Karel Kruger

Curriculum Vitae

I am a passionate lecturer and researcher, who truly enjoys the stimulating and challenging academic environment. For the past two years, I have been part of the academic staff at the Department of Mechanical and Mechatronic Engineering, at Stellenbosch University. My responsibilities have included lecturing, supervision, research and research group management. In this time, I also completed my PhD, which focussed on the use of the Erlang programming language in the control of modern manufacturing systems. My research interests include the development of platforms for cyber-physical, Industry 4.0 and Internet of Things systems; holonic and multi-agent systems; and human-centred manufacturing.

Contact details

kkruger@sun.ac.za

65 Rozenmeer Estate
Stellenbosch
South Africa

+27 83 751 2930

Skype: kkruger1810

Personal Attributes

I am a reliable and passionate individual who strives towards a well-balanced lifestyle. I am a fast, eager and independent learner, and a creative problem solver. I do not mind hard work, because I truly enjoy the challenges that the engineering field has to offer and find great satisfaction in both the research and teaching aspects of the academic environment. I have a very good understanding of the dynamics of teamwork – I have strong leadership qualities, but also know how to follow and support team members. I am confident in my abilities and continuously focus on improving on my shortcomings. I believe that my discipline, enthusiasm and organisational skills would add value to any working environment.

Publications

International journal papers:

Kruger, K. & Basson, A.H., 2017. Erlang-based Control Implementation for a Holonic Manufacturing Cell. *International Journal of Computer Integrated Manufacturing*. Taylor & Francis. Available online here.

Under review:

Kruger, K. & Basson, A.H., 2018. Evaluation Criteria for Holonic Control Implementations in Manufacturing Systems. *International Journal of Computer Integrated Manufacturing*.

Kruger, K. & Basson, A.H., 2018. Comparison of Multi-Agent System and Erlang Holonic Control Implementations for a Manufacturing Cell. *International Journal of Computer Integrated Manufacturing*.

International conference papers:

Kruger, K. & Basson, A.H., 2017. Erlang-based Holonic Controller for a Modular Conveyor System. *Studies in Computational Intelligence: Service Orientation in Holonic and Multi-Agent Manufacturing*. Springer. Available online here.

Kruger, K. & Basson, A.H., 2017. Validation of a Holonic Controller for a Modular Conveyor System using an Object-oriented Simulation Framework. *Studies in Computational Intelligence: Service Orientation in Holonic and Multi-Agent Manufacturing*. Springer. Available online here.

Fölscher, D.J. & Kruger, K., 2016. Saving time on robot programming: Programming by demonstration using stereoscopic motion capturing. *Proceedings of the 2016 PRASA-RobMech International Conference*. Stellenbosch, RSA, December 2016. Available online here.

Kruger, K. & Basson, A.H., 2015. Implementation of an Erlang-based Resource Holon for a Holonic Manufacturing Cell. *Studies in Computational Intelligence: Service Orientation in Holonic and Multi-Agent Manufacturing*. Springer. Available online here.

Kruger, K. & Basson, A.H., 2013. A Stepped Conveyor Singulator Design for reconfigurable Assembly. *Proceedings of the 5th International Conference on Changeable, Agile, Reconfigurable and Virtual Production (CARV)*, Munich, Germany. Available online here.

Kruger, K. & Basson, A.H., 2013. Multi-agent Systems vs IEC 61499 for Holonic Resource Control in Reconfigurable Systems. *Proceedings of the 46th CIRP Conference on Manufacturing Systems*. Vol. 7:503-508. Available online here.

Theses/Dissertations:

Kruger, K., 2013. *Control of the Feeder Subsystem for a Reconfigurable Manufacturing System*. MEng thesis, Stellenbosch University. Available online here.

Kruger, K., 2018. *Development and Evaluation of an Erlang Control System for Reconfigurable Manufacturing Systems*. PhD dissertation, Stellenbosch University.

Experience

2016-present: Appointed as permanent Lecturer at the Department of Mechanical and Mechatronic Engineering, Stellenbosch University.

Lecturing:

Lecturer for Control Systems 354 (introduction to feedback control), for third year mechanical and mechatronic engineering students – duties included:

- Module administration (class size over 200 students)
- Lecturing
- Setting and facilitating tutorials
- Design and facilitation of laboratory practicals
- Setting and marking examinations
- Curriculum development

Lecturer for Mechatronics 424, for fourth year mechanical and mechatronic engineering students – duties included:

- Facilitation of group design project (class size over 180 students)
- Facilitation of mechatronic experiment design assignment

Undergraduate supervision:

Conceptualized, structured and supervised 19 mechatronic projects for undergraduate final-year students.

Postgraduate supervision:

Graduated:

Leuvennink, J.C., 2018. *Integration of Human Workers as Resource Holons in a Holonic Manufacturing Cell*. MEng thesis, Stellenbosch University. (Supervisor)

Current:

Van der Merwe, R., 2019 (expected). *Utilization of Eye-Tracking Data in Manufacturing Environments using Artificial Intelligence*. MEng thesis. Stellenbosch University. (Supervisor)

Sparrow, D., 2019 (expected). *Workflow Monitoring for Human Workers in Industry 4.0 Manufacturing Environments*. MEng thesis. Stellenbosch University. (Supervisor)

Fölscher, D.J., 2019 (expected). *Robot Programming through Task Demonstrations*. MEng thesis. Stellenbosch University. (Supervisor)

Hawkridge, G., 2019 (expected). *Standby Redundant Control for a Manufacturing Cell using Erlang/OTP*. PhD thesis. Stellenbosch University. (Co-supervisor)

Redelinghuys, A.J.H., 2018 (expected). *Development of a Digital Twin for an Industry 4.0 Manufacturing Cell*. MEng thesis. Stellenbosch University. (Co-supervisor)

2015: Appointed as temporary Lecturer for the Control Systems 354 undergraduate module. Duties included:

- lecturing.
- preparation, marking and moderation of tests and examinations.
- preparation and facilitation of tutorials.
- preparation and facilitation of practical sessions. The making of introduction and instructional videos on the workings of the practical setup formed part of the faculty-wide blended learning projects.

Appointed as Junior Lecturer at the Department of Mechanical and Mechatronic Engineering, Stellenbosch University, for the undergraduate module Modelling 334.

Appointed as supervisor for the final year projects of two undergraduate students.

Invited to be a guest speaker for a discussion session hosted by Dr. Leslie van Rooi as part of the Leadership Development module for third and fourth years.

2013-2014: Appointed as Junior Lecturer at the Department of Mechanical and Mechatronic Engineering, Stellenbosch University. I was involved in two undergraduate modules – Modelling 334 and Control Systems 354. Duties included:

- marking and moderation of tests and examinations.
- preparation of test and examination memorandums.
- lecturing when needed.

During this time, I also acted as head student assistant for these modules.

Invited to be a guest speaker for a discussion session hosted by Dr. Leslie van Rooi as part of the Leadership Development module for third and fourth years.

2011-2012: Acted as student assistant for the following undergraduate modules:

- Engineering Drawings 123
- Strength of Materials 244
- Numerical Methods 262
- Modelling 334

Education

2018: Graduated with PhD degree at the Department of Mechanical and Mechatronic Engineering, Stellenbosch University, under supervision of Prof. A.H. Basson. The dissertation is titled "Development and Evaluation of an Erlang Control System for Reconfigurable Manufacturing Systems".

The research explored on the suitability of Erlang, a functional programming language, for implementing holonic control in reconfigurable manufacturing systems. The developed control implementation was compared to an equivalent multi-agent system, which is considered the *status quo* for holonic control implementation in holonic and reconfigurable manufacturing systems. The comparison, which is based on a formulated set of quantitative and qualitative performance measures, showed that the Erlang implementation exhibits significant advantages and has great potential for use in Industry 4.0, IOT and cyber-physical systems.

2012: Graduated with MScEng degree (cum laude) from Stellenbosch University. The thesis is titled "Control of the Feeder for a Reconfigurable Assembly System".

The research compared two holonic control implementations for a case study manufacturing cell. The implementations were based on JADE multi-agent systems and IEC61499 function blocks, respectively.

The following postgraduate modules were also completed:

- Finite Element Methods
- Advanced Strength of Materials
- Advanced Numerical Methods
- Advanced Design
- Reconfigurable Control

2010: Graduated with B.Eng. Mechatronics degree from Stellenbosch University.

My final year project was titled "The Design of an Automated Sorting System using Machine Vision".

Skills

Specialised engineering skills

- The setting up of machine vision inspections using DVT/Cognex hardware and software for part recognition, positioning and quality control.
- The motion programming and interfacing of a KUKA robot for flexible pick-and-place applications.
- PC-based control of hardware and data acquisition.
- Implementation of distributed control in automation applications.
- Control software validation using hardware emulation in a simulation environment.

Computer and programming skills

- Software development in C, C#, Java (including Java Agent Development Environment (JADE) and IEC 61499 Function Block Development Kit (FBDK) platforms), Erlang (functional programming), KRL (KUKA robot software platform) and Intellect scripting (Cognex machine vision software platform).
- Discrete event simulation in Simio.
- Computational programming and statistical analysis in MathCAD, Matlab (including Simulink), Scilab and Microsoft Excel.
- FEA modelling in SimExpert (NASTRAN).
- PLC programming using Wonderware and Siemens TIA Portal.
- Computer-Aided Design in Autodesk Inventor and Caddy.
- Electronic component and circuit simulation in LT Spice and WIN Spice.

Teaching skills

- Module management for class sizes over 200 students.
- Online platform/portal management using Moodle.
- Creation of educational and instructional videos using Camtasia.
- Creation of virtual/simulated laboratory practicals using Matlab's Simscape and Simulink.

Language skills

- Excellent communication skills in English and Afrikaans.
- Attended the course in advanced technical writing at Stellenbosch University.

Leadership skills

- Was elected as Head Boy at Edugate Academy (Otjiwarongo, Namibia) for 2006.
- Served as member of the Simonsberg House Committee for the 2011/2012 term, with portfolios of First years, Senior House and Secretary. Received the honorary awards of "House Committee member of the year" and "Simonsberger of the year" for 2012.
- Coach of Simonsberg 1st XV rugby team for 2012.

Personal information

Date of birth:	18 October 1988
Nationality:	Namibian citizen (with permanent residence in South Africa)
ID number:	88101800457 (Namibian) / 8810186222182 (South African)
Passport number:	P0490777
Marital status:	Married

References

Prof. Anton Basson *(Supervisor for MScEng and PhD projects)*

Professor and former chairperson at the Department of Mechanical and Mechatronic Engineering, and Vice-Dean (Teaching) at the Faculty of Engineering of Stellenbosch University.

Email: ahb@sun.ac.za
Phone: +27 21 808 4250 / +27 82 339 1091

Prof. Kristiaan Schreve *(Supervisor for BEng final year project)*

Professor and chairperson at the Department of Mechanical and Mechatronic Engineering, Stellenbosch University.

Email: kschreve@sun.ac.za
Phone: +27 82 474 4891

Dr. Leslie van Rooi *(Head of Residence at Simonsberg residence)*

Director of Frederik van Zyl Slabbert Leadership Institute and Head of Residence at Simonsberg residence at Stellenbosch University.

Email: lbvr@sun.ac.za
Phone: +27 71 194 2324