Department of Mathematics and Statistics
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Hans-Werner van Wyk
Curriculum Vitae

Research Interests

Uncertainty Quantification, Multi-Scale Modeling, Gaussian Random Fields, Sensitivity Analysis, Parameter Identification, Numerical Analysis, Scientific Computing.

Employment

Associate Professor Department of Mathematics and Statistics, Auburn University (10/2021–)

Assistant Professor Department of Mathematics and Statistics, Auburn University (8/2015–10/2021)

Postdoctoral Researcher Department of Scientific Computing, Florida State (7/2012–6/2015)

Advisor:	Max Gunzburger
Research:	Development, analysis and implementation of algorithms in aid of simulation and design under uncertainty.
Teaching:	Assistant for John Burkardt in a graduate course on the C++ finite element package Deal II (Summer 2014), as well as in the special topics course 'Computational tools for finite elements' (Fall 2014).

Graduate Teaching Assistant Department of Mathematics, Virginia Tech (August 2007 - May 2012)
Courses taught with full responsibility (lecturing, creating lesson plans, quizzes and exams, grading), except vector geometry

- Math 1205: Calculus - *Limits, differentiation and their applications for math-, science- and engineering majors*
- Math 2015: Elementary Calculus with Trig. - *Applications of elementary differential- and integral calculus to life sciences, for life science- and business majors*
- Math 2014: Elementary Differential Equations - *Introduction to the theory of linear (and elementary non-linear-) differential equations, techniques for their solution and applications*
- Math 2224: Multivariable Calculus - *Introduction to differential- and integral calculus for multivariable functions as well as infinite series*
- Math 2214: Vector Geometry - *Conducted recitation sessions*

Part-time Assistant Lecturer Dept. of Mathematics, Univ. of Pretoria (January 2005 - December 2006)
Courses taught with full responsibility (presentation of formal lectures and recitations, creating lesson plans, setting quizzes and exams, grading)

- Calculus: *First year differential- and integral calculus for math-, engineering majors.*
- Elementary Linear Algebra: *Linear Systems, Gauss elimination, Eigenvalues, -vectors*

Tutor and Teaching Assistant Univ. of Pretoria - Mamelodi Campus (January 2004 - December 2004)
Presentation of Tutorial sessions, grading of exams and quizzes for

- Foundation Mathematics: *Elementary Algebra and Pre-Calculus*
- Business Mathematics and Statistics: *Sampling, statistical hypothesis testing for economic data, time value of money*

Part-time Assistant Lecturer Tshwane University of Technology (July 2005 - July 2006)
Coordinated and taught an advanced calculus course to high school teachers and teachers in training, as part of a 'continuing education' program.

Education

Virginia Tech, Blacksburg Virginia

PhD Mathematics: May 2012
Dissertation Advisor: Dr. Jeff Borggaard
Dissertation Title: *Variational Estimation of Uncertain Parameters in Distributed Parameter Systems*
GPA: 3.975/4

University of Pretoria, South Africa

MSc. Mathematics: January 2008 (*with distinction*):
Advisor: Prof. Johan Swart
Dissertation: *The Blaschke-Santaló Inequality*
Relevant courses: Functional Analysis, Measure and Probability, Mathematics of Finance, Quantitative Risk Management

BSc. Honours, Mathematics of Finance June 2005 (*with distinction*):
Dissertation: *The Measurement and Interpretation of Default Risk by means of Structural models*
Relevant courses: Stochastic Calculus, Functional Analysis, Mathematics of Finance, Measure Theory, Numerical Analysis, Partial Differential Equations

BSc. Mathematics of Finance December 2003 (*with distinction*):
Relevant courses: Mathematical Statistics, Analysis, Financial Engineering, Differential Equations

Academic Honors and Awards

2022 **Maria Kraska Award** for Excellence in Teaching, Department of Mathematics and Statistics, Auburn University

2019, 2018, 2017 **Robert K. Butz Award** for Excellence in Teaching, Department of Mathematics and Stastistics, Auburn University.

2011 **Steeneck Fellowship:** For outstanding PhD candidate, Department of Mathematics Virginia Tech

2010 **Outstanding Graduate Teaching award:** Department of Mathematics Virginia Tech

2009 **Hatcher Fellowship:** Summer 2009

2005 **Gensec Prize:** For most outstanding honors student in financial mathematics, University of Pretoria.

2001 2003, 2004, 2006 **Achievement Bursaries:** University of Pretoria

Skills

Operating Systems: Linux, OS X, Windows

Programming: Python, Matlab (advanced), C++ (intermediate), Mathematica

Software: Paraview, FeniCS, Gmsh, Comsol, R, SAS, LaTeX, Word

Languages: English, German, Afrikaans (fluent in written and spoken form), French (conversational), Mandarin (rudimentary)

Professional Societies

- Society for Industrial and Applied Mathematics (SIAM)

Publications

In Preparation

- N. Guerngar, E. Nane, H.-W. van Wyk, *Inverse source problem for the space-time fractional diffusion with discrete random noise*
- M. Khatchatryan, E. Nane, H.-W. van Wyk, *The Numerical Approximation of Blow-Up Times for Fractional Reaction-Diffusion Equations*,
- S. Loch, K. Stewart, A. Foster, H.-W. van Wyk, *Uncertainties in Radiative Recombination Processes in Astrophysical Plasmas*

Submitted

2025: C. Eleh, M. Mwanza, E. Aguegboh, H.-W. van Wyk, *GeoAdaLer: Geometric Insights into Adaptive Stochastic Gradient Descent Algorithms*, SIOPT

2025: Y. Cao, S. Das, L. Oeding, H.-W. van Wyk, *Analysis of Stochastic Alternating Least Squares for the Decomposition of Random Tensors*, International Journal on Numerical Analysis and Modeling

Journal Articles

2023: N. Guerngar, E. Nane, S. Ulusoy, H.-W. van Wyk, *A uniqueness determination of the fractional exponents in a three-parameter fractional diffusion*, Fractional Differential Calculus, vol 13, No 1

2022: B. Hall, X. Han, P. Kloeden, H.-W. van Wyk, *A Nonautonmous Chemostat Model for the Growth of Gut Microbiome with Varying Nutrient*, Discrete and Continuous Dynamical Systems Series S, (accepted March 2022).

2022: C. Cao, S. Das, H.-W. van Wyk, *Adaptive stochastic gradient descent for optimal control of parabolic equations with random parameters*, Numerical Methods for Partial Differential Equations, Wiley, 2022

2021: N. Guerngar, E. Nane, R. Tinaztepe, S. Ulusoy, H.-W. van Wyk, *Simultaneous inversion for the fractional exponents in the space-time fractional diffusion equation* $\partial_t^\beta u = -\big(-\Delta\big)^{\alpha/2} u - \big(-\Delta\big)^{\gamma/2} u$, Fractional Calculus and Applied Analysis, vol 24, pp 818–847.

2019: Y. Cao, S. Chen, H.-W. van Wyk, *Well-posedness and finite element approximation of time dependent generalized bioconvective flow* Numerical Methods for Partial Differential Equations, Wiley, 2019

2018: G. Bao, Y. Cao, J. Lin, H.-W. van Wyk *Computational optimal design of random rough surfaces in thin film solar cells*, Communications in Computational Physics

2017: S. Duo, H.-W. van Wyk, Y. Zhang *A novel and accurate finite difference method for the fractional Laplacian and the fractional Poisson problem*, Journal of Computational Physics, Volume 355, 15 February 2018.

2015: H.-W. van Wyk, M. Gunzburger, J. Burkardt, M. Stoyanov *Power-law noises over general spatial domains and on non-standard meshes*, SIAM/ASA Journal on Uncertainty Quantification, Volume 3, Issue 1, pp. 1-369.

2015: J. Borggaard, H.-W. van Wyk *Gradient-Based Estimation of Uncertain Parameters for Elliptic Partial Differential Equations*, Inverse Problems **31**, 065008.

2014: H.-W. van Wyk *Multilevel Sparse Grid Methods for Elliptic Partial Differential Equations with Random Coefficients*, Computers & Mathematics with Applications.

2013: H.-W. van Wyk, J. Borggaard, V. Nunes *Sensitivity and Uncertainty Quantification of Random Distributed Parameter Systems* Mathematics in Engineering, Science and Aerospace, Vol 4, No.2

Conference Proceedings

2014: H.-W. van Wyk *Identification of Uncertain, Spatially Varying Parameters through Multilevel Sampling*, 19th IFAC World Congress, 2014

2013: H.-W. van Wyk, J. Borggaard, V. Nunes *Using Fréchet Sensitivity Analysis to Interrogate Distributed Parameters in Random Systems*, Proceedings of the 2013 ACC Conference, Washington DC, June 17-19.

2012: J. Borggaard, H.-W. van Wyk *Optimization-Based Estimation of Random Distributed Parameters in Elliptic Partial Differential Equations*, Proceedings of the 51st IEEE Conference on Decision and Control.

Editorial Boards

- Numerical Methods for PDEs, Wiley

Grants

- **2022–2028:** NSF 21-578 Robert Noyce Teacher Scholarship Program, *Developing, Recruiting, and Empowering Alabama Mathematics Teachers*, Gary Martin (PI), Marilyn Strutchen (co-PI), Huajun Huang (co-PI), H.-W. van Wyk (co-PI)
- **2019–2022:** NSF DMS-1949953: *Tenth Annual Graduate Student Mini-Conference in Computational Mathematics*, H.-W. van Wyk (PI), Y. Cao (Co-PI), J. Lin (Co-PI), T.T.P. Hoang (Co-PI). $10,650.00
- **2017–2021:** ROSES-2017 (ARPA): *What don't we know? A Theoretical Approach to Atomic Uncertainties for ASTRO-H*, A. Foster (PI), Stuart Loch (CO-PI), H.-W. van Wyk (CO-PI). $455'792

PhD Students

- Sharma Kirti, current student
- Menglei Wang (current student), *Dynamic Bayesian Model Averaging for Nonlinear Systems*

2025 Chinedu Eleh, *Data-Driven Machine Learning Aided Fine Scale Reconstruction for Hierarchical Parameter Systems and the Geometry of Adaptive Learners*

2023 Brittni Hall, *Dynamics and Optimal Control of the Growth of the Gut Microbiome with Varying Nutrient*

2022 Mariam Khatchatryan, *The Numerical Approximation of Blow-Up Times for Fractional Reaction-Diffusion Equations*

2022 Fauziya Yakasai, *Hybrid Sampling for Uncertainty Quantification in Systems with High-Dimensional Parameter Spaces*

2021 Somak Das, *Applications of Stochastic Gradient Descent for Optimization of Complex Systems with Uncertainty*

2020 Olcay Ciftci, *A Newton - Galerkin Finite Element Method to solve reduced dimensional Variable Density Flow and Solute Transport Equations using Proper Orthogonal Decomposition method*

2020 Baris Kopruluoglu, *Numerical Simulations of Conservation Laws in Random Heterogenous Media*

MSc Students

2025 Timothy Eller, *Dynamic System Models for Misinformation and Disease*

2024 Sydney Walker, *Behavioral Approach to Data-Driven Systems*

2024 Lizzy Harkey, *River Pollution Model*

Other Research Experience

- **Approximation of Large-Scale Linear Dynamical Systems: Summer 2007**
  Description: Research project centered on the implementation of a Newton-/Trust Region optimization algorithm to find the optimal interpolation points ('shifts') for rational Krylov-based model reduction of time-invariant linear systems. *Advisors: Dr. S. Gugercin, Dr. C. Beattie*
- **Thesis (MSc.) The Blaschke-Santaló inequality: Univ. of Pretoria, South Africa**
  Description: In finite dimensional Banach Spaces, the volume product of a centrally symmetric convex body is defined as the 'normalized' product of its volume with that of its dual polar body. The Blaschke-Santaló inequality establishes as well as characterizes an upper bound for the volume product. *Advisor: Prof. Johan Swart*

Conferences Organized

2021 SIAM South East Atlantic Section Regional Conference, Auburn University, September 2021 (on organizing committee)

2022 The Tenth Annual Graduate Student Mini-Conference in Computational Mathematics, Auburn University, December 10, 2022 (organizer)

Presentations and Workshops

2025 2025 Conference on Advances in Scientific Computing and Applied Mathematics, October 2025, *Leveraging Low-Complexity Parametrizations for UQ*

2025 UGA Applied Mathematics Seminar, October 21, *Leveraging Low-Complexity Parametrizations for UQ*

2025 SAMSA-Masamu CRN Virtual Colloquia Series, September 30, *Leveraging Low-Complexity Parametrizations for Uncertainty Quantification of Dynamical Systems*

2025 Auburn University Graduate Student Seminar, October 8, *Statistical Sampling for Uncertainties in Partial Differential Equations*

2023 SAMSA Conference, Pretoria, November 22, *Optimal Control of a Beneficial Bacterial Population in the Gut Microbiome*

2023 AMS Southeastern Sectional Meeting, University of South Alabama, *The Numerical Approximation of Blow-Up Times for Fractional Reaction-Diffusion Equations*

2023 AIMS Conference, June 3, Wilmington NC, *Quantifying Uncertainties in Astrophysical Spectra*

2023 SIAM SEAS, Virginia Tech, March 26, *Stochastic Gradient Descent Method for Optimal Rank One Decomposition of High Order Random Tensors*

2022 SIAM Conference in Data Science, *Stochastic Alternating Least Squares Tensor Decomposition*, E-poster.

2022 SIAM Annual Meeting, *Multilevel Sampling through Variational Auto-Encoders*

2022 Masamu Seminar Series, February 22, *Quantifying Uncertainties in Astrophysical Spectra*

2021 Auburn Graduate Student Seminar, November 17, *Uncertainties in Astrophysical Spectroscopy*

2021 University of Georgia Applied Mathematics Seminar, April 14, *Stochastic Optimization in Data Analysis and Design under Uncertainty*

2021 Auburn Graduate Student Seminar, March 17, *Statistical Sampling for Uncertainties in Partial Differential Equations & SIAM Student Chapter*

2021 Auburn Data Science Seminar, March 4, *Stochastic Optimization in Data Analysis and Design under Uncertainty*

2020 Amity Institute of Applied Sciences (Noida), October 22, *The Fractional Laplacian: Approximation and Applications*

2020 Auburn Mathematics Colloquium, September 18, *Approximating Uncertainties in Simulation and Design*

2020 Auburn DMS Graduate Student Seminar, February 20, *Between Physical Determinism and Uncertainty*

2019 SIAM SEAS Meeting, UT Knoxville, September 22, *A Hybrid Sampling Method for Partial Differential Equations with Multiscale Uncertain Coefficients*

2019 Invited talk, ICMSEC Beijing, July 2, *Chebyshev Methods for Statistics*

2019 Invited talk, Beijing Institute of Technology, July 3, *Finite Difference Approximations of the Fractional Laplacian*

2019 SIAM Control Conference, Chengdu China, June 20, *Optimal Control in the Presence of Multiscale Uncertain Parameters*

2018 Conversations in celebration of teaching, January 26, *Software in the classroom*

2017 Invited talk University of South Carolina, September 8, *Chebyshev methods for statistics*

2017 Statistics Seminar, Auburn University, May 5, *Statistical numerics, numerical statistics*

2017 SIAM SEAS Meeting, Tallahassee March 18, *Localizing uncertainty with Gaussian Markov random field models*

2017 SIAM CSE Meeting, Atlanta, February 27, *Localizing uncertainty with Gaussian Markov random field models*

2016 Applied Maths Seminar, Maths & Statistics, Auburn University, October 28, *A novel and accurate weighted trapezoidal finite difference method for the fractional Laplacian.*

2016 Graduate Student Seminar, Maths & Statistics, Auburn University, October 26, *Anomalous Diffusion*

2016 Minisymposium Talk, SIAM CSS (Central States Section) Meeting, September 29, *Random rough interfaces for optimal light absorption in thin film solar cells*

2016 Contributed Talk (& Poster), SIAM Mathematics of Planet Earth Meeting, September 27, *Random rough interfaces for optimal light absorption in thin film solar cells*

2016 Invited Talk, Physics Colloquium September 16, Auburn University, *Modeling, Simulation, and Design of Distributed Parameter Systems under Uncertainty.*

2016 Contributed Talk, SIAM Annual Meeting, July 13 *Chebyshev Rules for Statistics.*

2015 Graduate Student Seminar, Maths & Statistics, Auburn University, November 3, 2015, *Computational Tools for Applied Mathematics.*

2015 Contributed talk, Advances in in Scientific Computing and Applied Mathematics, Las Vegas, Nevada, October 11, *Scale Invariant Noise.*

2015 Applied Maths Seminar, Maths & Statistics, Auburn University, October 2, *Computing with Surface Roughness.*

2015 Contributed talk, SIAM SEAS regional conference, University of Birmingham, Alabama, March 20-22, *Multilevel Sampling with Spatial Adaptivity.*

2015 Scientific Computing Graduate Seminar, Florida State University, February 6, *Working with Noise.*

2015 Invited talk, Colloquium, Maths & Statistics, Auburn University, January 29, *Modeling, Simulation, and Design of Distributed Parameter Systems under Uncertainty.*

2014 Invited talk, University of Pittsburgh, November 10, *What color is your noise?*

2014 Department of Scientific Computing, FSU Colloquium, September 3, *What color is your noise?*

2014 SIAM UQ, Organized Minisymposium, *Spatial Aspects of Uncertainty Quantification*

2014 Invited talk, Applied Math Colloquium, Virginia Tech, March 7, *Multilevel Sampling Methods.*

2014 Invited talk, American University in Beirut, January 21, *Uncertainty Quantification for Distributed Parameter Systems.*

2013 Invited talk, Clemson University, December 6, *UQ, Multilevel Sampling and Parameter Identification.*

2013 Invited talk, Tulane University, November 11, *UQ, Multilevel Sampling and Parameter Identification.*

2013 Invited talk, Auburn University, November 8, *UQ, Multilevel Sampling and Parameter Identification.*

2013 Invited talk at Missouri University of Science and Technology, October 23, *UQ, Multilevel Sampling and Parameter Identification.*

2013 SIAM Annual Meeting, July 8-12, *Multilevel Sparse Grid Methods*, and *Sensitivity and Uncertainty*

2013 Invited talk, Oak Ridge National Lab, June 12 *Multilevel Sparse Grid Methods for PDEs with Random Coefficients.*

2013 SIAM SEAS, Knoxville TN, March 22-24, Presentation: *Multilevel Quadrature Methods*

2012 SIAM UQ April 2-5, Presentation: *Least-Squares Estimation of Distributed Random Diffusion Coefficients.*

2012 AMS/MAA Joint Math Meetings, Boston, January 3-7, Presentation: *The Estimation of Uncertain Parameters of Second Order Elliptic PDEs.*

2011 SIAM SEAS, March 26-27, Presentation: *Estimation of Parameter Uncertainty within a Least Squares Framework.*

2010 Attended, ICIAM Workshop on Uncertainty Quantification in Edinburgh, May 24-28

Service

2023 Faculty advisor for Science Olympiad.

2020 - Faculty advisor of SIAM Student Chapter at Auburn University

2021 - Senator representing the Department of Mathematics & Statistics at the Auburn University Senate

2022 On the search committee for the tenure track position in Analysis.

2021 On the search committee for the tenure track position in PDEs.

2020- Graduate Studies Committee, Department of Mathematics & Statistics at Auburn University

2016-2019 Computational Resource Committee] decides on the acquisition and maintenance of the math department's computational software. Serve as the graduate student representative.

2016-2019 Undergraduate Studies Committee

2015-2018 Undergraduate Program Advisor] Help undergraduate students in applied mathematics make sensible academic career choices

2015 Hosted the 'Job Hunting Workshop' for graduate students in Mathematics & Statistics 10/07.

2008-2011 SIAM Student Chapter VT: *Served as treasurer in 2008 and 2010 and as president in 2011.*