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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.

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 2003 (*with distinction*):

Relevant courses: Mathematical Statistics, Analysis, Financial Engineering, Differential Equations

Academic Honors

2011 **Steenekamp 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, L^AT_EX, Word

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

Professional Societies

- American Mathematical Society (AMS)
- Society for Industrial and Applied Mathematics (SIAM)

Publications

In Preparation

- 2014: J. Burkardt, H.-W. van Wyk *Density-weighted sparse grid Clenshaw-Curtis quadrature schemes over arbitrary hyper-rectangles*, in preparation.
- 2014: H.-W. van Wyk *Multilevel Sampling with Spatial Adaptivity*, in preparation.

Journal Articles

- 2014: H.-W. van Wyk, M. Gunzburger, J. Burkardt, M. Stoyanov *Power-law noises over general spatial domains and on non-standard meshes*, SIAM Journal on Uncertainty Quantification, (accepted).
- 2014: H.-W. van Wyk *Multilevel Sparse Grid Methods for Elliptic Partial Differential Equations with Random Coefficients*, Computers & Mathematics with Applications, (minor revisions).
- 2014: J. Borggaard, H.-W. van Wyk *Gradient-Based Estimation of Uncertain Parameters for Elliptic Partial Differential Equations*, Inverse Problems, (under review)
- 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.

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

Presentations and Workshops

- 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 2014, 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

SIAM Student Chapter VT Served as treasurer in 2008 and 2010 and as president in 2011. Projects included

- Organizing and hosting bi-monthly graduate student seminars.
- Helping with organization of SEARCDE (Southeastern Atlantic Conference on Differential Equations).

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

Employment

Postdoctoral Researcher: Department of Scientific Computing, Florida State (Fall 2012 -)

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 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 (Fall 2007 - Spring 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 multi-variable functions as well as infinite series*
- Math 2214: Vector Geometry - *Conducted recitation sessions*

Part-time Assistant Lecturer: Dept. of Mathematics, Univ. of Pretoria (Spring 2005 - Fall 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 (Spring 2004 - Fall 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.

References

Max Gunzburger, Scientific Computing, Florida State, Postdoc Advisor (mgunzburger@fsu.edu)

Jeff Borggaard, Mathematics, Virginia Tech, Ph.D. Advisor (jborggaard@vt.edu)

Eileen Shugart, Mathematics, Virginia Tech, Teaching Reference (shugart@math.vt.edu)

Joe Ball, Mathematics, Virginia Tech (ball@math.vt.edu)