conference on Analysis of Partial Differential Equations, Baltimore, MD. Dec 9-12, 2017.

- SIAM Central States Conference, Colorado State University, Fort Collins, CO. Sept 29-Oct 1, 2017.
- International Conference on Computational Mathematics and Inverse Problems, On occasion of the 60th birthday of Prof. Peter Monk, Michigan Technological University, Houghton MI. Aug 15-19, 2016.
- IMA PI Graduate Student Conference on Finite Element Methods for Eigenvalue Problems, Michigan Technological University, Houghton MI. Aug 10-14, 2016.
- DelMar Numerics Day, George Mason University, Fairfax VA. May 14 2016.
- Finite Element Circus, University of Maryland, College Park MD. Apr 15-16, 2016.
- Joint Mathematics Meetings, Seattle WA. Jan 4-7, 2016.
- Finite Element Circus, University of Massachusetts, Dartmouth MA. Oct 16-17, 2015.
- Franco-German Summer School, Inverse Problems for Waves, École Polytechnique, Palaiseau France. Aug 24-28, 2015.
- Mathematical Problems in Industry Workshop (MPI), University of Delaware, Newark DE. June 22-26 2015.
- Finite Element Circus, George Mason University, Fairfax VA. Mar 27-28, 2015.
- DelMar Numerics Day, University of Maryland Baltimore County, Baltimore MD. May 10, 2014.
- Finite Element Circus, Wayne State University, Detroit MI. Mar 28-29, 2014.
- Finite Element Circus, University of Delaware, Newark DE. Oct 18-19, 2013.
- International Conference on Novel Directions in Inverse Scattering, Honoring David Colton, University of Delaware, Newark DE. July 29-Aug 2, 2013.
- DelMar Numerics Day, University of Maryland, College Park MD. May 4, 2013.
- Mathematical General Relativity, Summer Course, MSRI Berkeley CA. July 9-20, 2012.
- NSF-CBMS Conference on Finite Element Exterior Calculus, Institute for Computational and Experimental Research in Mathematics (ICERM), Brown University. Jun 11-15, 2012.
- Joint Mathematics Meetings, San Francisco CA. Jan 13-16, 2010.

References

Prof. Peter Monk
Department of Mathematical Sciences, University of Delaware, Newark DE, 19716
monk@udel.edu

Prof. Ming-Jun Lai
Department of Mathematics, University of Georgia, Athens GA, 30602
mjlai@uga.edu

Dr. Hee Jung Kim (teaching)
Department of Mathematics, University of Georgia, Athens GA, 30602
hjk@uga.edu