

# Rudolph van der Merwe

## CURRICULUM VITAE

### PERSONAL DATA

Office Address            Adaptive Systems Lab  
Department of Computer Science & Electrical Engineering  
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### EDUCATION

2004                        **Ph.D.**, Oregon Health & Science University, in Electrical and Computer Engineering. Thesis advisor: Dr. Eric A. Wan. Title: “*Sigma-Point Kalman Filters for Probabilistic Inference in Dynamic State-Space Models*”.

1998                        **M.Eng.** (Cum Laude), University of Stellenbosch (South Africa), Masters of Electrical & Electronic Engineering. Thesis advisor: Dr. Johan du Preez. Title: “*Statistical Phoneme Recognition: A Hybrid Approach*”.

1995                        **B.Eng.** (Cum Laude), University of Stellenbosch (South Africa), Bachelors of Electrical & Electronic Engineering.

### EMPLOYMENT

11/04 – present            **Senior Research Associate**, *Adaptive Systems Lab*, Department of Computer Science and Electrical Engineering, OGI, OHSU. *Project: Data Assimilation for CORIE Project* (<http://www.ccalmr.ogi.edu/CORIE>) & (<http://adsyl.cse.ogi.edu>)

4/03 – 10/04                **Senior Research Associate**, *Adaptive Systems Lab*, Department of Computer Science and Electrical Engineering, OGI, OHSU. ( <http://adsyl.cse.ogi.edu> )

9/98 – 4/03                 **Graduate Research Assistant**, Department of Electrical and Computer Engineering, OGI, Oregon Health & Science University. ( <http://www.cse.ogi.edu> )

1/98 – 9/98                 **Research & Design Engineer**, *Peralex Electronic Development (Pty. Ltd)*, Cape Town, South Africa. ( <http://www.peralex.com> )

1/96 – 12/97                **Graduate Research Assistant**, Department of Electrical and Electronic Engineering, (1/96 – 12/96) Electronic Systems Laboratory (<http://esl.ee.sun.ac.za>), (1/97-12/97) DSP Group (<http://dsp.ee.sun.ac.za>), University of Stellenbosch, South Africa.

12/94 – 1/95                **Technical Consultant**, *Irdeto/M-Net*, South Africa.

11/94 – 1/94                **Member of Technical Staff**, *Houwteq* (Pty. Ltd), South Africa.

## RESEARCH & TECHNICAL INTERESTS

Probabilistic inference & machine learning. Dynamic Bayesian Networks. Data assimilation in large scale highly nonlinear dynamic systems. Neural, adaptive, and machine learning approaches to statistical signal processing, stochastic dynamic modeling, nonlinear estimation, pattern recognition, artificial intelligence, robotics and autonomous control. (See <http://vdmerwe.net> )

## SELECTED PUBLICATIONS

1. R. van der Merwe, E. A. Wan & S. Julier, "Sigma-Point Kalman Filters for Nonlinear Estimation and Sensor-Fusion: Applications to Integrated Navigation", In Proceedings of the *AIAA Guidance, Navigation & Control Conference (GNC)*, Providence, Rhode Island, August 2004.
2. R. van der Merwe and E. A. Wan, "Sigma-Point Kalman filters for Integrated Navigation", In Proceedings of the 60<sup>th</sup> Annual Meeting of the Institute of Navigation (ION), Dayton, OH, June 2004.
3. R. van der Merwe, "Sigma-Point Kalman Filters for Probabilistic Inference in Dynamic State-Space Models", Ph.D thesis, OGI School of Science & Engineering, Oregon Health & Science University, Portland, OR, April 2004.
4. R. van der Merwe and E. A. Wan, "Sigma-Point Kalman Filters for Probabilistic Inference in Dynamic State-Space Models", In Proceedings of the *Workshop on Advances in Machine Learning*, Montreal, Canada, June 2003.
5. R. van der Merwe and E. A. Wan, "Gaussian Mixture Sigma-Point Particle Filters for Sequential Probabilistic Inference in Dynamic State-Space Models", In Proceedings of the *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, Hong Kong, April 2003.
6. R. van der Merwe and E. A. Wan, "The Square-Root Unscented Kalman Filter for State and Parameter-Estimation", In Proceedings of the *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, Salt Lake City, Utah, May 2001.
7. R. van der Merwe and E. A. Wan, "Efficient Derivative-Free Kalman Filters for Online Learning", In Proceedings of the *European Symposium on Artificial Neural Networks (ESANN)*, Bruges, Belgium, April 2001.
8. E. A. Wan and R. van der Merwe, Book Chapter: "Chapter 7 : The Unscented Kalman Filter", In "Kalman Filtering and Neural Networks", Wiley Publishing, Eds. S. Haykin, September 2001.
9. R. van der Merwe, N. de Freitas, A. Doucet and E. A. Wan, "The Unscented Particle Filter", In *Advances in Neural Information Processing Systems (NIPS13)*, MIT Press, Eds. T. K. Leen, T. G. Dietterich and V. Tresp, December 2000.
10. R. van der Merwe, N. de Freitas, A. Doucet and E. A. Wan, "The Unscented Particle Filter", In *Technical Report CUED/F-INFENG/TR.380*, Cambridge University Engineering Department, Cambridge, England, August 2000.
11. E. A. Wan and R. van der Merwe, "The Unscented Kalman Filter for Nonlinear Estimation", In Proceedings of *IEEE Symposium 2000 on Adaptive Systems for Signal Processing, Communications and Control (AS-SPCC)*, Lake Louise, Canada, October 2000.
12. E. A. Wan, R. van der Merwe and A. T. Nelson, "Dual Estimation and the Unscented Transformation", In *Advances in Neural Information Processing Systems (NIPS12)*, MIT Press, Eds. S. A. Sola, T. K. Leen and K. R. Muller, November 2000.
13. E. A. Wan and R. van der Merwe, "Noise-Regularized Adaptive Filtering for Speech Enhancement.", In Proceedings of *EUROSPEECH*, Budapest, Hungary, September 1999.
14. R. van der Merwe and J. du Preez, "Combination of Knowledge- and Cepstral Based Features for Phoneme Recognition", In Proceedings of *IEEE Conference on Communications and Signal Processing (COMSIG)*, Cape Town, South Africa, Sept. 1998.
15. R. van der Merwe, "Variations on Statistical Phoneme Recognition: A Hybrid Approach", Masters thesis, University of Stellenbosch, South Africa, March 1998.

## PATENTS

1. R. van der Merwe, E. Wan and S. Julier. *SPKF based Integrated Navigation*. US Provisional patent filed 1/2004.

## CO-AUTHORED RESEARCH GRANTS

1. *NSF (ECS-0083106, 8/1/00-7/31/03, PI: E. Wan)*, “The Unscented Kalman Filter for Machine Learning”. (*granted/funded*)
2. *ONR (FNC - BAA 01-017, 8/1/02-7/31/03, PI: E. Wan)*, “Sigma-Point Kalman Filter Based Sensor Integration, Estimation and System Identification for Enhanced UAV Situational Awareness and Control”. (*granted/funded*)
3. *NSF (NSF-02-039 ITR, PI: E. Wan, Co-PI: S. Xong)*, “Bayesian Integrated Vision, Estimation, and Control for Unmanned Aerial Vehicles”. (*granted/funded*)

## EXPERTISE

- **MATHEMATICS & OTHER TECHNICAL SKILLS**

- Machine Learning, Pattern Recognition & Adaptive Systems
- Kalman filtering
- Digital Signal Processing
- Linear Algebra
- Calculus
- Probability Theory
- Estimation Theory
- Nonlinear Optimization Theory
- Numerical Methods
- Markov Chain Monte Carlo Methods
- Sequential Monte Carlo Methods

- **SOFTWARE DEVELOPMENT:**

Main developer for **ReBEL** (Recursive Bayesian Estimation Library). ReBEL is a Matlab® toolkit designed to facilitate sequential Bayesian inference (estimation) in general dynamic Bayesian networks (DBNs). This software consolidates research on new methods for recursive Bayesian estimation and Kalman filtering by Rudolph van der Merwe and Eric A. Wan.

To date, this software package has been downloaded by more than 1500 individuals and academic research groups under a free academic license. This software has also been licensed by a number of commercial companies for product development.

For more information, see: <http://choosh.cse.ogi.edu/rebel> and [http://www.ohsu.edu/tech-transfer/technologies/jaz\\_669.shtml](http://www.ohsu.edu/tech-transfer/technologies/jaz_669.shtml)

- **PROGRAMMING:**

- Matlab, C/C++, Python, HTML, VHDL, Pascal, Modula-2, Lisp.

- **OPERATING SYSTEMS:**

- Linux/Unix, Windows 95/98/NT/XP
- System admin for research groups Linux based compute and file servers.

## PROFESSIONAL SOCIETIES

- *IEEE Member* ( <http://www.ieee.org> )
- *Fulbright Fellow* ( <http://www.iie.org> )

## AWARDS, RECOGNITION & SCHOLARSHIPS

- OHSU/OGI, *Paul Clayton Student Achievement Award* for excellence in research, scholarship, leadership and service, 2002.
- OHSU/OGI, ECE Department - Student Paper Competition, First Place, 2001 and 2002.
- Institute of International Education (IIE) - *Fulbright Fellowship* for Ph.D. study in the USA, 1998.
- South African Foundation for Research Development Prestigious Scholarship for Masters study, 1997.
- Stellenbosch 2000 Merit Scholarship, 1996.
- Academic Honorary Colors for undergraduate academic achievement, 1995.
- University of Stellenbosch merit scholarship for undergraduate study, 1992-1995.
- Scholarship for Electronic Engineering from Houwteq (Pty. Ltd.), 1992-1994.
- Academic DUX award for best academic achievement throughout high school career received from D.F. Malan High School, 1987-1991.

## REFERENCES

- *Dr. Todd K. Leen* : Professor (CSEE Departments), OGI School of Science & Engineering, Oregon Health & Science University; Tel. no: +1-503-748-1160, email: [tleen@cse.ogi.edu](mailto:tleen@cse.ogi.edu)
- *Dr. Eric A. Wan* : Associate Professor (CSEE Department), at OGI School of Science & Engineering, Oregon Health & Science University; Tel. no: +1-503-748-1164, email: [ericwan@cse.ogi.edu](mailto:ericwan@cse.ogi.edu)
- *Dr. Jan P. H. van Santen* : Director of Center for Spoken Language Understanding (CSLU) at OGI School of Science & Engineering, Oregon Health & Science University; Tel. no: +1-503-748-1138, email: [vansanten@bme.ogi.edu](mailto:vansanten@bme.ogi.edu)
- *Dr. Misha Pavel* : Professor (BME Department), OGI School of Science & Engineering, Oregon Health Science University; Tel. no: +1-503-748-1155, email: [pavel@bme.ogi.edu](mailto:pavel@bme.ogi.edu)
- *Dr. Dieter Fox* : Assistant Professor (CSE Department), University of Washington; Tel. no: +1-206-685-2517, email: [fox@cs.washington.edu](mailto:fox@cs.washington.edu)
- *Dr. David Weber* : CEO - Stone Three Signal Processing (Pty. Ltd), P.O. Box 3505, Somerset West, 7129 South Africa, Tel. no: +27-21-851-3123, email : [weber@stonethree.com](mailto:weber@stonethree.com)
- *Dr. Thijs Wardenburg* : CTO – Peralex Electronic Development (Pty. Ltd), P.O. Box 215, Bergvliet, 7864, South Africa, Tel. no: +27-21-712 0203, email : [thijs@peralex.com](mailto:thijs@peralex.com)
- *Dr. Johan du Preez* : Associate Professor (EE Department), University of Stellenbosch, South Africa, Tel. no: +27-21-808-4342, email : [dupreez@dsp.sun.ac.za](mailto:dupreez@dsp.sun.ac.za)