Department of Electrical and Electronic Engineering

Research Topics ~ 2019

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturers: Prof Herman Steyn, Dr Lourens Visagie, Dr Willem Jordaan & Mr Arno Barnard	**E-mail:**	whsteyn@sun.ac.za
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	Office:	E402

Field of Research: Computers and Control

General Description ***(field of research):***

Research into autonomous attitude and orbit control systems for small satellites, e.g.

- Investigations into novel deorbiting devices for satellites.
- Space debris removal strategies and devices.
- Radiation testing of single event effects on electronic components.
- Attitude and rate estimator performance comparison study (EKF, UKF, etc) in the presence of increased system noise

To apply:

- Indicate your top 2 projects of interest and send your CV and latest academic transcript to Prof Steyn. The deadline for applications is **1 October 2018**.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Test facility for satellite docking experiments	X		R90,000 per year for 2 years
2	Development of a novel space debris removal technique for small satellites	X		R90,000 per year for 2 years
3	Development of a 3-axis stabilisation demonstration system using nanosatellite reaction wheels on an inverted pendulum platform	X		R90,000 per year for 2 years
4	Radiation Single Event Effect test strategy for microcontrollers	X		R90,000 per year for 2 years
5	Pose estimation of space debris	X		R90,000 per year for 2 years
6	A satellite atttitude and rate estimator performance comparison study in the presence of increased system noise	X	X	R90/R120, 000 per year for 2 - 3 years

Notes regarding Funding: SANSA, SCS Thrip and ESL bursaries are available

Prerequisites or Requirements: Only for Full Time Master's students starting in 2019

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering	
Lecturer: Dr Arnold Rix		**E-mail:**	rix@sun.ac.za
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		Office:	E304

Field of Research: Electrical Energy Systems

General Description ***(field of research):***

General area of research is solar photovoltaic systems.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Investigate AC vs DC reticulation in floating solar PV plants	X		R100,000 per year for 2 years
2	Investigate if the current surge protection equipment used at PV plants provide sufficient protection	X		R100,000 per year for 2 years
3	Investigate and implement data collecting hardware as well as data mining methodologies to monitor PV plant performance degradation and predict failures.	X		R100,000 per year for 2 years
4	Implement a sky monitor to help aid in the prediction of PV plant output variation due to clouds.	X		Funding t.b.c

Notes regarding Funding: Availability of funding will be confirmed

Prerequisites or Requirements: BEng in Mechatronic or Electrical and Electronic Engineering

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Dr Bernard Bekker	**E-mail:**	bbekker@sun.ac.za
	Tel:	+27 (0)21 808 4041
	Office:	K406 (CRSES - Knowledge Centre)

Field of Research: Electrical Energy Systems

General Description ***(field of research):***

Electrical Engineering - Modeling and control of minigrids and distributed storage, short and long term load and intermittent generation forecasting, and tariff design. The CRSES hosts the Eskom Power Plant Engineering Institute (EPPEI)'s Specialisation Centre for Renewable Energy. This Specialisation Centre coordinates inter-university research relevant to Eskom within the renewable energy & power system simulation fields.

The overarching research themes coordinated by the Specialisation Centre are:

- **Support services on the future grid:** What current and emerging ancillary services opportunities are available on the South African and South African Power Pool grids, and at what cost?
- **Flexibility on the future grid:** How does conventional and Renewable Energy Systems (RES) generation plants impact flexible operation of the South African grid? How does flexible operation impact Eskom's conventional generation plants? How can flexibility requirements be captured accurately in system planning and system operations?
- **Impact of Distributed Energy Resources on the network:** How does the increasing penetration of distributed energy resources (DERs - Distributed Generation, Energy Storage and Demand Side Management) impact QoS, personnel and asset safety, financial viability, network planning, system planning and system operations?

List of Research Topics:		**MEng**	**PhD**	**Funding**
1	Supply adequacy in RES-supplied off-grid minigrids: battery control strategies based on day-ahead load forecasting	X		CRSES bursary
2	The value of power system flexibility: constraining the intermittency of RES IPP plants through curtailment based on sub-hour forecasting.	X	X	CRSES or EPPEI bursary
3	The impact of adopting a Heterogenous rather than Homogenous Power Quality Requirement model of power delivery.	X	X	EPPEI bursary
4	Opportunities, cost and value of support from utility scale hydro to the future distributed grid.	X	X	CRSES or EPPEI bursary
5	Disruption of the power supply industry through blockchain & fintech: risks and opportunities.	X		EPPEI bursary

Notes regarding Funding:

- Bursaries are awarded from two sources, CRSES and Eskom EPPEI, based on criteria which includes academic merit and designated groups, including female students. Funding is limited to a maximum of R100,000 per year for 2 years for a Masters and R150,000 per year for 3 years for a PhD.
- CRSES bursary applications close 15 September 2018 (see http://crses.sun.ac.za/studies-bursaries).
- EPPEI bursaries depends on relevance of final topic to Eskom, and will only be confirmed by end October 2018.

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Dr Johan Beukes	**E-mail:**	jbeukes@sun.ac.za
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	Office:	E118

Field of Research: Electrical Energy Systems

General Description ***(field of research):***

Power system applications of power electronics is the general theme of this program. It involves integration of grid tied inverters fed from renewable energy sources, energy storage and power conditioning equipment. Power quality, power control, protection and safe system operation are some aspects being analysed and optimised in an evolving grid that becomes smarter with improved communication and data acquisition systems. A typical master study involves power system analysis involving various simulation platforms and prototype development of inverters, controllers and communication infrastructure.

List of Research Topics:		**MEng**	**PhD**	**Funding**
1	Power conditioning at the utility interface of a micro grid with renewable energy, energy storage and harmonic loads	X		R100,000 per year for 2 years

Notes regarding Funding:

- Funding is available.

Prerequisites or Requirements:

- Power electronics and power systems

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Prof Maarten Kamper	**E-mail:**	kamper@sun.ac.za
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	Office:	E309

Field of Research: Electrical Machine Technology and Application

General Description ***(field of research):***

The research focuses in general on conventional and new electrical machine technology for industry, electrical vehicles and renewable energy applications. Currently the focus is on wind energy systems, electromagnetic couplers, electromechanical storage and industry applications such as large direct-on-line fan motors. In gene-ral the research includes the design optimisation of the electrical machine systems to improve performance and lowering cost and to evaluate alternative technology. The building and the laboratory and field testing of these machine systems form an important part of the research.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Design and evaluation of induction machines with low cost non-overlap stator and rotor coils.	X	X	Refer to the notes below
2	Large electromechanical storage for wind and PV farms	X		Refer to the notes below
3	Design optimization and comparison of eddy-current and iron-cored permanent magnet slip couplers (amongst others for wind energy systems)	X	X	Refer to the notes below
4	Design and development of 2.2 kW and 10 kW slip-synchronous geared wind turbine systems for micro-grid connection.	X		Refer to the notes below
5	High torque density geared wind generator technology for small-scale battery charging wind energy systems.	X		Refer to the notes below
6	Support of diesel hybrid mini-grids with slip-synchronous generator fixed-pitch wind turbines.	X	X	Refer to the notes below
7	Cage winding design of line-start induction motors for geared fan loads.	X	X	Refer to the notes below

Notes regarding Funding:

- Research Topic # 1 = Master student @ R100,000 (funding is not yet finalised)
  Research Topic # 1 = PhD student @ R150,000 (funding is not yet finalised)
- Research Topic # 2 = Master student @ R100,000 (funding is not yet finalised)
- Research Topic # 3 = Master student @ R100,000 (funding is not yet finalised)

Research Topic # 3 = PhD student @ R150,000 (funding is not yet finalised)

- Research Topic # 4 = 2 x Master students @ R100,000/student (funding is not yet finalised)
- Research Topic # 5 = Master student @ R100,000 (funding is not yet finalised)
  Research Topic # 5 = Master student @ R100,000 (funding is not yet finalised)
- Research Topic # 6 = Master student @ R100,000 (funding is not yet finalised)
  Research Topic # 6 = PhD student @ R150,000 (funding is not yet finalised)
- Research Topic # 7 = PhD project already taken

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering	
Lecturer: Prof Rong-Jie Wang	**E-mail:**	rwang@sun.ac.za
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	Office:	E315

Field of Research: Electrical Energy Systems

General Description ***(field of research):***

Special electrical machines, novel topologies of permanent magnet machines, computer-aided design of electrical machines, finite element methods, optimization methodologies, cooling design and analysis, renewable energy systems.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Development of a computationally efficient core loss model for electrical machine designs	X	X	Refer to the notes below
2	Evaluation of emerging electrical motor technologies for EV application	X	X	Refer to the notes below
3	Development of high performance magnetic gears for renewable energy applications	X		CRSES
4	Optimum design of a line-fed permanent magnet synchronous motor for petrochemical industry	X		Refer to the notes below
5	Comparative study of magnetically geared high power wind generator technologies	X	X	CRSES

Notes regarding Funding:

- Bursaries may be available for these projects, but cannot be confirmed at this stage.
- Typically, R100,000 per year for 2 years for a Masters and R150,000 per year for 3 years for a PhD.
- CRSES bursary applications close 15 September 2018.

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Prof Toit Mouton	**E-mail:**	dtmouton@sun.ac.za
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Field of Research: Power Electronics

General Description ***(field of research):***

Power Electronics is the study of switching electronics to convert electrical energy from one form to another. Most renewable sources require power electronics to interface with the AC grid. For example, a solar panel is a DC source and requires a power electronic converter to connect to the AC grid.

My current research focus is on the topic of control in Power Electronics. By improving the control algorithms of power-electronic converters, both their efficiency and performance can be improved without adding additional hardware to the system.

One branch of my research focusses on model-predictive control of power-electronic converters. Model-predictive control (MPC) is an advanced control strategy that has been in use in chemical plants and oil refineries since the 1980s. A model of the system is used to predict the future values of the system's state variables. A cost function, that captures the control objective, is minimized over a finite horizon to calculate the optimal future switching states in real time.

Another branch of my research focusses on the small-signal modelling of pulse-width modulated converters with linear regulators. Even though linear regulators have been used to control power-electronic converters for many decades, the interaction of the regulator and the pulse-width modulator is not yet fully understood.

List of Research Topics:		**MEng**	**PhD**	**Funding**
1	Optimal pulse patterns for high-voltage drives	X		R90,000 for 2 years
2	Small-signal modelling of regularly-sampled three-phase power electronic converters	X	X	R90,000 for 2 years

Notes regarding Funding:

- N/A

Prerequisites or Requirements:

- N/A

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering	
Lecturer: Dr Carlo van Niekerk	**E-mail:**	cvanniekerk@sun.ac.za
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Field of Research: Antennas and Electromagnetics

General Description ***(field of research):***

My research focuses on the analysis and design of electrically small antennas and array systems. Recently I have been involved in passive microwave circuits for beamforming and balanced antenna feeds (Marchand Balun). My research background have been centred on modelling of antenna behaviour in order to better understand the workings and develop design guidelines. My research interests are also informed from my more than 3 years' work experience in the commercial electronics industry where antenna size, cost and mutual existence in systems are of concern and need for improvement.

Research topics are currently available in a variety of radio telescope antenna system applications for the Square Kilometre Array (SKA) project.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Investigate the use of slots in the design of Planar Marchand Balun The use of slots below the coupled lines in a Marchand Balun can be used to great effect to alter the odd and even impedances by using strategically placed slots. The location, size and shape of these slots are chosen by trial and error. In this project we will explore this problem and attempt to develop clear design guidelines for slot design.	X		Refer to notes below
2	Vivaldi antenna as feed for reflector antenna This project develop a dual polarized Vivaldi Antenna for use the feed for a reflector antenna. Comparison in performance and practical implementation with be made with other typical elements.	X		Refer to notes below
3	Evaluating the performance of a Phased Array with Reconfigurable Antenna Elements Reconfigurable antenna elements can improve the performance of a phased array antenna system and can reduce power consumption. In this project we seek to investigate the degree to the benefit of using reconfigurable elements for arrays.	X	X	Refer to notes below
4	Evaluating the performance of a Phased Array with Electrically Small Antenna Elements The physical size of these elements are much smaller than traditional elements. This would allow for closer electrical spacing, thus minimizing the effect of grating lobes. This projects seeks to evaluate the performance trade-offs	X	X	Refer to the notes below

	between size and bandwidth/efficiency for phased arrays with electrically small elements.			

Notes regarding Funding:

- Funding for MEng is typically >R110 per year and PhD level > R135k per year (amount finalised later this year), with supplementary equipment grants also available in some cases. Travel grants also become available from time-to-time to visit collaborators at European Universities as well as present talks at international conferences (more likely at PhD level).
- Not all topics will necessarily be offered, and a limited number of new students will be accepted on a competitive basis. The SARCHI funding program providing some of these bursaries has a strong equity and redress mandate, and applications from designated groups are encouraged.

Prerequisites or Requirements:

- Interest in mathematics and high frequency systems is helpful in many of these projects.

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Prof Coenrad Fourie	**E-mail:**	coenrad@sun.ac.za
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Field of Research: Superconducting electronics and integrated circuit design software and techniques

General Description ***(field of research):***

Development of Field-Programmable Gate Arrays with superconducting Single-Flux-Quantum logic, with ultimate clock frequency above 100 GHz, for the provision of system redundancy, rerouting and repurposing in 4 Kelvin cryogenic computing environments and for quantum circuit interfaces. Also the development of design methods and software for SFQ integrated circuit design, optimization, operating margin calculation, layout extraction of inductance, capacitance and interconnect impedance, schematic-versus-layout verification, compact spice-model extraction of IC devices and circuits in the presence of magnetic fields, magnetic flux trapping analysis, analysis of return currents in IC ground planes, and multicore speedup techniques for field solvers.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Develop a superconducting FPGA, complete with programming sublayer	X	X	R50,000/year for 2 years
2	Develop a capacitance extraction module for integrated circuits with complex 3D modelling capability	X		R100,000/year for 2 years
3	Develop techniques and software for synthesis of superconducting SFQ integrated circuits from high-level behavioural descriptions to logic gate netlists, with support for integrated clocking.	X		R100,000/year for 2 years
4	Develop techniques and software for place and route of superconducting SFQ integrated circuits layouts from logic gate netlists.	X		R100,000/year for 2 years
5	Develop compact Spice model extraction techniques for superconducting integrated circuit devices such as nTrons and ferromagnetic memory elements in the presence of magnetic fields, parasitic coupling and noise.	X	X	R100k – R150k /year for 2 - 3 years
6	Develop a fast and flexible IDE (Integrated Design Environment) that allows all the software modules developed by our group to plug into a Graphical User Interface.	X		R75,000/year for 2 years
7	Research the thermal characteristics of cryogenic materials at the micrometer to millimeter scale, and develop computational methods with which to calculate the temperature in discretized models of integrated circuits	X		R100,000/year for 2 years
8	Research bias return current distribution in superconducting integrated circuit ground planes, and	X	X	R100k – R150k /year

	develop analysis and mitigating layout techniques to prevent operating margin reduction at high bias currents.			for 2 - 3 years

Notes regarding Funding:

- Except for Project 1 (R50k/year), all funding is dependent on continuation of research contracts and timely delivery of milestones to the respective clients.

Prerequisites or Requirements:

- Strong ability to code in C++.

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Dr Danie Ludick	**E-mail:**	dludick@sun.ac.za
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	Office:	E318A

Field of Research: Electronics and Electromagnetics

General Description ***(field of research):***

My research is focussed on computational electromagnetics (CEM), specifically the development of fast and accurate solvers. Acceleration strategies include both hardware acceleration (using e.g. distributed/shared memory programming paradigms, GPUs and FPGAs) as well as algorithm development such as domain decomposition approaches. The application of the work is driven by the analysis of electrically large structures, e.g. finite antenna arrays such as those used in the MeerKAT and SKA radio telescopes.

I regularly collaborate with researchers from Belgium, Chalmers University of Technology in Sweden and ASTRON in the Netherlands.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Hardware acceleration for computational electromagnetics using FPGAs Traditional acceleration strategies for computational electromagnetics (CEM) involve distributed computing methods (such as MPI) and shared memory programming paradigms (using e.g. OpenMP). Additional improvements have also been established with graphic processing units (GPUs). The aim of this project is to implement a parallelised Method-of-Moments (MoM) solver using FPGAs.	X		Refer to notes below
2	Applying Characteristic Mode Analysis (CMA) to finite antenna array development Characteristic Mode Analysis (CMA) has received significant attention over the last decade, as it enables for a more systematic approach to antenna design. The basic premise of the technique is to decompose the current flowing on a structure into various eigenmodes and then to optimise the behaviour of each. This has the potential to improve antenna bandwidth, beam shape, etc. The aim of this project is to apply the CMA methodology to an antenna array environment, where mutual coupling plays a role.	X		Refer to notes below
3	Domain decomposition approach for computational electromagnetics using Iterative Field Bouncing (IFB)	X		Refer to notes below

	For large problems consisting of different parts, e.g. a reflector antenna with a phased array feed, the computational overhead in simulating the problem using a single solver can be significant. The aim of this project is to develop a domain decomposition approach based on iterative field bouncing (IFB), whereby an optimal solver is used within multiple domains. Domain interaction is then modelled through iterative field bouncing. This should enable a reduced computational overhead when simulating electrically large structures.			
4	<u>Efficient finite antenna array analysis using HARP</u> Simulating large aperture antenna arrays of identical elements is of interest to projects such as the SKA. Macro basis function (MBF) methods, e.g. the Characteristic Basis Function Method (CBFM), is an attractive domain decomposition-based approach that can reduce the memory and runtime requirements of such a large CEM solution. An additional enhancement, such as that offered by HARP (the harmonic polynomial model), is possible through pre-calculating the MBF interactions on a predetermined grid followed by an intelligent interpolation strategy. The goal of this project is to develop and apply HARP to various aperture array configurations. This work will be co-supervised with researchers from Université catholique de Louvain (UCL) in Belgium under leadership of Prof. Christophe Craeye.	X		Refer to the notes below

Notes regarding Funding:

- Funding for MEng is typically >R110 per year and PhD level > R135k per year (amount finalised later this year), with supplementary equipment grants also available in some cases. Travel grants also become available from time-to-time to visit collaborators at European Universities as well as present talks at international conferences (more likely at PhD level).
- Not all topics will necessarily be offered, and at most three new students will be accepted on a competitive basis. The SARCHI funding program providing these bursaries has a strong equity and redress mandate, and applications from designated groups is encouraged.

Prerequisites or Requirements:

- Interest in mathematics, programming and electromagnetics is helpful in all of these projects.

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Prof Dirk de Villiers	**E-mail:**	ddv@sun.ac.za
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Field of Research: Electronics and Electromagnetics – Research Chair in Antenna Systems for SKA

General Description ***(field of research):***

My research revolves around developing methods for the rapid design of antennas and microwave components. Specific applications include the design of reflector surfaces and wideband feeds for the MeerKAT and SKA radio telescopes, antenna array systems for radar and space communication systems, as well as power combiners for solid state amplifier and antenna array systems. These design problems are normally difficult to solve since they are high dimensional, non-linear and typically slow to evaluate (through computer simulations). We therefore use several methods from the surrogate modelling, interpolation, and optimization fields to find optimal designs for high performance high frequency antenna and microwave structures. I regularly collaborate with researchers from Pretoria University, Chalmers University of Technology in Sweden, Antwerp and Gent Universities in Belgium, Reykjavik University in Iceland, Cambridge University in England, and ASTRON in the Netherlands.

Research topics are currently available in a variety of radio telescope antenna system applications for the Square Kilometre Array (SKA) project.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Planar Sparse Regular Array Antenna Demonstrator Antenna arrays with elements arranged on a regular lattice, but spaced more than a wavelength apart, are an interesting option for large scale radio astronomy applications. There are some fundamental drawbacks with these systems, but a recent breakthrough in exponential analysis has made the fast and processing of these systems potentially tractable. This project will aim to develop the first working demonstrator system of this kind. It will require close collaboration with researchers from Antwerp University in Belgium, and from ASTRON in the Netherlands.		X	Refer to notes below
2	Linear Sparse Regular Array Antenna Demonstrator See notes for topic 1 – this will just be a simple 1D linear version instead of a 2D planar version of the same idea.	X		Refer to notes below
3	Integrated Wideband Reflector Feed and LNA Design A high performance wideband reflector feed for the SKA remains an elusive problem. Some good feeds are currently under development, but these still do not achieve the performance of highly optimised octave bandwidth antennas. This project will, in collaboration with Onsala observatory and Chalmers University in Sweden, aim to develop a wideband feed for the SKA with improved performance over current systems. This will be done		X	Refer to notes below

	through careful co-optimization and integration of the LNA into the antenna structure.			
4	<u>Fast, custom electromagnetic field solver for wide-band reflector antenna feeds</u> Reflector antennas incorporate a feed structure which illuminates the reflector. Design by optimization of wide-band feeds is difficult, because traditional simulation methods are very slow for these structures. A custom, hybrid solver will be developed and evaluated, which promises to be very fast. This topic is co-supervised with Prof. MM Botha	X	X	Refer to the notes below
5	<u>Development of a hot/cold antenna measurement system</u> Characterisation of antenna noise temperature is a critical part of the development of the low-noise systems required in sensitive radio astronomy systems. This project will develop a custom hot/cold antenna measurement box. Such systems are deployed in Canada and the Netherlands – for radio astronomy applications. A local system, possibly deployed at the SKA site, will make local measurements of such sensitive antennas possible, and is required for future development of radio telescope antennas at Stellenbosch university.	X		Refer to notes below
6	<u>"Spidercam" based near field antenna scanner</u> This project aims to expand on previous work where a small UAV was used to measure the antenna patterns of large, deployed, array antenna systems. The idea is to replace the UAV with a Spidercam like setup, which can be accurately moved in 3D space above a fixed antenna. Such a system can in principle be used to quickly calibrate the antenna under test, and can potentially be simpler, more reliable, and more accurate than a UAV based system. This project will be co-supervised by someone from the control systems group, and does not require a background in high-frequency systems.	X		Refer to notes below

Notes regarding Funding:

- Funding for MEng is typically >R110 per year and PhD level > R135k per year (amount finalised later this year), with supplementary equipment grants also available in some cases. Travel grants also become available from time-to-time to visit collaborators at European Universities as well as present talks at international conferences (more likely at PhD level).
- Not all topics will necessarily be offered, and a limited number of new students will be accepted on a competitive basis. The SARCHI funding program providing these bursaries has a strong equity and redress mandate, and applications from designated groups are encouraged.

Prerequisites or Requirements:

- Interest in mathematics and high frequency systems is helpful in many of these projects.

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering		
Lecturer: Dr Elmine Meyer	**E-mail:**	elmine@sun.ac.za	
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	Office:	E318	

Field of Research: Electronics and Electromagnetics

General Description ***(field of research):***

I specialise in the design, simulation, manufacturing and measurement of tunable microwave filters. However, my knowledge and interests extend to other RF and microwave component design for front-end receivers to provide miniaturised, low-cost solutions with competitive performance.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	<u>High Power Tunable Waveguide Filter</u> Tunable components, such as varactors and MEMS capacitors, commonly used for adding reconfigurability in RF systems have limited power handling capabilities which limit the overall power capabilities of the system. The power handling capabilities of a tunable filter may be improved by clever structural design and placement of the tuning components. This project will involve developing a tunable waveguide filter with high power handling capabilities.	X		Refer to notes below
2	<u>Wideband LNA for SKA MFAA</u> The SKA Mid-Frequency-Aperture-Array aims to station hundreds of antennas and front-end receiver elements in the Karoo. The sensitivity required by the system drives the need for front-ends with low system temperatures. Given the large amount of elements required, it is not feasible actively to cool the system. Therefore, the total sensitivity of the system will be highly dependent on the quality of the front-end design, the manufacturing accuracy, and the overall quality of the system in ambient conditions. Therefore, the main goal of this project is to design and develop a room temperature wideband low noise amplifier for the front-end of the SKA MFAA receiver system.	X		Refer to notes below
3	<u>Low-Cost Low-Power Tunable Filter for Satellite Communication Systems</u> Due to the large cost of launch, communication systems for satellites need to be lightweight, cheap and miniaturised. Given that satellites typically spend many years in space with limited power storage capability, it is also vital that the receiver system use as little power as possible. This project will involve investigating novel techniques for the design, miniaturisation and	X		Refer to notes below

	manufacturing of a tunable filter in order to minimise production cost, size, weight, and power consumption.			
4	Microwave Sensor for Pathogen Infection Bacteria, viruses and other microorganisms that cause disease may be detected in cell samples by means of a microwave sensor. The first step to detect pathogen infection is to define the effect of a pathogen on cellular characteristics. A cell containing pathogens will not have the exact same characteristics of one without pathogens when looking at various frequencies. This project will involve developing a low-cost sensor for pathogen infected cells at microwave frequencies.	X		Refer to notes below

Notes regarding Funding:

- Funding for MEng is typically >R110 per year and PhD level > R135k per year (amount finalised later this year), with supplementary equipment grants also available in some cases. Travel grants also become available from time-to-time to visit collaborators at European Universities as well as present talks at international conferences (more likely at PhD level).
- Not all topics will necessarily be offered, and a limited number of new students will be accepted on a competitive basis. The SARCHI funding program providing these bursaries has a strong equity and redress mandate, and applications from designated groups are encouraged.

Prerequisites or Requirements:

- EM314, EM344 and interests in hardware design.

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering	
Lecturer: Dr Gideon Wiid	**E-mail:**	wiidg@sun.ac.za
	Tel:	+27 (0)21 808 3748
	Office:	SE501

Field of Research: Electronics and Electromagnetics – Electromagnetic Compatibility (EMC) and Interference

General Description ***(field of research):***

The research field of electromagnetic compatibility, or EMC, deals with the ability of equipment to function properly in its given electromagnetic (EM) environment, and not to cause interference to other equipment in its vicinity. My research deals with this topic in the framework of the Square Kilometer Array (SKA) and MeerKAT telescopes, which are highly sensitive and susceptible to electromagnetic interference (EMI) and radio frequency interference (RFI). Projects are done in close collaboration to SARAO, the South African Radio Astronomy Observatory, and EMC consulting companies associated with SARAO. The research covers the development of low-cost interference measurement systems, interference characterisation and direction finding, as well as practical interference mitigation solutions to current SKA EMC challenges.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	<u>EM Material Development and Characterisation</u> To evaluate the electromagnetic properties of materials, different techniques apply to different frequency ranges. The available methods covering all the frequency ranges for SKA need to be investigated, evaluated and tested. The project will include the development of alternative materials for shielding and EM miniaturization purposes.		X	Refer to notes below
2	<u>Radio Telescope Data Direction Finding</u> The MeerKAT telescope will be made available for RFI and EMI scanning in between radio astronomy observations. The data obtained from these scans must be analysed in order to do real-time direction finding. Although several direction-finding algorithms are available, the raw telescope data needs to be formatted in order to apply these algorithms. Alternative measurement techniques on the telescope will also be investigated.	X		Refer to notes below
3	<u>Radio Quiet Electric Fences</u> The aim of this research project is to investigate and propose an alternative EMC compliant solution for electric fences as used on farms around the SKA site. The final solution should provide an alternative smart animal sensing architecture, with a very low-frequency-content shock-pulse only conducted on the fence wire when a disturbance is detected.	X		Refer to notes below
4	<u>SDR-Based Measurement Systems</u> This topic deals with the development of low-cost spectrum analysers and real-time spectrum analysers using	X		Refer to the notes below

	software-defined radio (SDR) boards together with mini-computer boards like the Raspberry Pi or Beaglebone Black and/or FPGA-based processing boards like the Parallela. System architecture and integration are important in this topic.			
5	<u>VHF Mobile Radio Harmonic Filter Design</u> Emergency communication mobile radios have high-level harmonics into the SKA telescope frequencies and need to be filtered. The project will include the development of such filters with a small form-factor, in order to be used on mobile radio handsets and vehicle radios.	X		Refer to notes below
6	<u>Modelling Aggregate Effect of Multiple Radiators Inside a Shielded Room</u> This investigation is applicable to all the instrumentation hosted inside the shielded correlation room of the SKA central processing facility. In order to effectively plan the required shielding levels for this facility, large conductive enclosures with multiple radiating sources inside will be modelled in EM software and with physical scale models.	X		Refer to notes below

Notes regarding Funding:

- Funding for MEng is typically >R110 per year and PhD level > R135k per year (amount finalised later this year), with supplementary equipment grants also available in some cases. Travel grants also become available from time-to-time to visit collaborators at European Universities as well as present talks at international conferences (more likely at PhD level).
- Not all topics will necessarily be offered, and a limited number of new students will be accepted on a competitive basis. The SARCHI funding program providing some of these bursaries has a strong equity and redress mandate, and applications from designated groups are encouraged.

Prerequisites or Requirements:

- Like Tony Starke, a love for challenges and tinkering is helpful in many of these projects.

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering	
Lecturer: Dr Jacki Gilmore	**E-mail:**	jackivdm@sun.ac.za
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Field of Research: Electronics and Electromagnetics

General Description ***(field of research):***

My area of research is primarily focussed on antennas and the various activities involved with the design, deployment and operation of large antenna arrays. This includes the development of efficient design techniques and evaluation of the applicability of the techniques for a given structure. The main applications for the research are radioastronomy and communication systems.

Currently we are developing a candidate topology for the SKA Mid-Frequency Aperture Array which is planned for phase 2 of the SKA. This work includes working on the electromagnetic aspects of active array design, addressing the effect of environmental aspects (like large variations in temperature) on the array performance as well as implementations of electronic beamforming and multibeam capabilities of large arrays.

Investigations on using new advances in 3D-printing to design active antenna arrays for communication systems are also underway.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	<u>Optimisation of the Dense Dipole Array (DDA) for the SKA Mid-Frequency Aperture Array</u> For Phase 2 of the SKA, large, electronically steerable phased arrays called “aperture arrays” are being developed for the mid-frequency band (450 - 1450 MHz). Stellenbosch University is a member of the Mid-Frequency Aperture Array (MFAA) Consortium which is tasked with developing the necessary technology to realise these large systems. This project involves the optimisation of a candidate topology for the MFAA that was developed at Stellenbosch called the Dense Dipole Array (DDA). Previous work on a mechanical support structure that helps with temperature stabilisation of the array will be combined with the optimised array to construct a functioning prototype tile of an active antenna array system.	X		Refer to the notes below
2	<u>Development of Active Antenna Array Design Methods</u> Previously, the design process of antenna arrays consisted of designing the antenna array with an output matching network to match the antenna to a specific characteristic impedance, then designing an LNA with an input matching network to also match to the chosen characteristic impedance. For applications like radioastronomy, the noise added to the system by the two matching networks degrades the performance of the instrument to an unacceptable degree. For this project, a method with	X	X	Refer to the notes below

	which the antenna and LNA is designed as a unit will be developed. The idea is that the antenna is optimised to match directly to the optimal source admittance of the transistor of the LNA in order to avoid the use of matching networks in the critical section of the signal chain before low noise amplification.			
3	<u>Using Software Defined Radio (SDR) to Implement Real-Time Digital Beamforming on an Antenna Array</u> The appeal of using antenna arrays for applications where reflector antennas had previously dominated lies in their versatility when it comes to electronic steering and multi-beam capabilities. For this project, real-time digital beamforming using software defined radio (SDR) will be implemented on an existing array.	X		Refer to the notes below
4	<u>Multiband Antenna Arrays for communication systems</u> With the vast strides being made in computational capabilities, more and more phased array systems are being deployed in industries previously dominated by other antenna topologies. This has opened up new opportunities for the development of antenna arrays that can cater to different needs. This project involves the design of an antenna array that is capable of operating at more than one frequency band. The rational is that the same hardware (antenna array and back-end electronics) can then be used to service more than one communication technology.	X		Refer to the notes below

Notes regarding Funding:

- Bursaries may be available for these projects, but cannot be confirmed at this stage.
- Not all topics will necessarily be offered, and a limited number of new students will be accepted on a competitive basis. The SARCHI funding program providing some of these bursaries has a strong equity and redress mandate, and applications from designated groups are encouraged.

Prerequisites or Requirements:

- Strong interest in mathematics.

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering	
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Field of Research: Electronics and Electromagnetics

General Description ***(field of research):***

This research activity focuses on the design of active components such as low-phase noise oscillators and phase-locked loops typically used in radars, low noise and high power amplifiers and microwave sensors.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Microwave components for communication systems	X	X	R110,000 for 2 years
2	Microwave sterilization of rooibos tea and/or liquids	X		R110,000 for 2 years

Notes regarding Funding:

- N/A

Prerequisites or Requirements:

- N/A

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Prof Matthys Botha	**E-mail:**	mmbotha@sun.ac.za
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	Office:	E414

Field of Research: Computational Electromagnetics

General Description ***(field of research):***

My students and I work in the field of computational electromagnetics. We develop custom numerical methods to efficiently and accurately solve specific classes of challenging electromagnetic field problems, relating to engineering applications of interest. This work brings together knowledge of applied mathematics, software development and electromagnetic field theory. The work is funded from various sources, including Altair Development S.A. (developers of FEKO), the National Research Foundation, the South African Square Kilometre Array project and the United States' Intelligence Advanced Research Projects Activity (IARPA). Have a look at my recent publications for further information (search 'MM Botha' on Google Scholar) or come by my office to learn more.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Efficient electromagnetic simulation of large antenna arrays for radio astronomy applications This topic involves devising and implementing special numerical methods which exploit a priori knowledge of array structural properties, to yield much faster solutions than are possible with conventional solvers.	X	X	Refer to the notes below
2	Error estimation and adaptive analysis for integration into commercial electromagnetic field solvers Generally, numerical methods involve approximation errors. This topic is mathematically intensive. Its aim is to devise methods of estimating such errors for widely-used commercial computational electromagnetics methods, such that solutions may be intelligently refined.	X	X	Refer to the notes below
3	Efficient electromagnetic simulation of cable bundles in the presence of arbitrary structures Accurate modelling of electromagnetic coupling between signal-carrying cable bundles and surrounding structures is a very challenging and industrially important problem. In this work, a new numerical method to achieve such results accurately and fast, will be developed and evaluated.	X	X	Refer to the notes below
4	Fast, custom electromagnetic field solver for wide-band reflector antenna feeds Reflector antennas incorporate a feed structure which illuminates the reflector. Design by optimization of wide-band feeds is difficult, because traditional simulation methods are very slow for these structures. A custom,	X	X	Refer to the notes below

	hybrid solver will be developed and evaluated, which promises to be very fast.			
5	<u>Fast solvers for superconducting, integrated circuit modelling</u> Superconducting integrated circuits have distinct advantages for specific applications. The design/optimization of such circuits require accurate and fast electromagnetic modelling tools; the development of the latter is the aim of this work.	X	X	Refer to the notes below

Notes regarding Funding:

- Funding for MEng is typically >R110 per year and PhD level >R125k per year (amounts finalised later this year). Travel grants also become available from time-to-time to visit collaborators/present talks at international conferences.
- Not all topics will necessarily be offered.

Prerequisites or Requirements:

- Interests in mathematics and electromagnetics.

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering	
Lecturer: Prof Petrie Meyer	**E-mail:**	pmeyer@sun.ac.za
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Field of Research: Microwaves and Electromagnetics

General Description ***(field of research):***

This research covers the fields of passive microwave devices, such as receiver and transmitter sub-systems, and antennas. Current work focuses on defensive jamming systems and RADAR sub-systems for local industry, wi-fi antenna design, antennas for the Square Kilometre Array, and and satellite receivers and transmitters for cube-sats.

These sub-systems use components that are typically not standard capacitors and inductors, but machined or 3D-printed aluminium structures, or etched lines. Most of the projects include advanced elecromagnetic modelling, design using equivalent circuits, physical realizations of the designs, and measurements.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Statistical design and analysis of 3D-printed waveguide filters Microwave filters are used to define receive or transmit bands. Recent advances in 3D-printers have made it possible to directly print these filters in Aluminium. However, a number of uncertainties are part of this process, which can influence the yield of a production run. Using advanced statistical modelling techniques, this project aims at analysing the 3D-printing process in detail, and developing a statistical yield model.		X	Refer to notes below
2	Tuneable notch filters for protection against jamming Jamming systems are aimed at blinding (or deafening) receivers, and disrupting communications. To guard against this, tuneable notch filters are required which can be swept over wide frequency ranges, and offer linear responses outside the notch, even for large jamming signals.	X		Refer to notes below
3	Cube-sat filters Cube-sats are very small satellites which are becoming hugely popular in universities around the world. To define receive and transmit bands for the communications and data streaming systems, very lightweight microwave filters are required.	X		Refer to notes below

Notes regarding Funding:

- Funding for MEng is typically >R110 per year and PhD level > R135k per year (amount finalised later this year), with supplementary equipment grants also available in some cases. Travel grants

also become available from time-to-time to visit collaborators at European Universities as well as present talks at international conferences (more likely at PhD level).

- Not all topics will necessarily be offered, and at most three new students will be accepted on a competitive basis.

Prerequisites or Requirements:

- Interest in mathematics and high frequency systems is helpful in many of these projects.

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering	
Lecturer: Prof Herman Engelbrecht	**E-mail:**	hebrecht@sun.ac.za
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Field of Research: Distributed systems, machine learning (reinforcement learning), augmented and virtual reality

General Description ***(field of research):***

My primary research field is cloud computing systems and network support for massive multi-user virtual environments (MMVEs). We are developing a research platform to allow 10,000 or more simultaneous users to participate in a single, contiguous virtual environment. Currently we are using a networked cluster of 120 Raspberry PIs to form private cloud computing infrastracture that grants us complete control over the experimental conditions. Some of the novel challenges I seek to address is the dynamic load balancing of a single, contiguous virtual environment that is distributed across a server cluster as well as distributed storage of the virtual environment elements. My secondary research field is novel applications of machine learning, specifically deep learning and reinforcement learning. I am interested in multi-agent reinforcement learning using Minecraft as research vehicle (for example as in Project Malmo).

List of Research Topics:		**MEng**	**PhD**	**Funding**
1	Dynamic load balancing of MMVE server cluster	X		>R110,000 for 2 years
2	The Pig Chase Challenge - Multi-agent reinforcement learning in Minecraft	X		>R110,000 for 2 years
3	Object detection in Minecraft using Convolutional Neural Networks	X		>R110,000 for 2 years
4	Video Watermarking using Generative Adversarial Networks	X		>R110,000 for 2 years

Notes regarding Funding:

- Funding for MEng is typically >R110k per year (amount finalised later this year), with supplementary equipment grants also available in some cases.
- Not all topics will necessarily be offered, and at most two new students will be accepted on a competitive basis.

Prerequisites or Requirements:

- Strong background in programming
- Excellent academic record
- Interest in cloud computing and high performance computing
- Interest in machine learning, specifically deep learning and reinforcement learning

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Dr Herman Kamper	**E-mail:**	kamperh@sun.ac.za
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	Office:	E427

Field of Research: Machine Learning and Signal Processing

General Description ***(field of research):***

By learning from and making predictions on data, *machine learning* attempts to solve problems where it is difficult to design solutions by hand. I apply machine learning to problems in speech and language processing, computer vision, and robotics.

Specifically, I am interested in methods that can learn from small amounts of data, and in unsupervised methods that can learn directly from raw unlabelled data. Imagine a paraplegic user that would like to specify a set of custom voice commands to control a robotic wheelchair, without the wheelchair knowing upfront what language or words the user would want to use. Here we need methods that can learn from a small set of example voice commands given initially by the user. Or imagine a farmer wanting to get information of crop prices over her mobile phone, but only speaking a minority African language for which no labelled speech corpus exists. This could be solved using an unsupervised system that takes a spoken query, searches through a collection of recent radio broadcasts, and plays back those reports containing the query. I work on the fundamentals of machine learning methods for addressing such problems in low- and zero-resource settings.

My long-term aim is to allow machines to autonomously (or with as little supervision as possible) acquire speech, language and visual processing capabilities in order to aid humans in some of the biggest problems they face.

List of Research Topics:		**MEng**	**PhD**	**Funding**
1	Robot language learning from only a few spoken instructions (one-shot speech learning)	X	X	Refer to the notes below
2	Using images to learn spoken language: Localising detected words and objects	X	X	Refer to the notes below
3	Using images to learn spoken language: Scaling systems to larger datasets to perform retrieval	X		Refer to the notes below
4	Unsupervised and low-resource models for query-by-example speech search	X	X	Refer to the notes below
5	Learning to perform extreme compression of images and video	X		Refer to the notes below
6	Cross-lingual keyword spotting: E.g. for a low-resource (e.g. African) language, spot radio news reports containing a keyword given in English	X	X	Refer to the notes below

Notes regarding Funding:

- Funding opportunities cannot be confirmed at this stage.

Prerequisites or Requirements:

All these projects have a strong programming component. Students will also benefit from having a strong mathematical background and some experience with probability and statistics.

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering	
Lecturer: Dr Japie Engelbrecht	**E-mail:**	jengelbr@sun.ac.za
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	Office:	E417

Field of Research: Computers and Control

General Description ***(field of research):***

The **Autonomous Vehicles** group of the Electronic Systems Laboratory (ESL) invites you to apply for Master's degree and PhD studies in Autonomous Vehicles in 2018. The Electronics Systems Laboratory, established in 1992, is an internationally respected postgraduate research laboratory that specialises in the automation and control of unmanned vehicles, including satellites, unmanned aerial vehicles, terrestrial robots, and autonomous underwater vehicles. The ESL is housed in the Department of Electrical and Electronic Engineering at Stellenbosch University. Master's degree and PhD research projects with associated competitive, multi-year bursaries are available. Final year and postgraduate students in Electrical & Electronic Engineering, Mechatronic Engineering, and Mechanical Engineering are invited to apply. Some topics are also suitable for students who have completed Honour's degrees in Applied Mathematics and Computer Science.

To apply:

- Indicate your top three projects of interest and send your CV and latest academic transcript to Dr Japie Engelbrecht (jengelbr@sun.ac.za) and copy Dr Corné van Daalen (cvdaalen@sun.ac.za).
- The deadline for applications is **31 August 2017**.

CSIR-DST Bursaries:

- We also recommend that you apply for a DST-CSIR bursary under the Inter-Bursary Support Programme grant scheme in the "Aerospace" or "Modelling and Digital Science" focus areas. The closing date for the CSIR-DST bursary applications is **30 September 2017**. It is important to note that the CSIR-DST bursary applications are handled separately from the ESL Autonomous Vehicles bursary applications.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Autonomous Navigation of a Rotary Wing UAV relative to an Inspection Target	X		R96,000 per year for 2 years
2	Automatic Cooperative Collision Avoidance for Unmanned Aerial Vehicles	X		R96,000 per year for 2 years
3	Probabilistic Collision Prediction for Unmanned Aerial Vehicles	X		R96,000 per year for 2 years
4	Automatic Path Planning for UAVs in Dynamic and Uncertain Environments	X		R96,000 per year for 2 years

5	Automatic Flight Control and Stabilisation for a Rotary Wing UAV with a Flexible Payload	X		R96,000 per year for 2 years
6	Robot Language Learning from Few Examples	X		R96,000 per year for 2 years

Notes regarding Funding:

- Funding availability for Research Topics 1 to 6 will depend on the quality of applications.

Prerequisites or Requirements:

- Postgraduate bursaries associated with these topics may, in some cases, be restricted to South African citizens.

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Prof Jaco Versfeld	**E-mail:**	djjversfeld@sun.ac.za
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	Office:	E317

Field of Research: Signal Processing for Telecommunications

General Description ***(field of research):***

My current research interest is in signal processing for communication systems. As such, I focus on two areas, namely Algebraic Coding and Signal processing. With algebraic coding, my focus is on linear block codes, where I look at bounded distance decoding, soft-decision decoding, coded modulation as well as code construction. With signal processing, I focus on algorithms related to radio signals and SONAR. As such, in collaboration with Wits, we focus on electronic warfare, RADAR as well as beamforming-related projects.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Soft-decision decoding of Algebraic block codes	X	X	See notes below
2	Direction-finding of radio sources at sea	X	X	See notes below
3	Investigation of algorithms used for SONAR	X		See notes below
4	Beamforming applied to SONAR	X	X	See note below
5	Construction of iteratively decodable codes	X	X	See notes
6	Developing a RADAR system for small boats	X	X	See notes below
7	Whale detection and alarm system	X	X	See notes below
8	Any related topic	X	X	See note below

Notes regarding Funding:

- There might be possible funding opportunities, but it cannot be confirmed at this stage. Interested students are encouraged to apply for NRF bursaries.

Prerequisites or Requirements:

- N/A

Faculty: Faculty of Engineering	**Department:** Electrical and Electronic Engineering	
Lecturer: Prof Johan du Preez	**E-mail:**	dupreez@sun.ac.za
	Tel:	+27 (0)21 808 4342
	Office:	E307

Field of Research: Machine Learning, Probabilistic Pattern Recognition, Image Processing

General Description ***(field of research):***

Using sophisticated probabilistic models (including Probabilistic Graphical Models, Neural Nets and other related techniques) to automatically identify, detect, segment, cluster etc all kinds of interesting signals.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Multi-spectral satelite image segmentation and classification	X		R100k for 2 years
2	Learning and integrating deep architectures for Probabilistic Graphical Models	X	X	R100k / R120k for 2 years
3	Custom machine learning research as defined by industry partner	X		R100k for 2 years

Notes regarding Funding:

- Amounts are approximate, awaiting final figures.

Prerequisites or Requirements:

- Excellent academic record with strong mathematical ability
- Fearless but meticulous programmer

Faculty: Faculty of Engineering		**Department:** Electrical and Electronic Engineering
Lecturer: Prof Thomas Niesler	**E-mail:**	dkruger@sun.ac.za
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Field of Research: Machine learning, pattern recognition, statistical signal processing

General Description ***(field of research):***

Signal processing deals with the measurement and conditioning of information, often from sensors, with a view of subsequent extraction of information and further processing. Pattern recognition deals with the (usually statistical) modelling of information extracted by a prior signal processing step, with a view of making automatic decisions based on the measured data. Machine learning broadly describes the algorithms used to infer (train) suitable models to be used in the pattern recognition step. Currently, deep-learning and neural-network-based machine learning is attracting a lot of research attention, and these techniques are applicable to several of the projects below, which each focus on a particular problem.

List of Research Topics:		**MEng**	**PhD**	**Funding**
1	Multilingual text harvesting using neural networks	X		Refer to the notes below
2	Real-time speech classification of live radio broadcasts on a Raspberry PI	X		Refer to the notes below
3	Ear-attached intelligent and autonomous animal-borne sensor for wildlife conservation and monitoring	X		Refer to the notes below
4	Automatic detection and classification of coughing sounds for healthcare	X		Refer to the notes below
5	Machine-learning based natural language processing (NLP) for code-switched speech (code-switching is when the language of discourse changes mid-sentence or even mid-word).	X		Refer to the notes below
6	Automatic discovery of patterns in speech when no or almost no labels are available.	X		Refer to the notes below

Notes regarding Funding:

- Funding may be available for these projects.

Prerequisites or Requirements:

- These projects are only available to South African citizens.