RESEARCH COLLABORATION

The CSIR and Stellenbosch University, University of Cape Town, and University of the Western Cape

2013-2015

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our future through science

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Foreword

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UWC Rector and
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The CSIR has a long history of collaboration with Stellenbosch University and the universities of Cape Town and the Western Cape. These relationships, which enable us to achieve our respective visions and mandates, have continued to grow over the last three years (2013 – 2015).

This report captures several of our recent achievements. They include the establishment of Research Chairs and programmes in new and exciting areas relating to information technology, photonics, life sciences and water resource management, as well as the joint supervision of students, and the production of peer-reviewed publications which have mainly been in the fields of ICT, biosciences, environment and nano science. Our complementary capabilities and resources contribute to developing the skills of young and emerging researchers who make a critical contribution to the South African economy.

We will continue to nurture our partnerships, which are critical for maintaining research excellence, South Africa's socio-economic development and achieving global competitiveness. We are pleased to report on another successful collaboration between the CSIR and Stellenbosch University and the universities of Cape Town and the Western Cape.

Overview

Dr Rachel Chikwamba
CSIR Group Executive
Strategic Alliances and
Communication

Prof Eugene Cloete
Stellenbosch University
Vice-Rector: Research and
Innovation

Prof Danie Visser
University of Cape Town
Vice-Chancellor: Research
and Internationalisation

Prof Frans Swanepoel
University of the Western
Cape Deputy Vice-Chancellor:
Research and Innovation

It is exciting to highlight two areas of intensified research between the CSIR's and Stellenbosch University. In both of these areas, we have launched two new Research Chairs - one in Quantum, Optical and Atomic Physics and the other in Artificial Intelligence.

The main highlights of the CSIR's collaboration with the University of Cape Town include peer-reviewed joint publications resulting from research work and student supervision, CSIR staff members who are studying for higher qualifications, as well as the establishment of the Centre for Translational Research.

With the University of the Western Cape, the most noteworthy research achievements are in water resources and energy, both of which have attracted international collaborators, as well as the involvement of CSIR staff in lecturing and supervising students.

The collaboration has been supported by outstanding facilities and highly qualified researchers in our institutions. We place a high premium on the collaboration, which we believe is to the benefit of our institutions, by building capacity through joint research programmes to benefit society through cutting-edge science.

Summary of indicators of collaboration

Research

	2013	2014	2015
Collaborative research projects implemented	46	67	40
Joint publications resulting from supervised and joint research	81	95	63

Human capital development

	2013	2014	2015
CSIR researchers lecturing/ supervising students	79	73	73
Students supported by the joint scholarship programme	26	15	14
CSIR staff and students studying	113	96	93
Scholarship students and CSIR staff who graduated	31	31	8
CSIR staff appointed extraordinary professors/ honorary research associates	7	7	9
University staff appointed to CSIR research advisory panels	2	2	2

Contents

Stellenbosch University and the CSIR

Indicators of collaboration

Research

	2013	2014	2015
Collaborative research projects implemented	27	29	12
Joint publications resulting from supervised and joint research	31	35	17

Human capital development

	2013	2014	2015
CSIR researchers lecturing/ supervising students	32	26	28
Students supported by the joint scholarship programme	3	1	0
CSIR staff and students studying	45	35	34
Scholarship students and CSIR staff who graduated	11	12	1
CSIR staff appointed extraordinary professors/ honorary research associates	3	3	5
University staff appointed to CSIR research advisory panels	0	0	0

Highlights of the collaboration

Biosciences

Expression of PAM enzyme in Aspergillus niger

Dr Lucia Steenkamp, CSIR • Prof Marinda Viljoen-Bloom, SU

Funding: SU, CSIR

Background

Peptides, which are increasingly used as pharmaceutical agents, as well as veterinary products, especially as antiviral, anti-diabetics and anti-cancer therapeutics, are currently produced commercially through solid or liquid phase chemical processes. Chemical synthesis allows peptide modifications, such as N-terminal acetylation and C-terminal amidation, and contribute to stability and activity of the pharmaceutical peptide. These modifications can only be achieved while the side-chains of the amino acids are still protected to avoid unwanted reactions.

These methods of producing peptides are expensive and harmful to the environment because they use large quantities of reagents and generate a lot of solvent waste. The CSIR has developed an environmentally friendly and low-cost technology for the heterologous production of peptides. The peptides produced with this technology still require modification for activity. An enzyme, peptidyl-glycine alpha-amidating monooxygenase (PAM), which allows the activation of the bio-active peptides without protecting side-chain groups, has been identified.

Commercial production of PAM is currently limited to mammalian cell lines, therefore making it expensive to produce and available only in limited quantities, insufficient for peptide commercial manufacturing. The PAM enzyme has two enzymatically active domains - peptidylglycine alpha-hydroxylating monooxygenase (PHM) and peptidyl-hydroxyglycine alpha-amidating lyase (PAL).

Response

The purpose of the collaboration is to clone and express the enzymes (PHM - a copper-monooxygenase, and PAL- a zinc metalloprotease) using *Aspergillus niger.* Copper-containing enzymes, such as laccases, can be produced in *A. niger* in high quantities, while other microorganism hosts have comparatively lower yields.

Researchers at Stellenbosch University (SU) will optimise expression of the PAM, PAL and PHM enzymes in *A. niger.* The CSIR will produce PHM or the complete PAM enzyme via fermentation, and also investigate the immobilisation of these enzymes to make the biocatalytic C-amidation of peptides more affordable, since this expensive enzyme can be recycled. This should enable South Africa to produce PAM for commercial applications at competitive prices using a technology that is more environmentally friendly than current chemical methods.

Progress

The PAM gene from *Rattus norvegicus* was cloned into an *A. niger* expression vector system and transformed into an *A. niger* laboratory strain. Transformants were grown and then lyophilised and stored. A protein species was observed. The corresponding band was absent in the control strain. Due to the scarcity of commercially produced PAM, which is required as a positive control to validate the assays, the activity of the PAM produced in *A. niger* could not be confirmed. Assays to determine the activity of the PAM produced in the *A. niger* are still being validated. The same sequence was attempted in Yarrowia lipolytica for expression. No expression was observed, highlighting the importance of the expression of the sequence in *A. niger.*

Additional work is being done with SU on the expression of PAM genes from other source organisms. The candidates that have been chosen represent model multicellular organisms with a basic nervous system, as well as another that potentially offers biotechnological and therapeutic treatments. The genes from these new organisms are novel in terms of expression, and have further been modified to express as minimal catalytic subunits of PAM. Three variants of each of the new genes could be expressed.

Future work

Following successful expression in *A.niger,* these novel enzymes will be characterised in terms of enzyme kinetics, substrate range and inhibition. This will be followed by production in larger quantities and immobilisation to demonstrate the technology on selected peptides. The enzyme might be also be used in an electrochemical bioreactor and a crystal structure investigated for establishing protein models.

Researchers at Stellenbosch University will **optimise expression** of the PAM, PAL and PHM enzymes in A. niger. **The CSIR will produce** PHM or the complete PAM enzyme via fermentation

Information and communication technology

Text-to-speech enhanced eBooks for emerging literacy development

Dr Febe de Wet, Dr Karen Calteux, Aby Louw, Laurette Marais, Tebogo Reid, CSIR • Dr Daleen Klop, Amanda Msindwana, SU

Funding: DST, CSIR

Background

Literacy enables academic success and is essential in a knowledge society. Literacy levels amongst South African children are lower than expected and these low levels are already apparent in the foundation phase, i.e. in Grades 1-3 of primary school. The Department of Basic Education's (DBE) Report on the Annual National Assessments of 2011 indicated that 53% of South African children in Grade 3 did not pass the literacy test and that the average score in literacy for a typical Grade 3 learner in South Africa was 35%.

A number of factors contribute to this situation. Many South African children learn to read and write in a language that is not their first one because they have to attend the school nearest to their homes. In addition, a large number of children do not have access to literacy development tools, supplementary reading material or literacy teachers because few state-run schools have a library. As a consequence, they start their formal schooling under-prepared for the formal curriculum and with limited experience with books and literacy and display limited early literacy skills.

The poorest children generally score lower for literacy, while the average literacy score for the least poor is higher. Once the lower income group children have acquired basic reading skills, they often fail to read with comprehension in the later grades. Poor reading skills and consequently poor language skills have a negative impact on a child's ability to acquire knowledge and skills in all subjects.

Addressing low levels of literacy in higher school grades seems to require an intervention that starts at the emerging literacy phase. Emergent literacy refers to the skills, knowledge and attitudes that are developmental precursors to reading and writing. Children who start their formal schooling with poorly developed emergent literacy skills are at risk of experiencing reading and writing problems, which usually persist throughout their school years.

It is also evident that children from lower income groups are at a higher risk of falling behind with literacy development than children from more affluent homes. Any intervention to address the low levels of emerging literacy in South Africa would have to be easily extendible to multiple languages.

Response

This challenge was addressed in a study by the CSIR in collaboration with SU. The aim of the study was to develop and test the effects of using a mobile application addressing aspects of emerging literacy using text-to-speech (TTS) technology in a South African context.

Although commercial mobile applications that support literacy development are available, none are available in the 11 South African official languages and none have content developed specifically for the South African environment. Furthermore, not all available applications use TTS technology. Only a few allow teachers and literacy experts to customise the content and technology to suit their requirements.

During the first intervention, an Afrikaans eBook was developed and tested with a group of six to seven year old children of lower socio-economic status in the Western Cape. The eBook was enhanced with TTS technology and contained locally developed and culturally relevant content. The book could either be played in storytelling mode or the children could participate in interactive activities such as matching pictures and words. The aim of the intervention was to measure the efficacy of a TTS-enhanced eBook to improve vocabulary and word recognition skills in children with poor vocabulary skills.

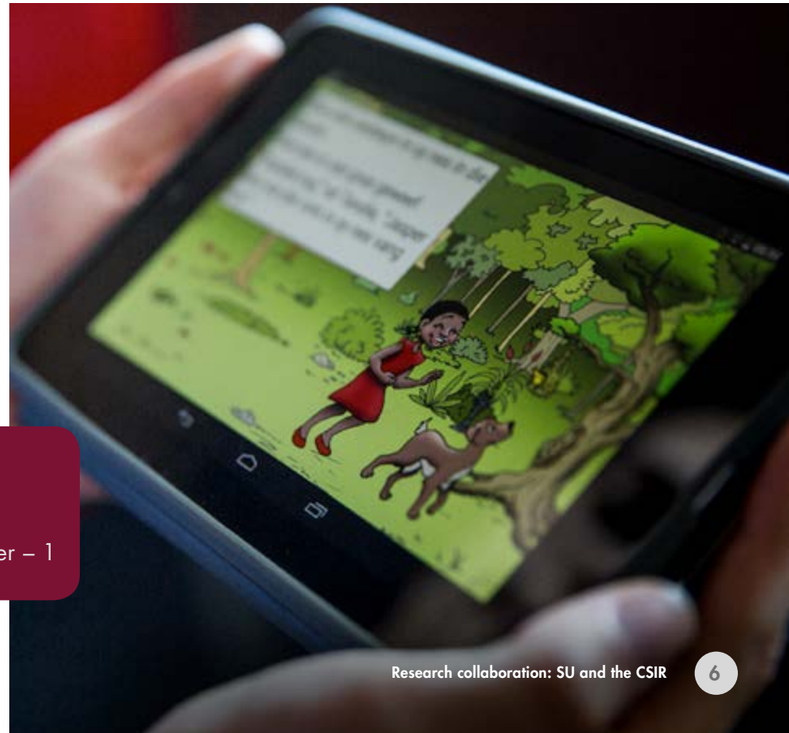
Progress

The results of the intervention indicated that children who were exposed to the eBook improved their receptive and expressive vocabulary skills. A retention test eight weeks after the intervention indicated that they had retained these skills after the intervention period. However, the intervention caused no significant improvement in their word recognition ability.

In the second intervention, the Afrikaans eBook was converted to isiXhosa with the assistance of a speech-language therapist whose first language is isiXhosa. The involvement of a first language speaker is essential to ensure correct translation, appropriate content modification, as well as to ensure that the learning aims and level of difficulty of the book are not influenced by the translation. The isiXhosa eBook was used in the Cofimvaba region of the Eastern Cape.

Outputs

Technology demonstrator – 1
Peer-reviewed conference paper – 1



Modelling

Robot path planning using optimal control

Dr Daniel Withey, Belinda Matebese, CSIR • Prof Mapundi Banda, Dr Willie Brink SU

Funding: SU, CSIR

Background

Mobile robots have recently been used in many applications, such as in mining, factory automation and space exploration. A basic task that the mobile robot needs to perform in these applications is to manoeuver from one point to another without colliding with obstacles, while remaining within its kinematic limitations. The path chosen by the robot should also optimise a performance measure which includes aspects such as distance, time or energy. Endowing machines with the ability to determine optimal paths is part of robotics research.

Wheeled mobile robots are the most popular because of their practical simplicity. Many wheeled mobile robots and wheeled vehicles, including typical automobiles have certain motion constraints, such as the inability to move sideways or to perform on-the-spot rotation. Although these systems are controllable, finding optimal paths for them is difficult.

Optimal control helps to determine control and state trajectories for a dynamic system to minimise a selected performance measure.

A number of methods have been developed for optimal control problems, but they require a good initial approximation to successfully

obtain solutions to the problem. The solution is iteratively determined by adjusting the initial approximation to form an intermediate solution, and repeating the process until all of the necessary optimality conditions are approximately satisfied.

The Leapfrog algorithm can solve optimal control problems. This algorithm has been applied to the control of general systems, that is, to generate control inputs for driving a nonlinear system.

Response

In this work, the Leapfrog algorithm is explored to find optimal paths for non-holonomic mobile robots in real-life contexts. This is a new application for the Leapfrog algorithm, which has previously only been applied in system control and only to academic problems. The effectiveness and capability of the method are demonstrated through simulations and experimental studies.

One advantage of the Leapfrog algorithm is that its solution satisfies the boundary conditions at every iteration step, while with other methods, the boundary conditions may be satisfied only after the whole iteration process is completed. This advantantage means that the Leapfrog algorithm provides a feasible path at each iteration step.

Progress

The Leapfrog algorithm can produce optimal paths for non-holonomic mobile robots executing movements from an initial position and orientation to reach a selected position and orientation while minimising energy control effort. It can also be used to plan collision-free paths in an environment that contains obstacles.

Future work will include using the Leapfrog algorithm to plan paths for mobile robots that include a robotic arm.

The addition of the robotic arm further complicates the optimal path planning problem, as the dynamics and kinematics of the arm must be considered along with those of the mobile robot base. Finding optimal paths, therefore, requires planning for simultaneous motion of the base and of the arm.

Outputs

Peer-reviewed conference papers – 1
Students trained – 1 PhD

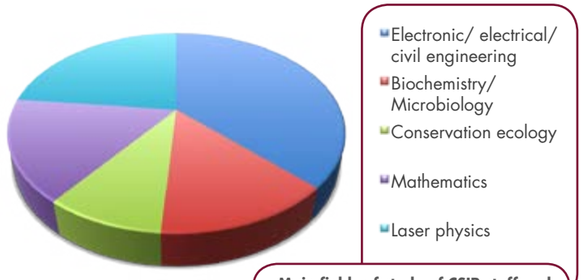
Optimal control helps to determine **control** and **state trajectories** for a **dynamic system** to minimise a selected **performance measure.**

Human capital development

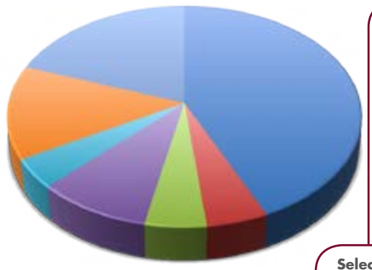
Overview

Between 2013 and 2015, 31 PhD and 36 Masters were funded to study at SU through the CSIR studentship programme and CSIR/SU joined scholarship programme. The qualifications were mainly in engineeringing, mathematics and laser science.

Eighteen of these have graduated. Most of the staff and students studying were supervised jointly by SU and CSIR researchers, and were involved in projects initiated by either or both institutions.



Main fields of study of CSIR staff and CSIR/SU scholarship students



Selected areas of research of NRF-rated reseachers at SU

The complementary capabilities of the CSIR and SU enable research programmes to be performed effectively. The university has over 130 NRF-rated researchers in the areas of collaboration highlighted in the MoU, mainly in biosciences, the natural environment and material science.

During 2015, SU and the CSIR launched two new Research Chairs - one in Quantum, Optical and Atomic Physics and the other in Artificial Intelligence. The university has also been awarded several Research Chairs, including South African Research Chairs Initiative (SARChI) Chairs in biosciences, materials science and manufacturing and natural resources and the environment.

These Chairs, together with researchers in centres of excellence (CoE), as well as in various departments and schools demonstrate the capacity to undertake leading research.

Stellenbosch University/ CSIR Joint Research Chairs

During 2015, SU and the CSIR launched two new Research Chairs - one in Quantum, Optical and Atomic Physics and the other in Artificial Intelligence.

The Faculty of Science hosts the Chair in Quantum, Optical and Atomic Physics, while the Department of Information Science in the Faculty of Arts and Social Sciences is home to the Chair in Artificial Intelligence. Dr Hermann Uys, a physicist at the CSIR and SU, and Prof Arina Britz, CSIR Centre for Artificial Intelligence Research (CAIR) representative at its SU node, are the holders of the respective Chairs.

Stellenbosch University is one of the partner institutions of CAIR, a national collaborative research network that originated in 2011 as a joint initiative between the CSIR and the University of KwaZulu-Natal.

There has been an increase in the number of CSIR staff enrolled for masters and doctoral programmes at the US and an increase in the number of joint student supervision by CSIR and SU staff.

SU places a high premium on the collaboration with the CSIR, that we believe is to the benefit of both institutions by building capacity through joint research programmes to benefit society through cutting edge science.

Prof Eugene Cloete, Vice Rector: Research, Innovation and Post graduate studies

Supervised post graduate research

Novel implementation of a phase-only spatial light modulator for laser beam shaping

Liesl Burger, CSIR • Supervisors: Dr Andrew Forbes, CSIR • Prof Erich Rohwer, SU

Background

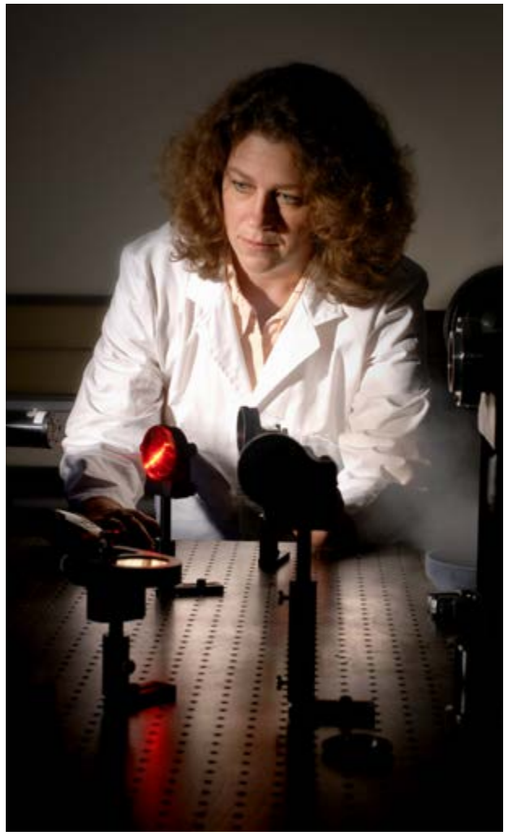
Laser beam shaping is a field of study that deals with the selection and manipulation of laser modes and with the modification of existing beams to create new patterns with particular phase and intensity properties.

The phase-only spatial light modulator (SLM) is the most common method of phase modulation for laser beam shaping. Digitally-generated phase patterns are displayed on a pixelated liquid crystal display panel that is controlled by a computer in order to dynamically generate custom phase patterns. This device has revolutionised the field of holographic laser beam shaping, making possible the creation of new types of laser beams with specific properties.

Novel beams created by SLMs form the basis of the field of laser tweezing. The beams have been used to study atmospheric aberrations, and for commercial applications such as laser marking and micro-machining, and hold promise for high-speed optical data transfer.

Response

The aim of the research was to identify new applications of SLMs in laser beam shaping.
The first investigation was whether or not an SLM could be used as an intra-cavity optical element. Until now, beam shaping using an SLM as an active phase element has been done outside the laser resonator. However, using it inside the resonator



in place of a back reflecting mirror would make real-time, dynamic shaping of a laser beam with low losses and high-mode purity possible.

The second application that was investigated was the self-healing properties of two different types of novel laser beams. These beams have advantages for data transfer because the data encoded in the beam can be recovered despite partial obscuration of the beam.

Progress

The use of an SLM as an intra-cavity element revealed subtle properties of SLMs that were not apparent when used in a conventional extra-cavity configuration. Two generations of liquid crystals, namely twisted nematic (TN) and parallel aligned (PA) liquid crystals (LCs), have been used in commercial SLMs.

The older SLMs, which contain TN LC material have a small residual amplitude modulation. This observation led to the selection of an SLM containing PA LCs and having almost no amplitude modulation with phase, which proved to be suitable for intra-cavity phase modulation and facilitated the further development of the 'digital laser'.

Self-healing in two types of laser beams was studied.
It was found that Laguerre-Gaussian beams self-heal due to the spiralling of the electric field along the optical axis. A theoretical model predicted the self-healing distance, which was then verified experimentally. In similar work, a theoretical model of Bessel-like beams showed self-healing by conical axial propagation and with an axially dependant self-healing distance, which was also verified experimentally.

The aim of the research was to **identify new applications** of SLMs in laser beam shaping. The first **investigation** was whether or not an SLM could be used as an **intra-cavity optical element.**

The second application that was investigated was the **self-healing properties of two different types of novel laser beams.**

Development of a close-quarter unmanned aerial system

Angus Steele, CSIR • **Supervisor**: Johann Treurnicht, SU

Background

Unmanned aerial systems have gained a lot of attention from researchers and developers across the world. Their ability to explore complex terrains quickly makes them ideal for a large number of applications, where terrestrial vehicles are not suitable. Recent advances in computing technologies make it possible to develop extremely agile and stable aerial systems.

The disadvantage of aerial systems is their limited ability to navigate close to physical objects. This restricts them from being used in a close-quarter environment, such as a recently blasted mine in search-and-rescue missions or safety inspections.

Response

The CSIR and SU are developing a drone that can withstand the disturbances introduced by proximity to physical objects such as a wall or the floor. The drone should withstand impacts from hitting unexpected objects and recover, so that it can complete its mission. To be a useful device, the platform is required to take a sensor payload and still maintain a flight time of at least 30 minutes.

Progress

The final configuration decisions are being made for the platform. Three concepts have been identified. Each concept will be validated and compared to the other two designs. The project is expected to end in 2017.

Outputs

Peer-reviewed conference papers – 1

Detailed indicators of collaboration

Collaborative research projects implemented

CSIR researchers	SU researchers	Name of project	2013	2014	2015	Research area
Wynand van der Merwe	Prof Alan Brent	Winetech energy management system guide	•	•		Natural environment
		Energy efficiency leadership network	•	•		
Dr Sebinasi Dzikiti; Dr Mark Gush	Dr Elmi Lötze; Dr Michael Schmeisser; Prof Stephanie Midgley	Quantifying water use of high performing apple orchards in the winter rainfall area of South Africa		•	•	
Dr Paul Oberholster	Prof Anna-Maria Botha	Mitigating water of the Loskop Irrigation Board		•	•	
Dr Ndeke Musee	Prof Chris Aldrich	Modelling the fate, behaviour and toxicity of engineered nanomaterials in aquatic systems	•	•		
Dr Nebo Jovanovic; Dr Richard Bugan	Dr Willem de Clercq	Dryland salinity and catchment management in the Berg river catchment	•			
Dr Nebo Jovanovic; Dr Richard Bugan	Dr Willem de Clercq	ACCESS – Water Theme	•			
Dr Keith Kennedy; Laurie Barwell; Dr Harrison Pienaar	Nico Elema	Support to NEPAD Southern African Network of Water Centres of Excellence	•			
Dr Nebo Jovanovic; Dr Constansia Musvoto	Dr Willem de Clercq; Cou Pienaar	EAU4Food: European Union and African Union cooperative research to increase food production in irrigated farming systems in Africa	•			
Ashton Maherry; Phil Hobbs; Dr Paul Oberholster; Dr Evison Kapangaziwiri; Dr Jean-Marc Mwenge-Kahinda	Dr Alakendra Roychudhury; Corne Engelbrecht	The development of a risk-based platform for the Waterberg area from an environmental and human health perspective	•			
Richard Bean	Prof Dimitri Dimitrov	Magma Simulation Centre	•	•		Energy
Ashley Bhugwandin	Nicholas Goniwe; Nosizo Pindela	Vehicle toolbox (Canopy design) for Eskom vehicle TAP company Calculus	•	•		
David Morrison; Dr Lucia Steenkamp	Prof Marinda Viljoen-Bloom	Expression of PAM in Aspergillus niger	•	•	•	Biosciences
Dr Petrus van Zyl; Dr Robin Roth	Prof Heinrich Volschenk	Botulism vaccine		•	•	
Dr Busisiwe Vilakazi	Dr Gerhard Theron	Obstetrics and gynaecology		•	•	
Dr Sonali Das	Prof Quinette Louw	Analysing gait using functional data analysis		•	•	Modelling & digital science
Daniel Withey; Belinda Matebese	Prof Mapundi Banda	Robot path planning using optimal control	•	•	•	
Dr Febe de Wet; Dr Karen Calteaux; Aby Louw	Dr Daleen Klop	Human language technology (HLT) enabled early literacy development	•	•		ICT
Dr Febe de Wet; Dr Karen Calteaux	Dr Philip Lewis	HLT-enabled computer assisted language learning	•	•		
Dr Anton Botha	Prof Pieter Swart	Quantitative analyses of mohair and blends	•	•		Advanced manufacturing
Pierre Rossouw; Neels Babst	Prof Dimitri Dimitrov	Resource efficient process chains for titanium components in aerospace, automotive and medical applications	•	•		
Dr Bernardt Duvenhage	Riaan van den Dool	Super resolution	•	•		Defence & security
Adelai van Heerden	Prof Marie de Beer	Behavioural sciences	•	•		
Marius Olivier	Prof Willem Perold	Light detection	•	•		
Dr Jason de Villiers	Dr Willie Brink; Prof Johan van der Spuy	PRISM	•	•		
Dr Igle Gledhill	Dr Johan van der Spuy; Prof Hansie Knoetze	Fluxion	•	•		
Dr Glen Snedden	Dr Johan van der Spuy	FUTURE	•	•		
	Prof Theodor von Backstrom; Dr Johan van der Spuy	BALLAST	•	•		
Anria Breytenbach	Jan van Vuuren	Synoptic	•	•		
Benoit Verhaeghe	Prof Kim Jenkins	Thin surfacings and mechanistic behaviour model		•	•	Built environment
		Guidelines for winter seals		•	•	
Dr Wayne Koen; Dr Hencharl Strauss	Prof Hubertus von Bergman; Dr Roelf Botha	End-pumped 1.3 micron Nd:YLF laser sources	•	•	•	Photonics
Loyiso Maweza; Dr Hencharl Strauss	Prof Erich Rohwer	Development and beam shaping of near- and mid-infrared laser sources	•	•	•	
Dr Hermann Uys	Dr Christine Steenkamp; Dr Michael Kastner	Structured light/matter interactions. Trapped ion quantum simulation	•	•	•	

Joint publications resulting from supervised and joint research

Authors	Title of paper	Publication
Peer-reviewed journal articles		
Oberholster PJ; Jappie S; Cheng PH; Botha AM; Matthews MW	First report of an Anabaena Bory strain containing microcystin-LR in a freshwater body in Africa	African Journal of Aquatic Science, Vol. 40(1), pages: 21-36, Mar 2015
Bugan RDH; Jovanovic NZ; De Clercq WP	Quantifying the catchment salt balance: an important component of salinity assessments	South African Journal of Science, Vol. 111(5/6), pages: DOI: http://dx.doi.org/10.17159/sajs.2015/20140196, Jun 2015
Swanepoel A; Du Preez I; Mahlangu T; Chetty A; Klumperman B	Development of bioconjugated dye-doped poly(styrene-co-maleimide) nanoparticles as a new bioprobe	Journal of Materials Chemistry B, Vol. 3, pages: 2635-2640, Feb 2015
Lemmer Y; Kalombo L; Pietersen R-D; Jones AT; Semete-Makokotlela B; Van Wyngaardt S; Ramalapa BE; Stoltz A; Baker B; Verschoor JA; Swai HS; De Chastellier C	Mycolic acids, a promising mycobacterial ligand for targeting of nanoencapsulated drugs in tuberculosis	Journal of Controlled Release, Vol. 211, pages: 94-104, Aug 2015
Callaghan K; Engelbrecht J; Kemp J	The use of Landsat and aerial photography for the assessment of coastal erosion and erosion susceptibility in False Bay, South Africa	South African Journal of Geomatics, Vol. 4(2), pages: 65-79, Jun 2015
Singh RG; Engelbrecht J; Kemp J	Change detection of bare areas in the Xolobeni region, South Africa using Landsat NDVI	South African Journal of Geomatics, Vol. 4(2), pages: 213-223, Jun 2015
Biggs RO; Rhode C; Archibald S; Kunene LM; Mutanga SS; Nkuna N; Ocholla PO; Phadima LJ	Strategies for managing complex social-ecological systems in the face of uncertainty: examples from South Africa and beyond	Ecology and Society, Vol. 20(1), pages: 52, Jan 2015
Ripley B; Visser V; Christin P; Archibald S; Martin T; Osborne C	Fire ecology of C3 and C4 grasses depends on evolutionary history and frequency of burning but not photosynthetic type	Ecology, Vol. 96(10), pages: 2679-2691, May 2015
Rebelo AJ; Le Maitre DC; Esler KJ; Cowling RM	Hydrological responses of a valley-bottom wetland to land-use/land-cover change in a South African catchment: making a case for wetland restoration	Restoration Ecology, Vol. 23(6), pages: 829-841, Nov 2015
Sweijd ML; Wright CY; Westwood A; Rouault M; Landman WA; MacKenzie ML; Nuttall JJC; Mahomed H; Cousins T; Winter K; Berhoozi F; Kalule B; Kruger P; Govender T; Minakawa N	Climate change is catchy – but when will it really hurt?	The South African Medical Journal, Vol. 105(12), pages: 1018-1023, Dec 2015
Heeringa W; De Wet F; Van Huyssteen GB	Afrikaans and Dutch as closely-related languages: A comparison to West Germanic languages and Dutch dialects	Stellenbosch Papers in Linguistics Plus, Vol. 47, pages: doi: 10.5842/470-649, April 2015
Truter JC; van Wyk JH; Newman BK	*In vitro* screening for endocrine disruptive activity in selected South African harbours and river mouths	African Journal of Marine Science, Vol. 37(4), pages: 567-574, Dec 2015
Leadley P; Proença V; Fernández-Manjarrés J; Pereira H; Alkemade R; Biggs R; Bruley E; Cheung W; Cooper D; Figueiredo J; Gilman E; Guénette S; Hurtt G; Mbow C; Oberdorff T; Revenga C; Scharlemann J; Scholes RJ; Stafford Smith M; Sumaila R; Walpole M	Interacting regional-scale regime shifts for biodiversity and ecosystem services	Bioscience, Vol. 64(8), pages: 665-679, Aug 2014
De Vries NJ; Davel MH; Badenhorst J; Basson WD; De Wet F; Barnard E; De Waal A	A smartphone-based ASR data collection tool for under-resourced languages	Speech Communication, Vol. 56, pages: 119-131, Jan 2014
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Goliger A; Kruger A; Retief J	Representivity of wind measurements for design wind speed estimations	European-African Conference on Wind Engineering 2013, Cambridge, United Kingdom, 6pp, Jul 2013
Kruger A; Goliger A; Retief J	Directional analysis of extreme winds under mixed climate conditions	European-African Conference on Wind Engineering 2013, Cambridge, United Kingdom, 8pp, Jul 2013
Dunn D; Snedden G; Von Backstrom T; Mdluli MP	Unsteady effects of a generic non-axisymmetric endwall contour on the rotor of a 1½ stage low speed turbine test rig	Proceedings of ASME Turbo Expo: Turbine Technical Conference and Exposition GT2013, San Antonio, Texas, USA, 3-7 June 2013, 11pp, Jun 2013
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CSIR staff studying

Name of CSIR Staff	Degree programme	CSIR supervisor	SU supervisor	2013	2014	2015
Andre Munian#	PhD (Chemistry)	None	Prof Louw Hoffman; Dr Lutz Auerswald	•		
Stefan Brink*	MEng (Electronic Engineering)	None	Prof Chris Aldrich	•	•	
Seshni Govender*	MSc (Microbiology)	Dr Petrus van Zyl	Prof Emile van Zyl	•	•	
Anjo Theron*	PhD (Molecular Biology)	Dr Colin Kenyon	Prof Ian Wiid	•		
Chris Burger	DEng (Electrical & Electronic Engineering)	None	Prof Thomas Jones	•	•	•
Riaan van den Dool*	PhD (Applied Mathematics)	None	Dr Stefan van der Walt	•		
Amy Maharaj#	MEng (Transportation Engineering)	None	None	•		
Johan Kieviet*	MEng (Electronic Engineering)	None	Geoff Toms	•		
Padhraic O' Connor#	MSc (Civil Engineering)	None		•		
Andre Breytenbach	PhD (Geographical Information Systems)	None	Dr Adriaan van Niekerk	•	•	•
Karien Venter*	MEng (Civil Engineering)	Kobus Labuschagne	Prof Marion Sinclair	•	•	
	PhD (Civil Engineering)					•
Ilse Kotzee	PhD (Conservation Ecology)	None	Dr Belinda Reyers	•	•	•
Odirilwe Selomane	PhD (Conservation Ecology)	Dr Belinda Reyers	Prof Karen Esler	•	•	•
Ryan Blanchard*	PhD (Botany)	Dr Patrick O'Farrell	Prof David Richardson	•		
Thozamile Yapi*	MSc (Conservation Ecology)	Dr Patrick O'Farrell Dr Luthando Dziba	Prof Karen Esler	•		
Andre Theron	PhD (Civil Engineering)	None	Geoff Toms	•	•	•
Patrick Shabangu*	MSc (Applied Mathematics)	Roy van Ballegooyen	Prof Francois Smit; Dr Hardus Diedericks	•	•	•
Sumaya Clarke*	PhD (Agriculture)	Dr Nebo Jovanovic	Dr Andrei Rosenov	•		
Shir Botha#	MSc (Genetics)	Dr Bettina Genthe; Dr Paul Oberholster	Prof Anna-Maria Botha	•		
Natasha van Horsten	MSc (Geology)	Dr Thato Mtshali	Dr Susanne Fietz	•	•	•
Melanie Mclaren*	PhD (Physics)	Dr Andrew Forbes; Dr Stef Roux	Prof Erich Rohwer	•	•	
Nicolene Botha*	PhD (Laser Physics)	Dr Anton du Plessis	Prof Heinrich Schwoerer	•	•	
Andre Smit*	PhD (Laser Physics)	None	Prof Erich Rohwer	•	•	
Attie Hendriks#	PhD (Laser Physics)	Dr Hermann Uys	Dr Christine Steenkamp	•	•	
Cobus Jacobs	PhD (Electronic Engineering)	None	Prof Thomas Jones	•	•	•
Darryl Naidoo*	PhD (Laser Physics)	Dr Andrew Forbes	Prof Erich Rohwer	•	•	
Liesl Burger	PhD (Laser Physics)			•	•	•
Wayne Koen*	PhD (Physics)	Dr Daniel Esser		•	•	
Belinda Matebese	PhD (Applied Mathematics)	Dr Daniel Withey	Prof Mapundi Banda	•	•	•
Mogomotsi Keaikitse*	MSc (Applied Mathematics)	Natasha Govender	Dr Willie Brink	•		
Dwain Dunn*	PhD (Mechanical Engineering)	None	Prof Theo von Backstrom	•	•	
Thomas Roos#	PhD (Mechanical Engineering)	None	Prof Thomas Harms	•	•	
Seanette van Rooyen	MSc (Applied Mathematics)	Herman le Roux	Prof Ben Herbst	•	•	•
Kobus Myburgh	MEng (Electronics)	Dr Derik Minnaar	Prof Johann de Swardt	•	•	•
Lynette van der Westhuizen#	MEng (Electronic Engineering)	None	None	•	•	
Gideon van der Kolf*	MSc (Electrical & Computer Engineering)	None	Dr Iain Peddle	•		
Niël Goslett*	MPhil (Futures Research)	None	Prof Andre Roux	•		

Martin Pelser#	MSc (Electronic Engineering)	Dr Fernando Camisani-Calzolari	Prof Hendrik du Mouton	•		
Charl Harding	MPhil (Futures Studies)	None	None		•	•
Loyiso Nxumalo*	MPhil (Development Finance)	None	Dr Charles Adjasi	•		
Nokulunga Maima	MSc (Biochemistry)	Dr Petrus van Zyl	Dr Heinrich Volschenk		•	•
Kishan Tulsi	MSc (Civil Engineering)	None	Prof Koos Schoonees		•	•
Mawande Ngidi*	MPhil (Urban & Regional Science)	Gerbrand Mans	Herman Geyer	•	•	
Petrus Matji#	PhD (Water & Environment Engineering)	None	None		•	
Cikizwa Mbolambi	MSc (Geography)	None	Dr Melanie Luck-Vogel		•	•
Arno de Klerk	PhD (Natural Sciences)	Dr Paul Oberholster	Prof Anna-Maria Botha			•
Antonie de Kock	MSc (Applied Mathematics)	Dick Mathekga	Dr Hanno Coetzer		•	•
Marius van Wyk	MEng (Electronics)	Niël Goslet	Prof Petrie Meyer			•
Andri Swanepoel*	MSc (Chemistry)	Dr Avashnee Chetty	Prof Bert Klumperman	•	•	
Nox Moyake	MPhil (Science & Technology Studies)	None	Dr Nelius Boshoff			•
Laurette Pretorius	PhD (Computer Science)	None	Prof Lynette van Zijl		•	•
Rynhardt Kruger	PhD (Electronic engineering)	Dr Febe de Wet	Prof Thomas Niesler			•
Heila-Marie Botha	PhD (Computer Science)	Dr Quentin Williams	Prof Willem Visser; Prof Brink van der Merwe			•
Janis Smith	PhD (Conservation Ecology)	Dr Jeanne Nel	Prof Karen Esler			•
Liesl Hill	PhD (Biochemistry)	Dr Paul Oberholster	Prof Anna-Maria Botha			•
Loyiso Maweza	PhD (Physics)	Dr Hencharl Strauss	Prof Erich Rohwer			•
Ramathabathe Madigoe	MSc (Laser Physics)	Kobie Smit	Dr Hermann Uys	•	•	•
Adel Coetzer	MEng (Electrical Engineering)	Geoffrey Turner	Prof Toit Mouton			•

Marelise Hattingh	MEng (Industrial Engineering)	Lorita Christelis	Louzanne Oosthuizen			•
Marius van Wyk	MEng (Electronics)	Niël Goslett	Prof Petrie Meyer			•
Marle Smit	MPhil (Management Coaching Studies)		Dr Dorian Aiken			•
Sipho Mbhokota	MBA	None	None			•
Angus Steele	MEng (Mechatronic Engineering)	Dawid Oosthuizen	Johann Treurnicht			•

**= graduated # = left CSIR/no longer studying*

Students supported by the scholarship programme

Name of student	Degree programme	2013	2014	2015
Annika Neethling*	MSc (Medical Science)	•		
Marinel Janse van Rensburg*	MSc (Mathematics)	•		
Charles Rigby*	PhD (Physics)	•	•	

**= graduated*

CSIR researchers lecturing/supervising students

Name of researcher	Type of collaboration	2013	2014	2015	Research area
Dr Robyn Roth	Supervising	•	•	•	Biosciences
Dr Petrus van Zyl	Examining, Supervising	•	•	•	
Dr Colin Kenyon	Supervising	•			
Kobus Labuschagne		•	•	•	
Dr Andre Theron	Supervising			•	Natural environment
Lara van Niekerk				•	
Dr Belinda Reyers		•	•		
Dr Patrick O'Farrell		•			
Dr Luthando Dziba		•			
Dr Nebo Jovanovic		•	•	•	
Roy van Ballegooyen		•			
Dr Bettina Genthe		•			
Dr Paul Oberholster		•		•	
Dr Thato Mtshali		•	•	•	
Dr Jeanne Nel				•	
Dr Andrew Forbes	Supervising	•	•		Lasers
Dr Stef Roux		•	•		
Dr Anton du Plessis		•	•		
Dr Daniel Esser		•	•		
Dr Hermann Uys		•	•		
Dr Hencharl Strauss				•	
Herman le Roux	Supervising	•	•	•	Defence & Security
Dr Derik Minnaar		•	•	•	
Dr Fernando Camisani-Calzolari		•			
Niël Goslett				•	
Geoffrey Turner				•	
Lorita christelis				•	
Johan Smit				•	
Nelis Willers				•	
Natasha Govender	Supervising	•			Modelling
Dr Daniel Withey		•	•	•	
Dick Mathekga			•	•	
Dr Kobie Smit		•	•	•	
Adam Goliger	Supervising	•	•	•	Built Environment
Gerbrand Mans			•		
Dr Aurona Gerber	Supervising			•	Information & communication technology
Mario Marais				•	
Dr Arina Britz		•	•		
Chris Burger		•	•	•	
Dr Febe de Wet		•	•	•	
Dr Quentin Williams		•	•	•	
Dr Jeanine Engelbrecht		•	•	•	
Dr Ilse du Preez	Supervising	•	•		Materials science & manufacturing
Dr Bilainu Oboirien		•	•		
Dr Avashnee Chetty		•	•		
Dawid Oosthuizen				•	

CSIR researchers holding extraordinary professorships/ honorary research associates

Name of researcher	Area of expertise	2013	2014	2015
Dr Melanie Luck-Vogel	Coastal systems	•	•	•
Dr Michelle Audouin	Environmental management	•	•	•
Dr Hermann Uys	Quantum technologies and ion tapping			•
Dr Arina Britz	Artificial intelligence			•
Dr Febe de Wet	Human language technology	•	•	•

NRF-rated researchers – Collaboration areas in CSIR/SU MoU

Researcher rating	Name of researcher	Research specialisation	Area
Leading international	Prof PR Donald	Early bacterial activiy of antibacterial drugs, Tuberculosis (TB) in child health, Pharmacokinetics and pharmacodynamics of anti-TB drugs	Biosciences
	Prof J-HS Hofmeyr	Enzymology, Metabolism - regulation, Complexity theory, Computer modelling	
	Prof HS Schaaf	HIV and AIDS - care, Infectious diseases, Community health, Child abuse, Multidrug resistant TB, Anti TB drugs, TB diagnostics and epidemiology	
Internationally acclaimed	Prof MF Cotton	Paediatrics, HIV care, Infectious diseases, Community health	
	Prof A Botha	Microbial ecology	
	Prof FF Bauer	Yeast metabolomics, Genomics, Yeast - flocculation, Wine science, Wine microbiology, Gene regulation	
	Prof AH Diacon	TB, Anti TB drugs, Interventional pulmonology, Biomarkers, Research methodology	
	Prof NC Gey van Pittius	Mycobacteria, Mycobacterial genetics, Molecular mycobacteriology, Mycobacterium TB - molecular epidemiology, molecular diagnostics, epidemiology, Multidrug resistant TB	
	Prof EG Hoal-van Helden	Genetics	
	Prof TF Kruger	Infertility, Andrology, Gynaecology	
	Prof A Lochner	Myocardial ischaemia, Cardioprotection, Cell signaling	
	Prof BJ Marais	TB and HIV, TB, multidrug resistant TB, Childhood TB	
	Prof SW Moore	Surgery, Paediatric Surgery, Genetics of congenital conditions, Molecular biology of cholinesterases	
	Prof E Strauss	Enzyme mechanisms, Enzyme inhibition, Drug design, Biocatalysis	
	Prof P Swart	Analytical biochemistry, Protein biochemistry, Steroidogenesis, Natural prodcuts, Enzymes	
	Prof MR Tomlinson	Priority setting, Public health, Postpartum depression, Infant development, Infant attachment, High risk infants, Depression, Mental	
Internationally acclaimed	Prof W Preiser	Medical virology, Virus diagnosis, Laboratory medicine, HIV - drug resistance, Zoonotic diseases, Virus epidemiology, HIV (Viruses) - testing, HIV co-infection, Opportunistic infections	Biosciences
	Prof BA Prior	Fungal biotechnology	
	Prof JM Rohwer	Computational systems biology, Metabolic control analysis, Plant physiology, Biological nuclear magnetic resonance, Microbial physiology - quantitative	
	Prof PD van Helden	TB, Infectious diseases, Biomedical sciences	
	Prof AA van Niekerk	Applied ethics, Biomedical ethics	
	Prof WAL van Otterlo	Medicinal chemistry, Synthetic chemistry	
	Prof RM Warren	Mycobacterium TB - molecular epidemiology, multidrug resistant TB	
	Prof G Walzl	TB, Immunological biomarkers	
	Prof WH van Zyl	Biofuels, Fungal biotechnology	
	Prof TC Victor	Mycobacterium TB - molecular epidemiology	
	Prof A Viljoen	Plant pathology, Host-plant resistance, Plant pathogen – characterisation	
Established	Prof RT Erasmus	Clinical chemistry, Laboratory medicine, Laboratory management and audits	
	Prof JM Akudugu	Radiobiology, Radiation damage, Radiation dosimetry, Cancer research, Anti-cancer drugs, Immunoconjugates (Cancer therapy), Radiation oncology, Nuclear medicine, Cytotoxicity, Applied radioactivity	
	Prof S Bardien-Kruger	Genetics of Parkinson's disease, Neurodegenerative disorders, Human molecular genetics	
	Prof DU Bellstedt	Molecular biology (Plant), Molecular systematics, Animal vaccines	
	Prof J Carr	Neuroscience, Human genetics, Neurodegeneration and protection	
	Prof SR Daniels	Molecular phylogeny, Phylogeography	
	Prof SS du Plessis	Spermatology, Human reproduction, Computer Assisted Sperm Analysis , Spermatozoa, Proteomics	
	Prof AM Engelbrecht	Cancer research	
	Prof MF Essop	Energy metabolism, Cellular and molecular biology, DNA markers, Mitochondrial metabolism, Signals and signalling, Cell death pathways, Carbohydrates - Metabolism, HIV treatment, Metabolic syndrome, Diving/exercise/hypoxia	

Established	Prof W Ferris	Stem cell research, Diabetes, Metabolic and endocrine systems, Bone metabolism, Obesity	Biosciences
	Prof PP Fourie	HIV (Viruses) – History, HIV and AIDS - policy, political aspects, political impact	
	Prof IR Green	Analytical organic chemistry, Synthetic organic chemistry, Biological chemistry, Medicinal, Natural Products	
	Prof B Huisamen	Molecular and cell biology, Signal transduction, Ethnopharmacology, Drugs - Pharmacological effect, Myocardial metabolism, Myocardial protection, Myocardial ischaemia	
	Dr AG Johnson	Molecular neuroscience	
	Prof SA Kagee	Clinical health psychology	
	Prof MJ Kotze	Human genetics	
	Dr JR Lloyd	Carbohydrates - metabolism, Sugar metabolism, Sugarcane biotechnology, Starch - metabolism	
	Prof A Louw	Steroid receptors	
	Prof XG Mbhenyane	Community nutrition, Public health nutrition	
	Prof K Moodley	Medical ethics, Research ethics, Family medicine	
	Prof PLN Mouton	Herpetology, Lizards, Evolutionary biology	
	Prof DJH Niehaus	Psychiatric genetics	
	Prof HJ Odendaal	Fetal alcohol syndrome, Fetal physiology, Drug abuse, Children - growth	
	Dr H Rabie	HIV care, Infectious diseases, Community health	
	Prof C Scheffer	Biomedical engineering	
	Prof J Smith	Paediatric neonatologist	
	Dr R van Toorn	Paediatrics, Child health	
	Dr GU van Zyl	Medical virology	
	Prof M Viljoen-Bloom	Fungal biotechnology, Molecular biology	
	Prof MA Vivier	Plant-pathogen interactions, Plant biotechnology, Molecular biology (Plant), Plant - growth hormones, host defence response, stress	
	Dr H Volschenk	Molecular biology, Molecular biotechnology, Yeast fungi - genetic engineering, Bioprospecting	
	Prof L Warnich	Pharmacogenetics, Human molecular genetics, Pharmacogenomics	
	Prof CS Wiysonge	Vaccinology, Systematic reviews, Knowledge translation, Health systems	

Internationally acclaimed	Prof KJ Jenkins	Pavement engineering	Built environment
Established	Prof SE Donaldson	Urban studies, Urban tourism development	
	Prof HS Geyer	Town and regional planning	
	Prof NJ le Roux	Statistics - applied, computational, mathematical, multivariate, Optimal designs (Statistics), Statistics - teaching, Data analysis, Visualisation of data, Biplots	
	Prof M Swilling	Urban development, Sustainable development, Natural resources - Management, Design and planning, African economy, Development economics, Public policy studies, Interdisciplinary research, Ecology (General), Community development, City planning, Sustainability science	
	Prof GPAG van Zijl	Construction materials, Durability of concrete, Cement-based materials, Structural engineering	
	Prof JA Wium	Structural engineering, Construction Engineering and Management	
Internationally acclaimed	Prof CJ Fourie	Superconductors (Electronics), Superconductors	Defence & security
	Prof P Meyer	Microwaves, Electromagnetics	
	Prof HDUT Mouton	Power electronics	
	Prof WJ Perold	Superconductors (Electronics), Nanoelectronic devices	
Established	Prof IJ van der Waag	Military science, Military history, Military studies	
	Prof GAJ van Dyk	Military psychology, Psychology - Africa, Psychological trauma, Psychotherapy	
	Prof R-J Wang	Electric machines, Renewable energy, Finite element modelling, Thermal analysis, Optimisation, Electrical motor drives, Power electrical engineering, Computational electromagnetics	
Internationally acclaimed	Prof WC Visser	Computers - Software failure, Software engineering, Software development	ICT
	Prof BW Watson	Programming languages, algorithmics, computational modelling, cybersecurity, Algorithms, Bioinformatics algorithms, Compiler algorithm - design, Algorithms for optimisation, Formal aspects of computer science, Programming languages	
	Prof JAC Weideman	Numerical analysis, Scientific computing	
	Prof DB Davidson	Computational electromagnetics, Radio astronomy, Antennas, High performance computing	

Established	Prof B Fischer	Software engineering, Formal methods, Program analysis, Model checking, Program verification, Generative programming (Computer science)	ICT
	Prof J Geldenhuys	Software engineering, Automata, Formal languages, Data structures (Computer science), Formal methods	
	Prof BM Herbst	Computer vision, Numerical analysis, Machine learning	
	Prof DG Kourie	Algorithms, Software engineering, Programming languages	
	Dr TR Niesler	Automatic speech recognition, Speech processing, Speech synthesis, Language technology, Machine learning, Statistical pattern recognition	
	Prof IM Rewitzky	Mathematics of computer science	
	Prof K Schreve	Computer aided design, Reverse engineering, Three-dimensional reconstruction	
	Prof MM Botha	Computational electromagnetics, Finite element methods, Boundary elements methods, Electromagnetic theory, Antennas and radiation	
Internationally acclaimed	Prof FG Scholtz	Quantum mechanics, Noncommutative quantum mechanics, Quantum field theory, Noncommutative quantum field theory	Laser science
	Prof HPH Schwoerer	Ultrafast Structural Dynamics, Ultrafast Spectroscopy, Laser physics	
Established	Dr FC Cinti	Numerical methods, Degenerate quantum gases, Quantum many-body theory, Magnetism, Nonlinear optics, Multiferroic materials	
	Prof JH Cloete	Radar remote sensing, Antennas and propagation, RF and microwave properties of matter, Lumped and distributed RF and microwave circuits	
	Prof HC Eggers	Multivariate statistics, Experimental high energy physics, Statistical inference	
	Dr CM Steenkamp	Laser spectroscopy, Nonlinear optics	
	Prof EG Rohwer	Laser spectroscopy	
Leading International	Prof L Klumperman	Free radical polymerisation, Polymer synthesis, Polymer-drug conjugates, Polymer chemistry, Emulsion polymerisation	Material science
	Prof LJ Barbour	Supramolecular chemistry, solid-state chemistry	
Internationally acclaimed	Prof KR Koch	Chemical speciation, Platinum group elements, Extraction metallurgy, Separation methods, Complexing ligands, NMR spectroscopy	
	Prof JM Kossmann	Metabolic engineering, Biopolymers, Biomass energy	
	Prof HG Raubenheimer	Organometallics, Homogeneous catalysis, Supramolecular chemistry, Ligand design	

Internationally acclaimed	Prof C Aldrich	Visualization of data, Nonlinear dynamic modelling, Control and signal processing, Condition monitoring, Exploratory data analysis, Data mining, Neural networks, Nonlinear time series analysis, Image analysis, Process control	Material science
	Prof H Pasch	Polymers - composites, spectroscopy, synthesis, characterization, Analytical organic chemistry, High performance liquid chromatography, Mass spectrometry, Separations/mass spectrometry Near infrared spectroscopy, Analytical polymer science	
	Prof BV Burger	Mass spectrometry, Gas chromatography, Analytical organic chemistry, Sample preparation, Trace analysis, Pheromones, Synthetic organic chemistry, Electroantennographic detection	
Established	Prof AH Basson	Mechanical design, Manufacturing processes, Computer aided design, Design	
	Prof KG Clarke	Bioprocess engineering	
	Prof DM Dimitrov	Advanced manufacturing, Rapid product development, Additive manufacturing, Decision support systems, Computer integrated manufacturing, Titanium machining, Manufacturing processes and systems	
	Prof C Esterhuysen	Computational chemistry, Crystallography	
	Prof JF Gorgens	Bioprocess engineering	
	Prof DA Haynes	Crystal engineering, Chemistry - main group elements	
	Dr RC Luckay	Ligand design, Solvent extraction, Membrane based solvent extraction, Complex stability, Stability constants	
	Prof PE Mallon	Analytical polymer science, Polymer nanocomposites, Positron annihilation spectroscopy	
	Prof SF Mapolie	Polymers, Catalysis (Homogeneous), Inorganic chemistry, Organic chemistry - synthesis, Dendrimer Chemistry	
	Prof AJ van Reenen	Polyolefins, Natural fibre-polymer composites, Kinetics of polymer crystallisation, Polymer characterisation, Bio-composites	
	Prof G Venter	Structural analysis and design, Finite element methods, Multidisciplinary optimisation, Structural optimisation, Nonlinear solid mechanics, Mechanical engineering	
Leading international	Prof DM Richardson	Plant ecology, Conservation ecology, Terrestrial ecology	

Internationally acclaimed	Dr BC Anderson	Plant biodiversity and evolution, Evolutionary ecology, Evolutionary biology, Evolution, Pollination, Pollination biology, Pollination ecology, Pollination experiments	Natural environment
	Prof CA Matthee	Systematics, Marine biodiversity, Evolution	
	Prof DF Frei	Geochemistry, Analytical, Sedimentary geochemistry, Geochronology, Sediment-related ore deposits, Clastic sediments, Tectonics and sedimentation, Thermochronology, Experimental petrology, Isotope geology, Industrial minerals	
	Prof JP Hattingh	Environmental ethics, Applied ethics, Business ethics, Climate change ethics	
	Prof D Baird	Ecosystem Modelling, Ecosystem ecology	
	Prof IS Buick	Isotope geochemistry, Geochronology, Metamorphic petrology, Geochemistry	
	Prof JD Clemens	Igneous petrology, Experimental petrology	
	Prof GF Midgley	Plant ecophysiology, Climate change - Impact, adaptation, vulnerability, Applied ecology	
	Dr JR Wilson	Invasion biology, Risk assessment, Entomology, Natural resources - Management, Applied ecology, Population ecology, Theoretical ecology, Spatial ecology, Biological control - Alien invasive plants, Community ecology	
	Prof TE Cloete	Nanotechnology applications in water, Environmental biotechnology, Nanotechnology applications in water	
Established	Dr HM de Klerk	GIS - teaching, Applied ecology, Conservation ecology, Biogeography, Fire ecology, Nature conservation, Remote sensing	
	Prof MP de Wit	Environmental and resource economics, Integrated environmental assessment, Cost benefit analysis, Policy - climate change, environment, water, Waste management, Biodiversity - planning	
	Prof LL Dreyer	Plant anatomy, Ecology, Molecular systematics, Palynology, Pollination biology, Plant morphology, Biogeography, Morphology	
	Dr JA du Plessis	Environmental management, Hydrology, Integrated water resources management, Groundwater hydrology, Water - law and legislation, Water conservation, Water demand - modelling, Water resource governance, Water resources and environmental engineering, Water policy	
	Dr B du Toit	Nutrient cycles, Silvicultural systems, Forest physiology, Forest soils, Fire management	
	Prof KJ Esler	Biological invasions, Plant ecology, Conservation ecology, Social-ecological systems, Ecological rehabilitation, Ecological restoration	
	Dr S Fietz	Climate change, Global change research	
	Prof K Jacobs	Mycology, Microbial ecology	

Established	Dr SM Jacobs	Plant herbivore, Biogeochemistry, Riparian Ecology	Natural environment
	Prof SE Kerwath	Acoustic telemetry, Individual-based modelling, Marine ecology, Fish biology, Stock assessment, Small-scale Fisheries, Marine conservation, Marine - protected areas	
	Dr S Matthee	Entomology and parasitology	
	Dr A McLeod	Diagnostic plant pathology, Plant pathology, Molecular plant pathology	
	Dr GJ Measey	Population genetics, Population modelling, Amphibians, Evolution, Functional morphology	
	Dr M Meincken	Climate change, Wood anatomy, Wood quality, Material sciences	
	Prof AJ Reinecke	Ecotoxicology, Zoology	
	Prof AJ Valentine	Plant physiology	

University of Cape Town and the CSIR

Indicators of collaboration

Research

	2013	2014	2015
Collaborative research projects implemented	13	28	22
Joint publications resulting from supervised and joint research	33	35	34

Human capital development

	2013	2014	2015
CSIR researchers lecturing/ supervising students	35	33	31
Students supported by the joint scholarship programme	15	12	9
CSIR staff and students studying	55	54	48
Scholarship students and CSIR staff who graduated	13	17	7
CSIR staff appointed extraordinary professors/ honorary research associates	2	2	2
University staff appointed to CSIR research advisory panels	1	1	1

Highlights and achievements

Health

Introducing Umbiflow™ at primary health level

Dr Busisiwe Vilakazi, Jeremy Wallis, CSIR • Dr Olufunke Alaba, Plaxcedes Chiwire, UCT

Funding: NRF, MRC, CSIR

Background

The South African Medical Research Council's Saving Babies Report (2012 – 2013) found that the main causes of perinatal deaths in South Africa's state health sector included unexplained stillbirth and spontaneous pre-term birth. Undiagnosed foetal growth restriction could be one of the major contributors to these conditions.

During a mother's visit to a prenatal clinic, foetal growth restriction is usually detected by using a tape to measure the mother's abdomen. When foetal growth restriction is suspected, the pregnant woman is referred to a facility with a higher level of care, where a conventional Doppler ultrasound test is done using an imaging device.

CSIR researchers have developed an ultrasound device called Umbiflow™ that helps to diagnose foetal intrauterine growth retardation at the primary healthcare level and reduce unnecessary referrals. By measuring the blood flow in the umbilical cord, the device detects when the placenta is no longer providing sufficient nutrients and oxygen for the baby to reach its growth potential.

A study in Kraaifontein in the Western Cape showed that referrals of patients with suspected foetal growth restriction can be reduced if the Umbiflow technology is used. The field trial also showed that 9% of the women who have their first antenatal visit after 28 weeks, had smaller babies, which would not have been detected.

In addition to the clinical study, an economic study was undertaken in collaboration with the UCT to evaluate whether the introduction of Umbiflow™ in a primary healthcare maternity facility could potentially reduce costs, compared to the current method of monitoring intrauterine growth of a foetus.

Response

The UCT team costed the Umbiflow™ intervention, which was offered to selected pregnant women with low symphysis-fundal measurement. A retrospective cost analysis was conducted on the women who received an Umbiflow™ using structured questionnaires. A societal cost and health provider perspective was adopted and the costs were divided into two categories, namely: Health system and patient costs. Patient costs analysis separated those patients referred back to the primary healthcare facilities from those held back for specialised care in the hospitals while the cost to the health system was calculated from a health provider perspective and included personnel, consumables, equipment, capital and training costs. Using this information, a cost-effectiveness analysis was conducted to compare the costs and health effects of an Umbiflow ™ intervention.

Progress

The preliminary findings of the study suggest that conducting an Umbiflow™ measurement at a clinic is more cost-effective than referral to a secondary hospital for a Doppler test. The results also indicate that screening with Umbiflow ™ can improve the management of pregnant women in primary healthcare by reducing the cost of avoidable referral, lowering the burden on secondary level health system and reducing the antenatal default rates.

Outputs

Student graduated – 1
Peer-reviewed conference papers – 1

A study in **Kraaifontein** in the Western Cape showed that referrals of patients with **suspected foetal growth restriction** can be reduced if the **Umbiflow technology** is used.

Natural environment

Understanding the biogeochemical response to physical drivers in the Southern Ocean using bio-optics

Dr Sandy Thomalla, Belinda Matebese, CSIR • Prof Marcello Vichi, Dr Sarah Fawcett, UCT

Funding: NRF, DEA, CSIR

Background

Biological production and carbon export to the deep ocean, 'the biological pump' is a major contributor to the Southern Ocean CO^2 sink, which removes about 33% of the global organic carbon flux south of 30°S each year. The Southern Ocean biological pump also regulates the supply of nutrients to Subantarctic Mode Water and Intermediate Water of the southern hemisphere and North Atlantic, which in turn drives low latitude production. Climate models and decadal data sets predict changes in the earth's climate that will influence the effectiveness of the Southern Ocean CO^2 sink through adjustments to sea surface temperature, stratification and mixing, all of which affect the nutrient and light supply required for phytoplankton production and associated carbon export.

The regional sensitivity of biological production to predicted changes in the earth's climate is unknown. This impedes prediction of the future response of the Southern Ocean's biological carbon pump to a changing climate. This lack of understanding is partly due to the inability to accurately resolve inter-annual variability and seasonal and intra-seasonal dynamics in physical drivers and biological response, due partially to operational limitations. This has required the use of autonomous and remotely sensed techniques that can address the temporal and spatial scale knowledge gaps.

Bio-optical sensors on autonomous platforms (e.g. gliders and floats) provide cost-effective measurements at high frequency; as do ocean colour remote sensing observations. These platforms can sample the Southern Ocean at the relevant time and space scales for addressing climate change questions.

Current ocean colour algorithms applied to Southern Ocean data sets tend to be unreliable, due largely to their parameterisation with low-latitude bio-optical data sets whose properties differ from those of the Southern Ocean.

Response

The aim of the research is to develop and apply emerging techniques to derive optimised and regionally robust information from ocean colour and autonomous platforms in the Southern Ocean in order to improve understanding of ecosystem function. A key focus is the ability to assess the event, seasonal and inter-annual variability in ecosystem physical drivers and their biogeochemical response.
The spectral nature of the light emerging from the world's oceans is intrinsically linked to the biogeochemical constituents of ocean waters. Ocean colour data therefore represents a vast resource of information through the use of schemes that relate optical measurements to constituents of interest.

The goal of determining plankton assemblage characteristics and physiology from remote sensing reflectance remains a big challenge. This relies on a substantial quantity of in situ data to ensure appropriate regional biogeochemical parameterisation. A primary focus of this research is gathering the necessary bio-optical, biogeochemical and physiological data to develop and validate appropriate regional ocean colour algorithms.

In addition, autonomous platforms provide high-resolution profiles of upper ocean physics and biogeochemistry, together with export flux estimates.

Progress

Starting in the winter of 2015, bio-optics float deployments have complemented the profiling glider study (winter 2015 to summer 2015) by completing the high-resolution sampling of the seasonal cycle in the sub-Antarctic zone (SAZ). The ability of the Inherent Optical Properties (IOP) sensors on the gliders and floats to sample the SAZ continuously over an annual seasonal cycle means that decent satellite matchups for ocean colour validation are likely to be extremely high.

It is anticipated that the combination of ship-based measurements of ongoing IOPs, together with the floats and gliders, will allow for the most substantial validation of Southern Ocean ocean colour data in existence.

A Southern Ocean bio-optical research competency and data collection, which provides a common and cost-effective research and development (R&D) platform for powerful new multi-ecosystem observations, has been established. It will allow improved understanding of environmental forcing mechanisms that regulate plankton communities and their role in mediating carbon exchange between the atmosphere and the ocean interior.

Outputs

Peer-reviewed journal articles – 8
Peer-reviewed conference papers – 13
Students graduated– 1 PhD, 6 MSc, 1 Honours

Health risks of chemicals and sun exposure in a changing climate

Dr Rebecca Garland, CSIR • Prof Hanna-Andrea Rother, UCT

Funding: CSIR

Background

The impacts of increased temperatures on human health, due to possible climate change, are complex. Africa has already experienced increasing warming and it is likely that future temperature increases on the continent will be faster than the projected global average. There is inadequate information on the specific relationship between climate change and health in Africa, especially regarding outdoor workers who are exposed to numerous stresses simultaneously, such as in South Africa's Working for Water (WfW) programme, which controls the spread of alien invasive plants.

Response

This collaboration investigated the potential impact of chemicals and sun exposure on outdoor workers from the WfW programme. The multiple stresses that these workers are exposed to simultaneously can compound the health effects. For example, the vaporisation of herbicides increases with increasing temperatures. High temperatures could, therefore, pose a direct health risk (i.e. heat stress), as well as increase the inhalation of chemicals by workers.

However, there are potential trade-offs. For example, WfW workers must wear protective clothing when applying herbicides. But, this could increase their risk of heat stress. Therefore, the health risk to WfW workers from working outside with herbicides will also depend on behavioural and managerial decisions (such as wearing protective clothing, requiring breaks on hot days).

Workshops that were held in Citrusdal, Western Cape, were used to highlight the perceptions of exposure, associated health risks, and the needs of WfW workers; evaluate the responses of managers, assess knowledge of climate change; and discuss how to reduce exposure to sun, heat and chemicals.

Progress

The responses from the workshops are being analysed. The research will contribute to strategies and policies of WfW to reduce the risks of heat and sun exposure on employees, as well as inform future research in climate change and occupational health risks.

During the discussions, a key issue was that the most exposure to sun, heat and chemicals took place during follow-up visits, which occur about six months after the previous visit. During these follow-up visits, the exposure may be greater because of reduced protection from the sun due to the absence of big trees that provide shade.

The follow-up visits are usually during the summer, when the potential for exposure to sun, heat and chemicals is at its highest. Therefore, the team has developed a proposal for a decision-support tool to assist in planning WfW clearing schedule that accounts for exposure to sun, heat and chemicals, as well as needed plant characteristics for herbicide application.

The research will **contribute to strategies** and **policies** of WfW to reduce the risks of heat and sun exposure on employees, as well as inform future research in **climate change and occupational health risks.**

Defence and security

Development of a robust auto-reconfigurable network intrusion detection system

Andre McDonald, CSIR • Prof Alireza Baghai-Wadji, UCT

Funding: CSIR, UCT

Background

South Africa is becoming increasingly reliant on information and communications technology (ICT) to provide access to information and services. A significant risk of using ICT to connect communities is greater exposure to cybercrime and an evolving number of increasingly sophisticated threats against personal and confidential information of organisations and individuals. Cybercrime costs South African companies around R5.8 billion a year, which equal to 0.14% of the country's GDP. Cybercrime constitutes a wide spectrum of illegitimate activity such as unlawful access to personal or sensitive information on networked computer systems, which may lead to financial loss and identity theft, fraud, and extortion. Research on the prevention of cybercrime has led to the commercialisation of network intrusion detection technology. This technology consists of hardware and software systems that are deployed in a computer network to monitor network traffic, in order to detect intrusions in an automated fashion. If an intrusion is detected in its early phases, it may be blocked before the confidentiality or integrity of information is compromised.

Current network intrusion detection technology has limited accuracy in detecting previously unobserved or emerging security threats. Specifically, anomaly-based systems for detecting these unknown threats exhibit unacceptably high false positive rates when deployed in real life networks. This characteristic of anomaly detection systems limits their usefulness and is a barrier towards their widespread deployment.

Response

The CSIR started a project in 2013 to address the shortcomings of existing network intrusion detection technology. The goal of this project is to create more reliable and accurate algorithms for detecting unknown threats to computer networks through multidisciplinary research, as well as to develop and commercialise a technology that incorporates these algorithms. Initial work on this project has resulted in the development of a prototype system that can be deployed throughout a network and that detects threats in real time by scanning for unusial or unexspected network traffic patterns.

The CSIR, in collaboration with UCT, is continuing the research work. The research involves the application of advanced signal processing techniques to develop a range of detectors that operate in synergy to suppress false positives, thereby improving the performance of the prototype system that was developed at the CSIR.

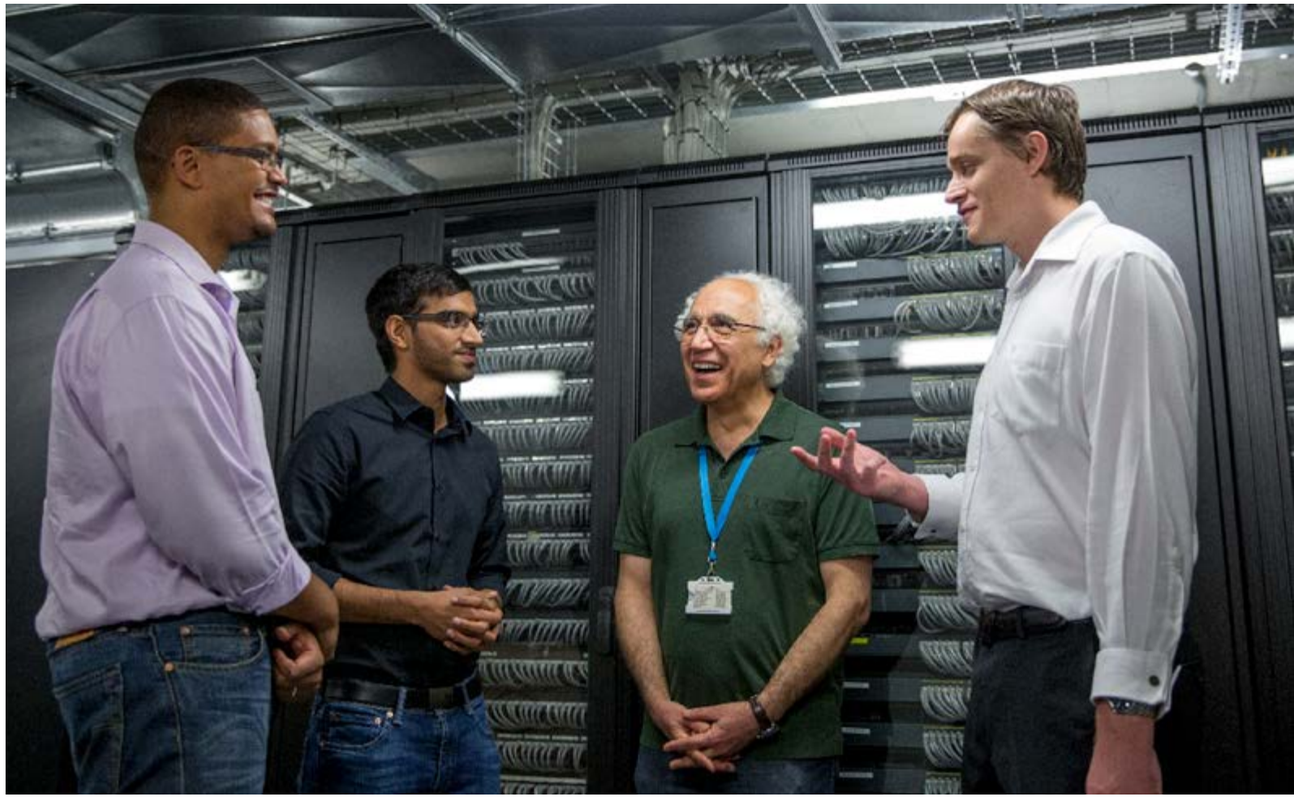
Progress

Multiresolution signal processing techniques has potential in suppressing false positives during anomaly detection. Two technical workshops on the principles and application of wavelets were presented by UCT to staff from CSIR Modelling and Digital Science. These workshops were of significant value to the participants, as the subject is not part of undergraduate computer science or engineering curricula in general.

Future work

The research team is exploring opportunities for partnering with industry to further develop and commercialise the network intrusion detection system.

Outputs
Prototype – 1



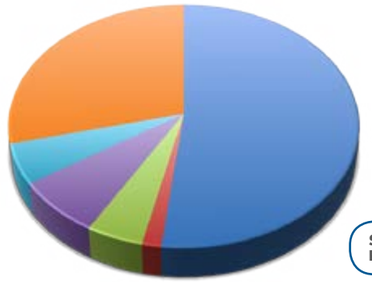
Human capital development

Overview

Between 2013 and 2015, 41 Masters, 36 Phd and 4 Honours students were funded to study at UCT through the CSIR studentship and CSIR/ UCT scholarships programme. The qualifications were mainly in engineering, oceanography and medical sciences. Thirty-seven of these have graduated. Most of the staff and students studying were supervised jointly by CSIR and UCT researchers.

Main fields of study of CSIR staff and CSIR/UCT scholarship students

The complementary capabilities of the CSIR and UCT enable research programmes to be performed effectively. The university has over 150 NRF-rated researchers in the areas of collaboration contained in the MoU, mainly in biosciences and the natural environment.



Selected areas of research of NRF-rated researchers at UCT

The university has also been awarded several research Chairs, including SARChI Chairs in biosciences, natural resources and the environment, ICT, defence and security, materials science and manufacturing and renewable energy. These Chairs, together with other researchers in centres of excellence, as well as in various departments and schools, demonstrate the capacity of the university to undertake leading research.

UCT SARChI Chairs in:

- Brain imaging
- Lung infection & immunity in poverty related diseases
- Clinical neurosciences research
- Cancer biology
- Functional proteomics (molecular biology)
- Vaccinology
- Dermatology and toxicology
- Biomedical engineering and innovation
- Systems biology
- Security & justice
- Astrophysics & space physics
- Extragalactic multi-wavelength astronomy
- Physical cosmology
- Scientific computing
- Industrial computational fluid dynamics
- Computational mechanics
- Mineral beneficiation
- Reaction engineering
- Nano-materials for catalysis
- Mineral law in Africa
- Climate change
- Oceanic circulation in the Agulhas Regime
- Econometric modelling
- Marine ecology and fisheries
- Environmental & social dimension of bio-economy
- Stable isotopes in archaeology & palaeoennvironmental studies
- Animal evolution and systematics

CoE in:

- Catalysis (gas liquid fuel)
- Biomedical tuberculosis research
- Biodiversity conservation

Biomedical Translational Research Initiative

The Biomedical Translational Research Initiative (BTRI) is a new initiative by the CSIR and the UCT, with support from the Department of Science and Technology. Its aim is to bring scientists from a number of institutions to work with each other to support translational research. The proposed translational research would advance cutting edge gene-based therapies, treatments, diagnostics, training, education, and lead to job creation for scientists in South Africa.

This initiative brings together complementary capabilities between the two institutions in the biomedical field research. The CSIR has a portfolio of world class basic and applied biomedical research and associated intellectual property. The UCT at its Institute of Infectious Disease and Molecular Medicine (IDM) has strong competencies in systems medicine. The research laboratories at UCT's IDM conduct cutting edge discovery research in systems medicine. Systems medicine aims at a measurable improvement of patient health through systems-based approaches and practice.

Complementary to that, is the CSIR's Synthetic Biology competence. Synthetic Biology bridges the gap between systems medicine and translational medicine. Synthetic biology has more emphasis on the discovery, testing and validation/verification, and ultimately, development and implementation of novel interventions, treatments and therapies. In a translational research setting, Synthetic biology pursuits are more generally geared towards personalized treatments and interventions.

This initiative will in due course also engage South African and international industry parties and other relevant medical schools to broaden its reach and potential impact.

Dr Musa Mhlanga, CSIR

Testimonials

Ketumetsi Mabelebele is a Master of Commerce student in Information Systems. Her research is on the adoption of the Capability Maturity Model Integration (CMMI) to improve software process Improvement in South Africa.

The research is important because technology, specifically software, plays a crucial role in the business operations of many organisations. It helps to leverage competitive advantage. However, in South Africa, the lack of software quality standards, like the CMMI, is one of the causes of the uncompetitiveness of the South African software industry. As a result, many organisations have realised that, they should invest in software process improvement to enhance their competitiveness in product quality and productivity, as well as maximise their profits.

The benefits of research will be consistent delivery, cost-saving and self-improvement. Companies will be able to use CMMI to differentiate themselves locally, which will make them more competitive.

Sherazaan Ismail is a BSc Honours student in Medical Sciences in Infectious Disease and Immunology with a focus on HIV transmission and pathogenesis. About 70% of the global burden of HIV is carried by individuals in sub-Saharan Africa, with women in the region being the most affected. Consequently, strategies that will allow women to control their protection from acquiring HIV are needed. One such intervention is the use of microbicide gels containing ARVs (such as tenofovir) as pre-exposure prophylaxis. No ARV microbicide has been shown to be completely effective. However, the Centre for the AIDS Programme of Research in South Africa (CAPRISA) has demonstrated an overall efficacy of 39% of a 1% tenofovir gel formulation in reducing HIV acquisition in women.

A follow-up study showed that women who became infected despite the use of tenofovir, had higher viral loads over time. Studies in host and viral characteristics, which allowed the drug barrier to be circumvented, are therefore crucial in order to inform drug design. Additionally, viral and host factors at the time of transmission, which may have contributed to a more severe disease outcome, need to be understood. Sherazaan investigated the role of the HIV Envelope protein as an underlying factor for increased viral load over time in the tenofovir arm of the CAPRISA 004 trial. She is currently continuing this research towards her MSc degree in Medical Virology.

Supervised post graduate research

Evaluation of the competitive performance of an indigenous eicosapentaenoic acid producing microalgal isolate

Monique Smit, CSIR • ***Supervisors:*** *Dheepak Maharajh, CSIR* • *Dr Robert van Hille, UCT*

Background

Omega-3 fatty acids, which are sold predominantly as fish oil concentrates, have positive effects on the brain, as well as cardiovascular function. This source of Omega-3 is unsustainable because of diminishing fish stocks in open waters. To mitigate long-term fish depletion, the cultivation of edible fish through aquaculture should become a priority. However, fish produced through aquaculture will not contain Omega-3 fatty acids if feed containing fatty acids is not a part of their diet.

Microalgae are of interest with regard to the production of Omega-3 fatty acids because they are the ultimate de novo source of Omega-3 fatty acids. Microalgae are an ideal alternative to fish oil, as well as a source of Omega-3 fatty acids for cultivated fish when they are used as feed.

South Africa has a large potential to commercialise microalgal technology, due to its biodiversity and climate. Over 750 microalgal isolates have been collected throughout the country and are kept at the CSIR, Durban University of Technology and the University of Cape Town.

Response

The study investigated whether or not a locally selected isolate was more suitable for Omega-3 fatty acid production in an open raceway pond than a commercial isolate. The biomass, Omega-3 fatty acid production, as well as response to reactor configuration and process conditions were studied to assess the potential to further scale up the bioprocess.

Progress

A literature review identified six potential species of Omega-3 producing candidates and an initial experimental analysis indicated that *Phaeodactylum tricornutum* was a suitable control species against which to compare the locally selected isolate with regard to biomass and Omega-3 production. Average specific growth rate and Omega-3 fatty acid productivity were higher for P. tricornutum than for the chosen CSIR species (WCA 23.2).

Selected environmental factors, such as pH and different nutrient regimes were chosen to study the effect on growth rate, biomass production and Omega-3 production under laboratory conditions. The effects of pH control under maintained nutrient conditions were also tested. All studies were subjected to a period of nutrient deficiency to assess the effect on Omega-3 induction.

The pH studies resulted in similar average specific growth rates for both species under pH controlled compared to uncontrolled conditions. Omega-3 productivity was negatively affected for both species in the absence of pH control, where the pH increased to above pH 9.4. For the pH studies, there was no observed increase in Omega-3 content under nutrient deficient conditions. Subsequent experiments were performed with the pH controlled at pH 8.3 to ensure optimal biomass and specific Omega-3 production.

To evaluate the impact of different nutrient addition regimes at a chosen pH, cultures were supplied with the

same amount of nutrients where (1) the batch culture had all the nutrients supplied at the start and (2) a fed-batch regime where smaller amounts of nutrients were supplied every second day. Average specific growth rates were similar for both species under batch and fed-batch conditions. Specific Omega-3 productivities, however, were higher for both cultures when cultivated under the batch conditions.

To assess the impact of scale-up, biomass and specific Omega-3 production were assessed in an open raceway pond system where species were cultivated, in duplicate, under batch conditions at a pH of 8.3, relying on the environmental temperatures and natural sunlight. Biomass productivities for both cultures were significantly lower when compared to the productivities from the laboratory scale studies.

While the locally selected isolate had a lower specific Omega-3 production rate, it was quicker and easier to harvest.

The experimental data indicated that Omega-3 productivity was higher in P. tricornutum than WCA 23.2, under the conditions tested. However, the ease of biomass recovery and regulatory advantages associated with using an endemic species mean that a more thorough economic evaluation is required to draw a definitive conclusion.

Outputs

Student trained – 1 MSc
Book chapter – 1

Medicinal plants for diabetes

Prenitha Sewnarain, CSIR • Supervisors: Prof Pete Smith, UCT • Dr Christo Muller, MRC

Background

Plants have always been an important source of drugs such as morphine, quinine and metformin. During the last 20 years, there has been a resurgence of interest in herbals as self-medication remedies in the Western world. Although Southern Africa contains approximately 10% of the world's plant diversity, little work has been done on the medicinal plants from this region partly due to loss of traditional knowledge. Modern extraction and separation techniques are valuable in isolating pure compounds that can be applied against biological activities. Phytochemical research has advanced with several groups from academia and industry actively involved in screening programmes for wide-ranging plant activities.

Diabetes currently affects 246 million people throughout the world. In some of the poorest regions like Africa, diabetes cases are expected to increase substantially by 2030. Treatment of diabetes and its associated complications places an enormous burden on health services. Therefore, there is an urgent need for novel, non-cytotoxic, inexpensive and effective drugs to combat the spread of the disease.

Currently, there is no cure for Type 1 Diabetes (T1D). T1D patients produce little or no insulin. In Type 2 diabetes (T2D) patients, the pancreas continues to manufacture insulin which, however, does not work effectively, resulting in the accumulation of glucose in the blood. In response to the increasing insulin resistance, beta cells temporarily produce increased amounts of glucose resulting in abnormally high levels of blood insulin. However, diabetes left untreated can lead to debilitating complications, particularly damage of the eyes, kidneys, feet, cardiovascular system, as well as death.

Response

The increasing reliance on drugs from natural sources has led to the development of several drugs from traditional plants that are abundant in Southern Africa. The rapid increase in the incidence of T2D in South Africa makes alternative therapeutics a priority. In the last few decades there have been changes to healthcare. Traditional medicine is a parallel system to conventional Western healthcare in Africa, just as complementary medicine is in Europe and America. The high cost of conventional Western medicine in most African countries has resulted in the investigation of alternative ways of managing illnesses. Traditional medicine, which has always been practised in the indigenous cultures, is increasingly being used.

Progress

This study investigated a medicinal plant that is indigenous to South America, but found in other parts of the world like Mexico, Africa, Southern Arizona and Texas. The aim is to identify and isolate the active ingredient responsible for enhancing glucose uptake *in vitro* and lowering blood glucose levels in streptozotocin - induced diabetic rats. Screening of the plant extract and its isolated active fractions/compound for antidiabetic activity in *in vitro* and *in vivo* assays will validate its use for diabetes. This could potentially provide a cheap and easily available alternative to help control blood glucose levels for people with low incomes. The mode of action studies will help identify the key molecular mechanisms responsible for antidiabetic activity. The pharmacokinetic study will conclude the investigation by examining the bioavailability of the active ingredient. Medicinal plants could be a potential treatment for diabetes, as well as a source of new chemical entities for the pharmaceutical industry.

A novel vizualisation for optimization of parallel programmes

Mabule Samuel Mabakane, CSIR • Supervisor: Prof Michelle Kuttel, UCT

Background

Visualization tools are useful for profiling and analysing parallel programmes running on different supercomputing architectures such as distributed memory systems, shared memory machines and vector computers. Researchers use parallel programmes, to perform different calculations simultaneously and share resources within the supercomputers.

Many common parallel programmes do not fully utilise computational resources, such as memory and processors, within the supercomputer. The performance of these parallel applications is mainly affected by factors such as limited network bandwidth, the uneven distribution of message passing, slow read/write operations in storage, improper logic of the parallel code, high memory latency and processor utilisation in the execution nodes of the parallel systems. The programmes written using general programming technologies must usually be optimized to perform well on specific parallel architectures.

Response

The purpose of this study is to develop visualisation techniques that will be used to optimise the parallel execution of programmes and enable the full utilisation of computational resources within the parallel computers. The research will develop an effective callgraph visualisation system that will enable users to efficiently identify performance bottlenecks in parallel programmes.

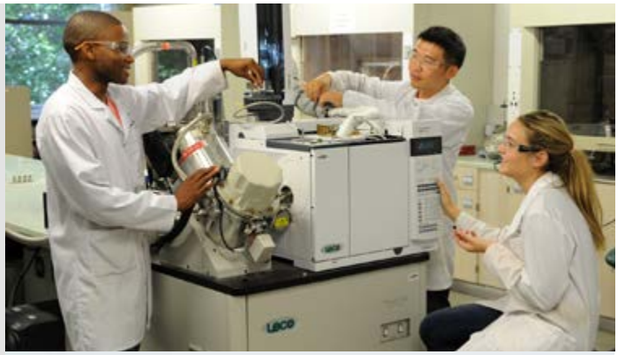
Progress

The study has produced four new different callgraph visualizations using JavaScript Library, namely expandable tree, none expandable tree, expandable star and collapse star visualizations.

The visualisations were tested at the University of Tennessee. The results of the tests were positive and will be used to develop the final callgraph visualization system which will help parallel programme users to quickly optimise scientific programmes running on supercomputing systems.

The purpose of this study is to **develop visualisation techniques** that will be used to **optimise the parallel execution of programmes** and **enable the full utilisation of computational resources** within the parallel computers.

Our complementary **capabilities** and **resources** contribute to **developing the skills** of **young and emerging researchers** who make a **critical contribution** to the Sout African **economy**.



Detailed indicators of collaboration

Collaborative research projects implemented

CSIR researchers	UCT researchers	Name of project	2013	2014	2015	Research area
Dr Hilda Chikwanda; Pierre Rossouw; Dr Sagren Govender	Prof Robert Knutsen	Physical metallurgy of titanium	•	•	•	Advanced manufacturing
Dr Hilda Chikwanda; Dr Silethelwe Chikosha		Consolidation of CSIR Ti powder into mill products		•	•	
Prof Francois Engelbrecht	Prof Bruce Hewitson	Future resilience for African cities and lands		•	•	Natural environment
Dr Emma Archer van Garderen; Prof Francois Engelbrecht		ACCESS climate change theme		•	•	
		SASSCAL climate change theme		•	•	
Prof Willem Landman; Prof Francois Engelbrecht; Dr Emma Archer van Garderen		ACCESS climate variability theme		•	•	
		SASSCAL climate variability theme		•	•	
Dr Sandy Thomalla	Prof Marcello Vichi; Dr Sarah Fawcett	Understanding the biogeochemical response to physical drivers in the Southern Ocean using bio-optics		•	•	
Dr Sebastiaan Swart	Prof Marcello Vichi	Surface ocean physical dynamics of the Southern Ocean		•	•	
Dr Pedro Monteiro	Prof Chris Reason	Scale sensitivities of CO_2 fluxes in the Southern Ocean		•	•	
Dr Patrick O'Farrell	Pippin Anderson	ACCESS			•	
Dr Rebecca Garland; Dr Caradee Wright	Andrea Rother; James Irlam	Health risks of chemicals and sun exposure among outdoor workers in a changing climate in South Africa	•	•		
Dr Julia Mambo; Dr Emma Archer van Garderen; Dr Bob Scholes; Willem Landman; Prof Francois Engelbrecht; Alize le Roux; Elsona van Huysteen; Dr Belinda Reyers; Dr Luthando Dziba; Pierre de Wet; Daleen Lotter; Claire Davis; Tirusha Thambiran; Thamsanqa Mzinyane	Prof Bruce Hewitson; Dr Chris Jack; Lisa Coop; Anna Steynor; Ruwani Walawege; Dr Chris Lennard; Dr Peter Johnston; Dr Babatunde Abiodun; Dr Piotr Wolski; Olivier Crespo; Kate Sutherland; Dr Joe Daron; Dr Ross Blamey	Risk and vulnerability Atlas	•	•		Natural environment
Dr Bob Scholes; Marc Pienaar	Bruno Merven	IkusaSA: Energy modelling component	•	•		Biosciences
Dr Raj Lalloo	Prof Vernon Coyne	Industrial biologics	•	•		
Dr Dashnie Naidoo	Prof Nonhlanhla Khumalo	Cosmeceuticals	•	•		
Dr Busi Vilakazi	Dr Olufunke Alaba	Economic impact of umbiflow™ fetal umbilical blood flow velocity doppler system at primary health level		•	•	
Dr Makobetsa Khati	Prof Jonathan Blackburn	Point-of-care aptamer based diagnostic	•	•	•	
	Prof Keertan Dheda	TB diagnostic	•	•	•	
	Prof Bongani Mayosi	HIV prevention aptamers	•	•	•	
Dr Musa Mhlanga	Professor Frank Brombacher	Bacteria-host interaction and HIV micro RNA screening	•	•	•	
Dr Gerda Fouché	Prof Kelly Chibale	Natural product development (BP21)	•	•		
Dr Colin Kenyon		Creation of a national repository of extracts, semi purified fractions and compounds	•	•	•	
Dr Dalu Mancama		MMV-SAMI screening programme	•	•		
David Morrison; Dr Lucia Steenkamp	Prof Edward Sturrock	Expression of PAM in Yarrowia		•	•	
Dheepak Maharajh	Prof Sue Harrison	Algal database		•	•	
Dr Tsepo Tsekoa	Prof Edward Rybicki	Plant production systems		•	•	
Dr Justin Jordaan; Dr Dusty Gardiner; Henriette Hobbs; Fezile Khumalo	Prof Jonathan Blackburn; Prof Keertan Dheda; Prof Edward Rybicki	Next generation microsphere technology		•	•	
Andre McDonald	Prof Alireza Baghai-Wadji	Network intrusion detection		•	•	Defence & security

Joint publications resulting from supervised and joint research

Authors	Title of paper	Publication
Peer-reviewed journal articles		
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Keet CM; Ongoma EAN	Temporal Attributes: Their Status and subsumption	Australasian Computer Science Week, Sydney, NSW, Australia,27 - 30 January 2015, pages: 61-70, Jan 2015
Engelbrecht J; Inggs M	Coherence optimisation and its limitations for deformation monitoring in agricultural regions	IGARSS 2015, Milan, Italy, July 26-31 2015, pages: 1429-1432, Jul 2015

Coetzee L; Smith A; Rubalcava AE; Corici AA; Magedanz T; Steinke R; Catalan M; Paradells J; Madhoo H; Willemse T; Mwangama J; Mukudu N; Ventura N; Barros M; Gavras A	TRESCIMO: European Union and South African smart city contextual dimension	2015 IEEE 2nd World Forum on Internet of Things (WF-IoT) 2015, Milan, Italy, 14-16 December 2015, 7pp, Dec 2015
Melebari A; Mishra AK; Abdul Gaffar MY	Comparison of square law, linear and bessel detectors for CA and OS CFAR algorithms	2015 IEEE Radar Conference, Johannesburg, 28-30 October 2015, pages: 383-388, Oct 2015
De Villiers J; Jermy R; Nicolls F	A study on the effect of different image centres on stereo triangulation accuracy	Proceedings of the 2015 Pattern Recognition Association of South Africa and Robotics and Mechatronics International Conference (PRASA-RobMech), 26-27 November 2015, Port Elizabeth, pages: 24-29, Nov 2015
Hamann R; Faccer K; Methner N; Herbstein T	Systemic engagement: How and why companies become agents of positive change for social-ecological resilience	74th Annual Meeting of the Academy of Management, 1-5 August 2014, Philadelphia, USA, Aug 2014
Pandelani T; Reinecke JD; Sono TJ; Ahmed R; Beetge FJ; Nkosi P; Dicks P; Nurick GN	The design of a modified lower limb impactor to assess lower limb injury at typical blast loading rates	The 9th South African Conference on Computational and Applied Mechanics, Somerset West,10pp, 14-16, Jan2014
Mokgalaka H; Mans G; Smit J; McKelly D	Validating the accuracy of GIS-based accessibility analysis in determining public primary health care demand in Metropolitan areas	AfricaGEO 2014 Conference, Cape Town, 18pp, 1-3, Jul 2014
Ongoma EAN; Keet CM; Meyer T	Transition constraints for temporal attributes	27th International Workshop on Description Logics (DL2014), Vienna, Austria, pages: 684-695, 17-20, Jul 2014
Mangera R; Senekal F; Nicolls F	Cascading neural networks for upper-body gesture recognition	Proceedings of the International Conference on Machine Vision and Machine Learning, Prague, Czech Republic, 8pp, 14-15, Aug 2014

Khan ZC; Mashiane T	An analysis of facebook's graph search	Information Security for South Africa (ISSA), Sandton, 8pp, 13 -14, Aug 2014
De Villiers J; Nicolls F	A study on the sensitivity of photogrammetric camera calibration and stitching	2014 PRASA, RobMech and AfLaT International Joint Symposium, Cape Town, pages: 6pp, 27-28, Nov 2014
Khan ZC; Keet CM	Feasibility of automated foundational ontology interchangeability	Knowledge Engineering and Knowledge Management, 19th International Conference, EKAW 2014, Linköping, Sweden, 12pp, 24-28, Nov 2014
Engelbrecht J; Inggs M	Polinsar coherence optimisation for deformation measurement in an agricultural region	10th International Conference of African Association of Remote Sensing of the Environment, University of Johannesburg, 27 – 31, Oct 2014
Maasdorp FDV; Nadjiasngar R; Inggs MR	A Cramer Rao analysis on receiver placement in a FM band commensal radar system based on doppler only measurements	2014 International Radar Conference, Lille, France, 6pp, 13-17, Oct 2014
Liddiard A; Tapson J; Verrinder R	A robust implementation of the Spatial Pooler within the theory of Hierarchical Temporal Memory	IEEE Robotics and Mechatronics Conference, Durban, 30-31, Oct 2013
Govender N; Claassens J; Nicolls F; Warrell J	Active object recognition using vocabulary trees	IEEE Workshop on Robot Vision, Tampa, Florida, 16-18 Jan 2013
Janse van Rensburg V; Mishra A; Nel W	Quality measures for HRR alignment based ISAR imaging algorithms	IEEE Radar Conference 2013, Ottawa, Canada, 29 April -3, May 2013
Manqele S; Dlodlo N; Mvelase P; Dlodlo M; Xulu SS; Adigun M	Selection and provisioning of services in a cloud using recommender systems approach for SMME	ZA-WWW 2013, Cape Town, Sep 2013
Bidwell NJ; Reitmaier T; Rey-Moreno C; Roro Z; Siya MJ; Dlutu B	Timely relations in rural Africa	12th International Conference on Social Implications of Computers in Developing Countries, Ocho Rios, Jamaica, May 2013
Govender N; Warrell J; Torr P; Nicolls F	Probabilistic object and viewpoint models for active object recognition	IEEE Africon 2013, Mauritius, 9-12, Sept 2013

De Villiers J; Cronje J	Improved real-time photogrammetric stitching	SPIE Defense Security and Sensing 2013, Baltimore, Maryland, USA, April 2013
Ogunleye OS; Van Belle JP	Enhancement in M-Government and mobile computing in developing countries	IEEE ICAST 2013, CSIR, Pretoria, 25-27 November 2013, 6pp, Nov 2013
Tong C; Inggs M; Maasdorp F	Performance improvements using the separated reference configuration in a multi-site commensal radar system	Radar 2013 International Conference, Adelaide, Australia, 9-12 September 2013, pages: 224-229, Sep 2013
Ebrahim-Trollope R; Durrheim RJ; Smith G	Measuring the size of mining-induced earthquakes: a proposal	Proceedings of the 13th SAGA Biennial and 6th AEM Conferences, Skukuza, 6-9 October 2013, 5pp, Oct 2013
Liddiard A; Tapson J; Verrinder R	A robust implementation of the Spatial Pooler within the theory of Hierarchical Temporal Memory	IEEE Robotics and Mechatronics Conference, Durban, 30-31 October 2013, pages: 4pp, Oct 2013
Chapter in book		
Govender N; Warrell J; Keaikitse M; Torr P; Nicolls F	Probabilistic active recognition of multiple objects using Hough-based geometric matching features	New Development in Robot Vision, Vol. 23 Cognitive Systems Monographs pages: 89-109, Jan 2015
Ogunleye OS; Van Belle J-P	Scalability and sustainability of M-government projects implementation in developing countries	Emerging Mobile and Web 2.0 Technologies for Connected E-Government, pages: 180-202, May 2015
Krug M; Cipollini P; Dufois F	Observing the Agulhas Current with sea surface temperature and altimetry data: challenges and perspectives	Remote Sensing of the African Seas, pages: 233-249, Jun 2014
Book		
Napier M; Berrisford S; Wanjiku Kihato C; McGaffin R; Royston L	Trading places: accessing land in African cities	African Minds for Urban Landmark, pages: 144, Oct 2013

CSIR staff studying

Name of CSIR Staff	Degree programme	CSIR supervisor	UCT supervisor	2013	2014	2015
Monique Smit*	MSc (Bioprocess Engineering)	Dheepak Maharajh	Dr Rob van Hille	•	•	
Prenitha Sewnarain	PhD (Pharmacology)	Dr Vinesh Maharaj	Prof Peter Smith	•	•	•
Hester Catharina (Therese) Stark*	PhD (Molecular Biology)	Dr Rachel Chikwamba	Prof Edward Rybicki	•		
Matsopiane Charlotte Maserumule*	MSc (Medical Science)	Dr Lionel Gresh	Prof Keertan Dheda	•		
Fezile Khumalo	PhD (Medical Biochemistry)	Dr Justin Jordaan	Prof Jonathan Blackburn	•	•	•
Henriette Hobbs	PhD (Medical Biochemistry)			•	•	•
Grace Mothepane London*	PhD (Medical Science)	Dr Makobetsa Khati	Prof Bongani Mayosi	•		
Jerolen Naidoo	PhD (Cell Biology)	Dr Musa Mhlanga	Prof Frank Brombacher	•	•	•
Loretta Magagula*	MSc (Cell Biology)			•	•	
Jane Hewitson#	PhD (Electrical Engineering)	Dr Colin Wright	Prof Michael Inggs	•	•	
Samuel Mabakane	PhD (Computer Science)	None	Prof Michelle Kuttel	•	•	•
Lindelwe Manqele*	MEng (Electronic Engineering)	Dr Louis Coetzee; Dr Quentin Williams	Prof Mqhele Dlodlo	•	•	
	PhD (Electronic Engineering)					•
Samuel Ogunleye	PhD (Information Systems)	Dr Quentin Williams	Prof Jean-Paul van Belle	•	•	•
Boroto Hwabamungu*	PhD (Information Systems)		Prof Irwin Brown; Prof Wallace Chigona	•	•	
Hunadi Mokgalaka *	MSc (Geomatics Engineering)	Gerbrand Mans	Prof Julian Smit	•	•	
Claire Davis*	MSc (Botany)	Dr Wesley Roberts	Prof Timm Hoffman	•		

Johanna Magdalena Lotter	PhD (Geography)	Dr Emma Archer van Garderen	Dr Mark Tadross	•	•	•
Emma Bone	PhD (Oceanography)	Dr Stewart Barnard; Dr Sandy Thomalla	Dr Howard Waldron	•	•	•
Alecia Nickless	PhD (Applied Science)	Dr Bob Scholes	Dr Peter Raner; Dr Birgit Erni; Prof Les Underhill	•	•	•
Nomkwezane Kobo	PhD (Earth Systems Sciences)	Dr Pedro Monteiro	Dr Steven Herbette; Prof Chris Reason	•	•	•
Precious Mongwe*	MSc (Ocean & Climate Dynamics)		Dr Howard Waldron; Prof Marcello Vichi	•	•	
	PhD (Ocean & Climate Dynamics)					•
Alfred Bogaers	PhD (Mechanical Engineering)	Dr Schalk Kok	Prof Daya Reddy	•	•	•
Ndivhuwo Makondo*	MSc (Electrical Engineering)	Dr Nkgatho Tlale	Prof Martin Braae	•		
Sisa James*	MSc (Electrical Engineering)	Ali Shahdi; Deon Sabatta	Robyn Verrinder	•	•	
Francois Maasdorp	PhD (Electrical & Electronic Engineering)	None	Prof Michael Inggs	•	•	•
Hendrik Jan de Wind#	MEng (Electronic Engineering)	Jacques Cilliers	Prof Michael Inggs	•	•	
Richard Focke	PhD (Electrical Engineering)	None		•	•	•
Richard Van Schalkwyk*	MEng (Electronic Engineering)	None		•		
Sulayman Salie	MEng (Electrical Engineering)	Willie Nel	Dr Amit Mishra	•	•	•

Umur Kathree*	MEng (Electrical Engineering)		Prof Michael Inggs	•	•	
Vanessa Janse van Rensburg*	MEng (Electrical Engineering)	None	Prof Michael Inggs	•		
Willem Nel	PhD (Electrical & Electronic Engineering)	None	Prof Michael Inggs	•	•	•
Asheer Bachoo*	PhD (Electrical Engineering)	None	Dr Fred Nicolls	•	•	
Jason de Villiers*	PhD (Electronic Engineering)	None		•	•	
Thanyani Pandelani *	MSc (Bioengineering)	Dr Tleyane Sono	Prof Gerald Nurik	•	•	
Jacques van Tonder*	MBA	None	None	•		
Lambert de Wet*	MBA	None	None	•		
Andrish Reddy	PhD (Biotechnology)	Dr Justin Jordaan	Dr Deon Bezuidenhout	•	•	•
Josiah Jideani*	MSc (Electrical Engineering)	None	Prof Andrew Wilkinson	•		
Kyriacos Eftychiou Nicolaides	MEng (Electrical Engineering)	Dr Philip Loveday	Prof Andrew Wilkinson	•	•	•
Nokuthula Zama	M (MPhil)	None	Prof Anton Schlechter		•	•
Israel Tshililo	MSc (Electrical Engineering)	Prof Catherine Cress	Dr Simon Winberg		•	•
Matthew Cawood*	MSc (Electrical Engineering)		Prof Michael Inggs		•	•
Phethedi Joshua Kekana	MSc (Chemical Engineering)	Dr Njabulo Siyakatshana	Dr Aubrey Mainza		•	•
Ndivhuwo Musehane	MSc (Applied Mathematics)	Dr Oliver Oxtoby	Prof Daya Reddy		•	•
Abubaker Jaffer#	MEng (Electrical Engineering)	None	None		•	•
Dembe Nenzhelele	MEng (Electrical Engineering)	Francois Maasdorp	Prof Daniel O' Hagan		•	•

Kaveer Manickchand	MSc (Electronic Engineering)	Jurgen Strydon	Dr Amit Mishra		•	•
Unathi Petros	MPhil (Inclusive Innovation)	Prof Thembela Hillie	Prof Geoff Bick			•
Dave Morrison	PhD (Medical Biochemistry)	Dr Lucia Steenkamp	Prof Edward Sturrock		•	•
Mthetho Sovara	PhD (Physical Oceanography)	Dr Francois Englebrecht	Prof Chris Reason		•	•
Benon Kagezi	MBL	None	None			•
Brenwen Ntlangu	MSc (Electrical Engineering)	Andre McDonald	Prof Alireza Baghai-Wadji			•
Natasha Govender	PhD (Electronic Engineering)	None	Dr Fred Nicolls			•
Zubeida Dawood	PhD (Computer Science)	None	Dr Maria Keet		•	•
Ernest Mngomezulu	MEng (Electronic Engineering	Louis Botha	Prof Daniel O' Hagan			•
Kgothatso Mahlaole	MEng (Electronic Engineering)	None				•
Thabang Matladi	PhD (Electronic Engineering)	Jacques Cilliers				•
Vusumzi Taliwe	MSc (Electrical Engineering)	Dr Jacobus Vlok	Prof Mqhele Dlodlo			•
Dean Aucamp	MSc (Electronic Engineering)	None	Dr Fred Nicolls		•	•

*= graduated # = left CSIR/no longer studying

Students supported by the scholarship programme

Name of student	Degree programme	2013	2014	2015
Vezi Mfundo*	MEng (Civil Engineering)	•		
Bianca Amos-Brown*	PhD (Biochemistry)	•	•	•
Buchule Mbobo*	BSc Honours (Molecular & Cell Biology)	•		
Hapiloe Maranyane*	PhD (Biochemistry)	•		
Lerato Majara*	MSc (Medical Microbiology)	•	•	
Shaun Garnett*	PhD (Biochemistry)	•	•	
Simon Broadley*	PhD (Clinical Laboratory Sciences)	•	•	•
Sherazaan Ismail*	BSc Honours (Infectious Disease)	•	•	
Dylan Brown*	MSc (Computer Science)	•	•	•
Neal Derman*	MSc (Biomedical Engineering)	•	•	
Ketumetsi Mabelebele*	MSc (Information Systems)	•	•	
Roxane Mohunlal*	MSc (Chemistry)	•	•	
Sumayah Salie*	PhD (Clinical Science & Immunology)	•	•	•
Elisabeth Lain*	PhD (Oceanography)	•	•	
Sarah-Anne Nicholson*	PhD (Oceanography)	•	•	•
Kehilwe Nakedi	PhD (Medical Biochemistry)			•
Sibusisiwe Maseko	MSc (Medical Biomaterials)			•
Jason Hlozek	BSc Honours (Computer Science)			•
Koketso Molepo	BSc Honours (Environmental & Geographical Science)			•

*= graduated

CSIR researchers lecturing/supervising students

Name of researcher	Type of collaboration	2013	2014	2015	Research area
Chris Elphinstone	Supervising	•	•	•	Built environment
Gerbrand Mans		•	•		
Andre McDonald	Supervising	•	•	•	Modelling
Dr Nkgatho Tlale		•			
Dr Njabulo Siyakatshana			•	•	
Dr Schalk Kok		•	•		
Dr Anwar Vahed	Supervising Examining	•	•	•	Information & communication technology
Anton Lopis	Supervising	•	•	•	
Dr Bruce Becker		•	•	•	
Chris Burger		•	•	•	
David Johnson	Lecturing, Supervising	•	•	•	
Jeanine Engelbrecht		•	•	•	
Dr Keith Ferguson	Supervising	•	•	•	
Dr Tommie Meyer		•	•	•	
Dr Quentin Williams		•	•	•	
Dr Colin Wright		•	•	•	
Dr Louis Coetzee		•	•	•	
Dr Catherine Cress			•	•	
Dr Frans Van den Berg				•	
Dr Sally Archibald				•	
Dheepak Maharajh	Supervising	•	•		Biosciences
Dr Vinesh Maharaj		•			
Dr Rachel Chikwamba		•			
Dr Lionel Gresh		•			
Dr Justin Jordaan		•			
Dr Makobetsa Khati		•			
Dr Musa Mhlanga		•	•	•	
Dr Lucia Steenkamp			•	•	
Dr Wesley Roberts	Supervising	•			Natural environment
Dr Emma Archer van Garderen		•	•	•	
Dr Stewart Barnard		•	•		
Dr Sandy Thomalla		•	•	•	
Dr Rebecca Garland		•	•		
Dr Bob Scholes		•			
Dr Pedro Monteiro		•	•	•	
Dr Francois Englebrecht			•	•	
Hein Moller	Supervising	•	•		Advanced manufacturing
Dr Philip Loveday		•			
Prof Thembela Hillie				•	
Louis Botha	Supervising			•	Defence & security
Dr Jacobus Vlok				•	
Francois Maasdorp			•	•	
Jurgen Strydon			•	•	
Dr Oliver Oxtoby			•		
Jacques Cilliers		•	•		
Willie Nel		•	•	•	
Dr Tleyane Sono		•	•		
Dr Igle Gledhill				•	

CSIR researchers holding extraordinary professorships/ honorary research associates

Name of researcher	Area of expertise	2013	2014	2015
Dr Petro Monteiro	Environmental management	•	•	•
Dr Musa Mhlanga	Molecular biology	•	•	•

UCT researchers serving on CSIR advisory panels

Name of researcher	Area of expertise	2013	2014	2015
Prof Andrew Wilkinson	Sonar processing	•	•	•

NRF-rated researchers – Collaboration areas in CSIR/UCT MoU

Researcher rating	Name of researcher	Research specialisation	Area
Leading international	Prof ED Bateman	Pulmonology and Internal medicine	Biosciences
	Prof JM Farrant	Plant desiccation tolerance, Seed science, Medicinal plants - natural products	
	Prof G Gade	Invertebrates - neurobiology, physiology, taxonomy, Crustacean neuroendocrinology, Insect neuroendocrinology, Aquaculture, Separations/mass spectrometry, Insect neuropeptides	
	Prof R Wood	HIV and TB co-infection, TB - clinical aspects, HIV and AIDS	
	Prof HJ Zar	Paediatric pulmonology	
	Prof ML Solms	Neuropsychology	
	Prof DJ Stein	Magnetic resonance imaging, Behavioural pharmacology, Neurogenetics	
Internationally acclaimed	Prof TD Noakes	Exercise science, Nutrition	Biosciences
	Prof V Mizrahi	Anti TB drugs, Molecular mycobacteriology, Mycobacterial genetics, Mycobacterial physiology	
	Prof EP Rybicki	Virology, Computational virology, Biotechnology	
	Prof LH Opie	Cardioprotection	
	Prof RPA Abratt	Oncology and radiation oncology	
	A/Prof RR Ackermann	Human evolution, Human and primate anatomy, Evolutionary theory, Evolutionary biology and morphology	
	Prof PH Beighton	Medical genetics	
	Prof KI Barnes	Tropical infectious diseases, Antimalarial drugs, Health policy, Malaria control and Antimalarial compounds	
	Prof K Chibale	Drug discovery, Medicinal chemistry	
	Prof MR Collins	Molecular and cell biology, Medical biochemistry, Collagen, Collagen biochemistry, Human molecular genetics, Exercise biochemistry, Molecular biochemistry, Exercise physiology, Human physiology	
	Prof MR Caira	Solid state chemistry, Polymorphs, Cyclodextrins, X-ray diffraction, Inclusion compounds, Thermal analysis, Biomedical sciences	
	Prof LA Denny	Cancer of the cervix, Gynaecological cancer - prevention, Gynaecological cancer - diagnosis/ treatment, sexual violence	
	Prof KD Dheda	Pulmonology, TB	
	Prof TJ Egan	Bio-inorganic chemistry, Medicinal chemistry, Antimalarial compounds	
	Prof R Hunter	Medicinal chemistry, Organic chemistry - synthesis, Research methodology	
	Prof N Illing	Evolutionary biology, Developmental biology, Gene regulation, Computational biology	

Internationally acclaimed	Prof JP Hapgood	HIV pathogenesis, Stress - immunological response, Steroid receptors, Cellular immunology, Sexual and reproductive health, Cell signaling, Cell stress and chaperones, Gene regulation, Molecular and cell biology, Tissue culture	Biosciences
	Dr DP Martin	Bioinformatics, Virology	
	Prof EV Lambert	Obesity, Physical activity, Public health	
	Prof CM Gray	Cellular immunology, HIV	
	Prof HH Klump	Protein physical biochemistry, Nucleic acids, Biophysical chemistry	
	Prof A-L Williamson	Biomedical sciences, Vaccinology, Virology, Immunology	
	Prof C Williamson	HIV diversity, Pathogenesis and vaccines	
	Prof NJ van der Merwe	Bioarchaeology	
	Dr NP Steyn	HIV (Viruses) - Breast feeding, Food security, Health, Weight management, Organisational wellness, Internet technology, Employee health, Non-communicable disease of lifestyle, Health promotion and disease prevention	
	Prof ED Sturrock	Biomedical sciences, Medical biochemistry, Protein structure	
	Prof MF Jeebhay	Occupational health, Occupational allergy, Asthma	
	Prof MC Kew	Hepatology, Molecular biology, Virology, Carcinogenesis	
	A/Prof NJ Mulder	Bioinformatics, Biomedical sciences, Infectious diseases, Microbial genetics, Human genetics, Genomics	
	Prof JE Myers	Occupational health, Occupational medicine, Epidemiology	
	Prof PP Zilla	Heart valve disease, Vascular disease, Vascular and vein grafts, Tissue engineering and regeneration, Heart valve prostheses	

Internationally acclaimed	Dr SC Lecour	Cardioprotection	Biosciences
	A/Prof GA Meintjes	HIV and TB, HIV and Cryptococcal meningitis, Immune reconstitution inflammatory syndrome, Antiretroviral therapy	
	Prof K Sliwa-Hahnle	Cardiology	
	Prof PC Potter	Allergology, Immunology	
	A/Prof HM McIlleron	Anti TB drugs, Pediatric antiretroviral therapy	
	Prof DE McIntyre	Equity and health systems, Health care financing, Health economics, Health services - access, Health care resource allocation, Health systems, Health policy	
	Prof G Maartens	HIV and AIDS - Care, HIV and TB	
	Prof VA Russell	Neuroscience, Neurophysiology, Attention-deficit hyperactivity disorder, Effect of stress and exercise on the brain	
	Prof AL Rodgers	Biophysical chemistry, Physical chemistry, Bioanalytical chemistry, Clinical chemistry, Medical chemistry, Physiological chemistry, Analytical chemistry, Crystallization processes - In vivo	
	Prof AJW Millar	Paediatric trauma, Paediatric oncology, Transplantation of organs, tissues, etc., Paediatric surgery, Neonatology, Short bowel syndrome	
	A/Prof BT Sewell	Structural biology, Electron microscopy, Protein crystallography	
	Dr T Oelgeschläger	Gene regulation, Chromatin, RNA analysis, Transcriptional regulation, Transcription factors, Transcription, Protein biochemistry, Protein engineering, Histones and nuclear proteins, Protein structure-function relationship	
	Dr TA Moultrie	Fertility, Human, Fertility and HIV/AIDS, Population dynamics, Demography, Fertility levels and differentials, Mortality and fertility, Population studies	

Established	Prof VR Abratt	Gut microbiota, Pathogenesis, Virulence (Microbiology), Anaerobe bacteriology and host-pathogen interaction	Biosciences
	Dr MHY Badri	HIV and TB Epidemiology and Clinical Intervention	
	Dr D Bezuidenhout	Biomaterials, Biomimetics, Drug delivery (Controlled), Device research, Surface chemistry, Biocompatibility, Neovascularisation	
	Prof JM Blackburn	Microarray technology, Enzymology, Protein physical biochemistry, Protein engineering, Molecular evolution, Protein protein interaction, Molecular diagnostics, Protein chemistry, Proteomics	
	Dr DJ Blom	Lipid disorders	
	Dr PV Bruyns	Plant molecular systematics, Plant systematics, Taxonomy of African succulents, Plant morphology	
	Dr WA Burgers	Cellular immunology, HIV (Viruses), HIV and TB co-infection, Mucosal immunology, HIV vaccine, HIV pathogenesis	
	Dr GK Chege	HIV vaccine, Cellular immunology, Animal models for AIDS	
	A/Prof C Dandara	Pharmacogenomics, Pharmacogenetics, Cancer genetics, Drug metabolism, HIV and AIDS - patients, Gene regulation	
	Dr NH Davies	Biomaterials, Regenerative medicine, Angiogenesis, Cardiovascular research	
	A/Prof EC February	Biological Sciences, Environmental isotopes, Community ecology	
	A/Prof T Franz	Biomechanics, Regenerative medicine, Tissue engineering, Cardiovascular system, Computational mechanics, Computational modelling, Biomaterials, Myocardial ischaemia	
	A/Prof DW Gammon	Organic chemistry - synthesis, Carbohydrate chemistry	

Established	Prof LJHL Greenberg	Diseases-in-a-dish modelling using induced pluripotent stem cells (iPSCs), Translational genetics, Genetics of Neurodegeneration and late onset genetic diseases, Ophthalmic genetic research	Biosciences
	Dr DM Lang	Microscopy imaging, Confocal laser scanning microscopy, Histology, Cell culture, Animal development, Fluorescence microscopy, Immunohistochemistry, Invertebrate neurobiology, Neurophysiology, Cell biology	
	Dr FN Gumedze	Biostatistics	
	Dr II Hitzeroth	HPV Vaccines	
	Prof GE Jackson	Chemical speciation, Computational chemistry, Chemical thermodynamics, Biological nuclear magnetic resonance	
	A/Prof DS Jacobs	Evolutionary biology, Evolution and systematics, Evolutionary ecology, Animal behaviour, Animal diversity (Bats), Behavioural ecology, Comparative morphology	
	Dr M Jacobs	Infectious diseases	
	Prof SH Kidson	Stem cell biology, Developmental biology, Cell differentiation	
	Prof AG Morris	Human skeletal biology, Forensic anthropology, Fossil record of human evolution, African prehistory, History of biology/evolution	
	Dr VD Leaner	Cancer, Carcinogenesis	
	Prof ME Levin	Allergology and Paediatrics and child health	
	Prof NS Levitt	Diabetes and Endocrinology	
	A/Prof F Little	Medical statistics, Linear models (Statistics) and Applied statistics	
	Dr DR Shamley	Breast cancer - Latent effects of adjuvant therapies - long term surveillance	

	Prof AS Mall	Biochemistry - Mucus	Biosciences
	Dr HG Marco	Neuropeptides, Crustacea - Metabolism - regulation, Insects - Metabolism - regulation, Astaxanthin availability, Insect neuroendocrinology, Crustacean neuroendocrinology, Spiny lobsters - growth and development	
	A/Dr GA Verboom	Plant biosystematics, Evolutionary biology, Plant ecology	
	Dr DF Warner	Molecular mycobacteriology	
	A/Prof EM Meintjes	Neuroimaging, Magnetic resonance imaging, Neuroscience, Child development, Biomedical technology	
	Prof PN Meissner	Porphyrins, Porphyrias, Molecular aspects of liver disease	
	Dr PR Meyers	Actinomycetes, Isolation of actinomycetes, Antibiotics, Biosystematics, Molecular systematics, Streptomyces, Novel antibiotics, Antibiotic screening, Antimicrobial compound - Isolation and characterisation, Bacterial taxonomy	
	Dr H Segal	Molecular mechanisms of antibiotic resistance	
	Prof N Novitzky	Internal medicine, Paediatrics - clinical haematology	
	A/Prof EO Ojuka	Glucose transporter (Glut4), Mitochondrial biogenesis - Exercise, Nutritional physiology, Fructose consumption - health, Exercise biochemistry, Histone deacetylation - effect of exercise on, Exercise - physiological aspects, Insulin resistance	
	Dr IG Okpechi	Nephrology	

	Dr CJ Orrell	Medication adherence, Drug resistance, Clinical pharmacology	Biosciences
	Dr C O'Ryan	Population genetics, Behavioural genetics, Genotyping, Gene expression and regulation, Molecular phylogeny	
	Prof MI Parker	Molecular oncology, Gene regulation, Transcription factors, Gene expression profiling - Cancer cells, Drug development, Oesophageal carcinogenesis	
	Prof ZM van der Spuy	Reproductive medicine, Reproductive endocrinology - Clinical, Infertility, Obstetrics and maternal health, Women's health, Benign gynaecological conditions - Genetics, Contraception and interception	
	A/Prof S Prince	Transcription factors, Cell cycle regulation, Cancer research, Anti-cancer drugs, Gene expression profiling - Cancer cells, Cell signalling	
	Prof BL Rayner	Nephrology, Hypertension	
	Prof SJY Reid	Rural health services, Community-based research, AIDS	
	Dr KJ Sales	Gynaecological cancer - prevention, Cervical cancer - prevention, G protein-coupled receptors, Signal transduction	
	Dr SW Peterson	Physics - Applied radiation, applied nuclear, Experimental nuclear physics, medical, medical radiation, nuclear, computational, radiation physics, Monte Carlo methods	
Leading international	Prof BM Mayosi	Genetics	Defence & security
	Prof CD Shearing	Security, Governance	
Established	Prof GS Langdon	Materials and structures - impact and blast effect, Impact engineering	

Internationally acclaimed	A/Prof P Pillay	Electric machines, Machine design, Electrical motor drives, Renewable energy systems, Energy efficiency, Waste to energy	Energy
	Prof SM Perez	Nuclear physics	
	Prof CT Gaunt	Electrical transmission, Electricity supply, Power systems reliability, Electrification, Electricity distribution, Geomagnetism, Engineering management, Electrical tariff structure	
	Dr R Herman	Power systems reliability, Customer interruption cost assessment, Probabilistic mathematical modelling, Probabilistic analyses and design, Load modelling	
Established	A/Prof T Bello-Ochende	Fluid mechanics thermodynamics energy systems	
Established	A/Prof KA Folly	Power system stability, Power systems analysis, Power systems dynamics, Power systems optimisation, Power electrical engineering, Wind power, Renewable energy systems, Intelligent systems	Energy
	A/Prof MA Khan	Renewable energy, Wind power plants - Impact	
	Dr A Madhlopa	Energy engineering, Sustainable energy engineering	
Leading international	Prof AR Taylor	Observational radio astronomy, Big data, Astrophysics, Computational astrophysics	Astronomy
Internationally acclaimed	Prof V Brattka	Computable analysis	ICT
	Prof EH Blake	Human-computer interaction, Collaborative virtual environments, ICT - policies, user experience, ICT for development	
	Prof KJ Naidoo	Scientific computing including computational and theoretical chemistry	
	Prof O Ngwenyama	Software development, critical social theory, ICT for development, IS research methods	

Established	Prof ITJ Brown	Information systems	ICT
	A/Prof WMG Chigona	ICT - development	
	Prof ES Boje	Control engineering	
	A/Prof JE Gain	Computer graphics	
	A/Prof ME Kyobe	Information security, Information security governance, IT - Strategies, IT governance, IT law	
	Dr PC Marais	Computer graphics, Computer simulation, GPU computing, Pattern recognition and image processing, Computer vision	
	Prof JP van Belle	ICT for development, Emerging technologies, IT adoption	
	Prof P Moyo	Signal processing, Structural strengthening, Structural analysis (Engineering), Structural dynamics, Vibration testing, Structural health monitoring	
	Prof G de Jager	Digital Image Processing	
	A/Prof D Ng'ambi	Educational Technology, e-learning, Mobile Learning, Education, IT - education, Information Systems Education, IT - Applications, Mobile learning	
Internationally acclaimed	A/Prof M Harting	Nanostructured materials	Materials science & manufacturing
	Dr J Petersen	Hydrometallurgy, Heap bioleaching, Leaching, Heap leaching, Environmental engineering	
	Prof EWJ van Steen	Heterogeneous catalysis, Molecular modelling, Nanoparticles	
	Prof SA Bourne	Supramolecular chemistry, Crystallography, Thermal analysis, Crystal engineering	
	Prof DT Britton	Nanomaterials	
	Prof MC Claeys	Fischer-Tropsch synthesis, Heterogeneous catalysis, Metal nanoparticles, Nanomaterial synthesis, In-situ instrumentation, In situ PXRD, Magnetometry, Two-dimensional gas chromatography, Materials evaluation Instrumentation	

Established	Prof CM Comrie	Thin film growth, Electronic materials, Diffusion	
	Prof R Knutsen	Metallurgy (Characterisation), Electron microscopy, Non-ferrous metals, Metals, Physical metallurgy	
	A/Prof K Kuppuswamy	Machining, Advanced manufacturing, Nanocoating, Nanosciences	
	Prof CI Lang	Physical metallurgy, Electron microscopy	
Leading international	Prof DS Butterworth	Nature conservation	Natural environment
	Prof GA Ekama	Biological wastewater treatment, Industrial effluent - treatment, Anaerobic treatment, Wastewater and leachate treatment, Process biotechnology	
	Prof CJC Reason	Climate variability, Climate modelling, Climate change	
	Prof BC Hewitson	Climatology, Climate change, Climate modelling	
Internationally acclaimed	Prof HE Winkler	Environmental economics, Environmental modelling, Energy studies, Energy policy, Renewable energy, Environmental policy	
	A/Prof RP Wynberg	Environment - development, Sustainable rural livelihoods, Natural resources and benefit sharing, Bioprospecting, Environmental governance, Forest products (Non-timber), Traditional knowledge, Biodiversity policy, Commercial use of biodiversity, Applied molecular diagnostics	
	Dr CD van der Lingen	Biological oceanography, Ecology of marine small pelagic fish, Structure and functioning of marine pelagic food webs, Climate change impacts on marine pelagic ecosystems, Management of fisheries for small pelagic fish, Ecosystem approach to fisheries management	
	Prof JE van Zyl	Water - supply, leakage, demand modelling, distribution system modelling, Reliability engineering	
	Prof JJ Bolton	Seaweeds, Marine biology, Marine biodiversity	
	Prof GS Cumming	Landscape ecology, Conservation biology, Interdisciplinary research	
	Dr LJ Shannon	Ecosystem modelling, Fishing - effect of ecosystem on, Fisheries, Fisheries management, Trophic webs, ecosystem indicators	

Internationally acclaimed	A/Prof VE Coyne	Marine biotechnology, Abalone - Health aspects, Abalone mariculture, Proteomics, Molecular genetics, Molecular immunology, Molecular markers, Molecular and cell biology, Probiotics, Stress responses	Natural environment
	A/Prof MD Cramer	Plant ecophysiology	
Leading international	Prof FA Shillington	Regional oceanography, Satellite oceanography, Remote sensing, Coastal oceanography	
	Dr M Rouault	Oceanography, Ocean atmosphere interaction, Climate variability, Agulhas, Southwest Indian Ocean, Satellite oceanography	
	Prof PG Ryan	Conservation biology, Ornithology, Marine pollution	
	Prof JP Franzidis	Flotation (mineral)	
	Prof L Gillson	Conservation ecology, Palaeoecology	
	Prof CL Griffiths	Taxonomy, Ecology, Marine ecology, Ecophysiology, Biodiversity	
	Prof C Harris	Igneous petrology, Stable isotope geochemistry (rocks)	
	Prof STL Harrison	Wastewater treatment, Biohydrometallurgy, Algal biotechnology, Fungal fermentations, Bioprocess engineering, Biological product recovery, Acid mine drainage	
	Prof TAJ Hedderson	Bryology, Molecular systematics, Life histories, Population genetics, Nature conservation	
	Prof DA Deglon	Froth flotation, Mineral beneficiation	
	Prof MT Hoffman	Environmental history, Historical ecology, Land degradation, Desertification, Semi-arid rangelands, Rangeland ecology, Communal rangelands, Conservation, Resource management	
	Prof AP le Roex	Igneous petrology, Geochemistry (rock)	
	Prof ME Meadows	Palaeo environments, Palaeo ecology	
	Prof JJ Midgley	Evolutionary ecology, Plant-animal interactions, Plant ecology, Ecosystem ecology	

Established	A/Prof CL Moloney	Ecological modelling, Marine biology, Ecosystem modelling, Population modelling, Marine biophysical modelling, Marine ecology, Plankton ecology, Climate change	Natural environment
	Prof MG New	Climatology, Climate change - impact, adaptation, policy	
	Prof MJ O'Riain	Behavioural ecology, Animal behaviour, Behavioural physiology, Evolution	
	Dr R Altwegg	Population ecology, Statistical ecology, Demography	
	Dr A Amar	Ornithology, Animal ecology, Biodiversity conservation	
	Dr IJ Ansorge	Antarctic/Southern ocean	
	Dr EM Bordy	Karoo sedimentology, Basin analysis, Fluvial sediments, Clastic sediments, Ichnology (Trace fossils)	
	Dr GN Bronner	Evolution and systematics, Animal ecology, Environmental rehabilitation	
	Dr SBM Chimphango	Plant ecophysiology, Organic agriculture, Plant-soil relations, Soil fertility, Plant metabolism, Biological nitrogen fixation, Phosphorus deficiency, Nutritional physiology	
	Dr B Cohen	Climate change, Waste management, Sustainable energy, Strategic planning, Multi criteria decision analysis, Clean technology	
	A/Prof JS Compton	Marine geoscience, Palaeoceanography, Sedimentary geochemistry	
	A/Prof MA Dalvie	Environmental health, Occupational health, Endocrine disruptors, Pesticides, Exposure assessment	
	Prof LG Underhill	Ornithology, Ecological modelling, Statistical modelling	

Established	Dr CL de Moor	Fisheries management, Mathematical modelling, Pelagic fishes, Stock assessment, Bayesian statistics	Natural environment
	Prof TS Douglas	Medical imaging, Appropriate technology, Knowledge production	
	Dr FD Eckardt	Remote sensing, Aeolian and dryland geomorphology, Geomorphology, GIS	
	Dr AT Lombard	Systematic conservation planning, Marine spatial conservation planning, Animal welfare, GIS, Advocacy, Evidence-based policy making	
	Prof MI Lucas	Marine biogeochemistry, Algae & phytoplankton, Marine climate change, Southern Ocean & North, South Atlantic	
	A/Prof AN Mainza	Mineral beneficiation	
	Dr F Matose	Environmental sociology	
	A/Prof MD Picker	Entomology, Ecology, Biogeography, Systematics	
	Dr T Samaai	Marine biodiversity, Benthic invertebrates, Sponges - taxonomy, diversity and distribution	
	Dr RE Simmons	Climate change - Impact, Biodiversity conservation, Wind power plants - Impact	
	A/Prof C Thiart	GIS, Geostatistics, Spatial statistics, Spatial modelling	
	Dr M Vichi	Physical oceanography, Climate change, Marine biogeochemistry, Ocean modelling, Ecological modelling	
	Prof H von Blottnitz	Waste management, Industrial ecology, Life cycle assessment, Biofuels, Urban infrastructure, Biogas, Informal food systems, Clean and renewable energy, Mineral beneficiation, Agroprocessing technologies	
	Dr P Wolski	Hydrology, Hydrologic modelling, Climate change, Climate variability, Hydrogeochemistry, Ecohydrology, Wetland hydrology	
	Dr HN Waldron	Biological nitrogen fixation	

University of the Western Cape and the CSIR

Indicators of collaboration

Research

	2013	2014	2015
Collaborative research projects implemented	6	10	6
Joint publications resulting from supervised and joint research	17	25	12

Human capital development

	2013	2014	2015
CSIR researchers lecturing/ supervising students	12	14	14
Students supported by the joint scholarship programme	8	2	5
CSIR staff and students studying	13	7	11
Scholarship students and CSIR staff who graduated	7	2	0
CSIR staff appointed extraordinary professors/ honorary research associates	2	2	2
University staff appointed to CSIR research advisory panels	1	1	1

Highlights and achievements

Natural environment

Modelling of wetland processes impacting water resources at a catchment scale

Ashton Maherry, CSIR • Prof Dominic Mazvimavi, UWC • Gary Marneweck, Wetland Consulting Services

Funding: WRC

Background

Wetlands perform two major ecosystem services, namely water purification, which improves water quality in rivers and stream flow regulation, which has an impact on the water quantity in the rivers, especially during droughts and floods.

Typically, catchments have several wetlands of varying sizes, types and connectivity to rivers. The relationship of wetlands to the catchment hydrological processes and water resources also varies.

Examples include, pans which are typically endorheic and disconnected from rivers, channelled valley bottom wetlands which are connected to rivers, and seeps which are typically areas of groundwater and surface water interaction. They can be connected through river networks, groundwater or soil moisture. The impact of wetlands on catchment hydrological processes and water resources can be significant at a catchment or basin scale.

Response

Management of water resources in a catchment depends on suitable strategies and tools.
Hydrological models have been used to support management decisions such as modelling the Water Resources of South Africa studies and surface water reserve determinations. The hydrological models are calibrated according to measured stream flow records so that the modelled simulated flow matches the observed stream flow. By evaluating the current wetland modules of the different hydrological models and understanding the assumptions and limitations of the wetland components, the models can be successfully applied to the correct catchments. Modelling has been done in Limpopo Province (Mokolo Catchment ande GaMampa Wetland) using a suite of models. Modelling the impact of wetland on streamflow without the wetland modules reproduced better observed flows than when the wetland module was included. The findings can be improved by further investigating the dominant hydrological processes of the wetlands in the catchment, prior to selecting a model, to improve the accuracy of the results.

The incorporation of wetland processes in this study is useful, especially in areas of the country where wetlands have an important role in hydrological process, by enabling understanding and management of the water resources of the relevant basins.

Progress

A key finding of this study is that there is an insufficient representation of the underlying hydrological processes of wetlands in current water resources assessments. Although wetlands exist in all catchments, the hydrological modelling does not take into account the complex hydrological processes within wetlands, particularly the complex interaction of surface water and groundwater. Although the Water Research Commission project has been completed, the MSc is still continuing with an additional case study in the Western Cape. Further additional related work is being done by Rhodes University to improve the wetland module for one of the models. The research group has a Parliamentary Grant project is further integrating groundwater and surface water models into an integrated water-resources decision making tool.

Materials science and manufacturing

Nanotechnology applied to drugs for tuberculosis infection

Dr Matshawe Tukulula, CSIR • Dr Admire Dube, Dr Mervin Meyer, Myolisi Ndumiso, UWC

Funding: UWC, CSIR

Background

South Africa has the highest incidence of tuberculosis in the world. Cells known as macrophages are the primary hosts to the causative organism, Mycobacterium tuberculosis (M.tb). The bacterium is able to remain in these cells in a latent state for periods up to a lifetime of the infected individual or become active, leading to clinical symptoms of TB.

While drug treatments, which can kill the bacteria exist, they are not very effective in reaching the host cells. This is due to poor absorption of drugs into the blood stream, high binding to proteins in blood (resulting in low drug concentrations available to penetrate infected cells) and rapid clearance of the drugs from the body before they can effectively eradicate the bacteria. As a result, treatment of TB lasts up to six months and in some cases, even longer.

Response

The research uses nanotechnology to design strategies to effectively deliver TB treatment drugs to infected cells. TB drugs can be encapsulated in these delivery vehicles using nanoparticles to deliver the drugs in a sustained fashion to infected cells, thereby increasing absorption. Furthermore, nanoparticles can shield the drug molecules from binding to blood proteins, therefore increasing potential drug concentrations that reach the infected cells. This will lead to a faster and more effective treatment of TB.

Progress

The research team has successfully synthesised and characterised polymeric nanoparticles, which are loaded with a TB drug cargo. The method of formulating these drug delivery systems is reproducible. Studies to understand the protein binding dynamics between the TB drugs and the nanoparticles are going on at the UWC. In future phases of the project, proteomic analysis will be performed to assess the nature of the protein bio-corona formed as the drug and nanoparticles interact with blood.

Outputs

Peer-reviewed conference paper – 1

Synthesis of crystalline thin films by electrochemical atomic layer deposition technique for energy application

Dr Mmalewane Modibedi, Dr Mkhulu Mathe, CSIR • Dr Lindiwe Khotseng, UWC

Funding: NRF, UWC, US Airforce, CSIR

Background

Fuel cells are an attractive option for energy conversion because they are highly efficient and produce little or no pollution. The main goal of the research is to investigate new fabrication techniques that will contribute to a reduction in the cost of fuel cells and compete with current technologies, including gasoline internal combustion engines.

The development of a new fabrication technique for electrocatalysts and membrane-electrode assembly (MEA), which will increase electrocatalyst utilisation, is one of the key aspects of fuel cell research. Thin films have a high surface to volume ratio, geometrical control, single crystal-like properties, and are compact. Physical and chemical deposition methods for the preparation of thin films,

such as chemical vapour deposition, and molecular beam epitaxy have several disadvantages. These methods require expensive equipment, the use of high temperatures and vacuum, as well as toxic precursors.

The electrochemical deposition method is appropriate for the fabrication of nanostructured catalysts for energy materials. The Electrochemical Atomic Layer deposition (EC-ALD) technique involves alternate electrodeposition of atomic layers of elements on a substrate.

Previous work on EC-ALD at the CSIR established an experimental framework to explore sequential automated electrodeposition of platinum group metals nanostructures and tested the electro-catalytic effects produced by the formed nanostructures. EC-ALD was also used to electrodeposit Pt nanostructures on fuel cell gas diffusion layers and other support material such as Ti and Ni foam for the electro-oxidation of hydrogen and alcohols.

Response

The EC-ALD technique is used for fabricating crystalline thin films on several substrates for varied electrocatalytic applications in fuel cells. The project focuses on understanding the role of the film structure, morphology and composition on the efficiencies of these materials, developing advanced oxygen reduction reaction electrocatalysts for the direct alcohol fuel cells and investigating the extension of EC-ALD to electrode materials for other devices, such Na-ion batteries.

Progress

The project was implemented through three experimental phases, namely: Oxygen reduction reaction (ORR) for fuel cell applications, alcohol oxidation reaction (AOR) for fuel cell applications and anode material for sodium ion battery applications.

Monometallic Pd and Pt nanostructured electrocatalysts were synthesised on various substrates through surface limited redox replacement reaction and a small over-potential deposition using EC-ALD. The electrodeposition of Pd-Pt bimetallic electrocatalysts was performed on carbon paper. Three deposition sequences for Pt and Pd were explored. Since the ORR catalyst for direct alcohol fuel cells needs to be tolerant to alcohols, the prepared electrocatalysts were tested for methanol tolerance using electrochemical methods. This task was added at this stage since the alcohol oxidation reaction catalyst (anode) and the membrane together with the cathode catalyst (ORR) will be required in the fabrication of MEAs, which is vital for demonstrating fuel cell performance.

EC-ALD was also used to prepare thin films for application in Na-ion batteries. Gold-coated glass and copper foil were used as substrates for Sn and Bi deposition. The under-potential deposition of these elements on gold-coated glass was determined. Deposition parameters, such as deposition time and cycles for depositing Sn on the substrates, are being optimised.

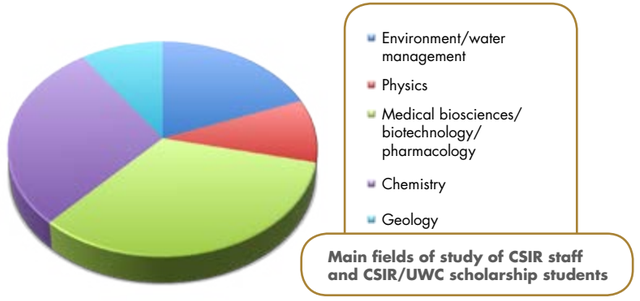
Outputs

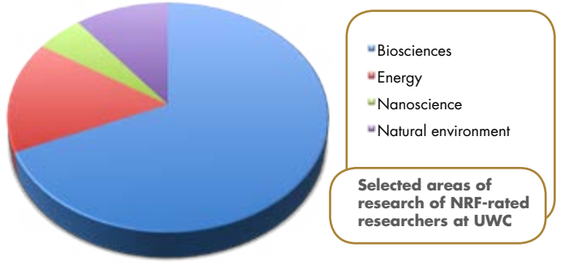
Conference presentations – 8
Peer-reviewed conference paper – 1
Peer-reviewed journal articles – 3
Students graduated – 1 MSc,
1 BSc (Honours)

Human capital development

Overview

Twenty-two CSIR staff members and students funded through the CSIR studentship programme and the joint scholarship programme with UWC (6 Masters, 9 PhD, 7 Honours) were supported to study for postgraduate qualifications mainly in chemistry and biosciences. Ten of these have graduated. Most of the staff and students studying were supervised jointly by UWC and CSIR researchers and were involved in projects initiated by either or both institutions.





The complementary capabilities of the CSIR and the UWC enable research programmes to be performed effectively. The university has over 30 NRF-rated researchers in the areas of collaboration contained in the MoU, mainly in biosciences and energy.

The university has also been awarded several SARChI Chairs in bioinformatics and public health; in health systems, complexity and social change; in microbial genomics; in astronomy and astrophysics; in poverty, land and agrarian studies; in nuclear science, nano-electrochemistry and sensor technology.

These Chairs are complemented by researchers in centres of excellence such as food security and hydrogen South Africa systems integration and technology validation centre of competence, as well as in various departments and schools. These provide a potential resource that can advance the objectives of the collaboration, including training a new generation of researchers.

Hydrogen SA

Hydrogen South Africa (HySA) is a long-term programme involving UWC, the CSIR, UCT and several other partners, which is developing South African intellectual property, knowledge, human resources, products, components and processes to support the country's participation in hydrogen and fuel cell technologies.

The programme performs R&D work to achieve 25% share of the global hydrogen and fuel cell market using novel Platinum Group Metal catalysts, components and systems. In order to achieve this, the structure of the programme supports the parallel development of knowledge and technology across all areas of the hydrogen and fuel cell value chain.

The three HySA Centres of Competence, each with a unique responsibility - HySA Infrastructure (co-hosted by the North-West University and the CSIR), HySA Catalyst (co-hosted by UCT/Mintek) and HySA Systems (hosted by UWC) form a national network through collaboration with institutions and partners from the R&D sector, higher education, as well as industry.

In addition to co-hosting HySA Infrastructure, the CSIR also contributes to the work of the HySA/ESKOM Centre for Electrocatalytic Research by jointly investigating new fabrication techniques that will contribute to a reduction in the cost of fuel cells with UWC.

Dr Mmalewane Modibedi, CSIR

Testimonials

Dewald Schoeman is studying for an MSc degree in Medical Bioscience specialising in environmental toxicology. His research focuses on using rapid detection assays to monitor adverse effects of environmental pollutants, such as heavy metals and chemicals that can disrupt hormones. These pollutants are often found in water from agricultural run-off and improperly treated industrial and sewage effluents. The polluted water could pose risks to human and animal health, and may also impact the environment. The research is important because pollutants can affect single or multiple levels of the food chain and damage whole ecosystems. These pollutants can accumulate in the environment and are not easily eliminated.

One way of detecting pollutants in the environment is to use proteins called biomarkers that are produced in response to these pollutants. Dewald has produced monoclonal antibodies, which are highly specific, and can detect the biomarkers in organisms that provide information on the state of their environment. With these rapid detection assays, it is possible to monitor environmental pollutants and their effects

Hakundwi Mandende is studying for a PhD in Applied Geology in the field of exploration geochemistry and economic geology. The aim of this study is to apply GIS-based techniques for the integration and interpretation of geological, geochemical, geophysical and remote sensing data in the highly deformed and metamorphosed rocks in the eastern part of the Namaqua Metamorphic Province. This approach should allow for the development of predictive maps showing potential zones of VMS exploration in the study area. The combination of high-grade regional metamorphism and deformation, coupled with the intrusion of various types of igneous rocks at different stages throughout the tectonic evolution and the very poorly exposed nature of the eastern part of the Namaqua Province, makes it very difficult to identify features related to the primary environment within which the ore deposits formed. The integration of data sets is very important especially in areas affected by deformation, high-grade metamorphism and with poor rock exposure as this technique not only enhances exploration for known deposits, but can generate new targets through this method.

Most of the staff and students studying were **supervised jointly by UWC and CSIR researchers** and were involved in projects initiated by **either or both institutions.**

Supervised post graduate research

A comparative assessment of the quantity and sources of water used by alien invasive Prosopis spp and indigenous Vachellia karroo in the Northern Cape Province

*Zanele Ntshidi, CSIR • **Supervisors:** Dr Sebinasi Dzikiti, CSIR • Prof Dominic Mazvimavi, UWC*

Background

Invasive alien plants (IAPs) use more water than indigenous plants. IAPs can also adapt to harsh environmental conditions and spread rapidly, thereby threatening water resources, agricultural land and biodiversity. Approximately 10 million hectares of land in South Africa is estimated to be invaded by alien plants, with an estimated average annual rate of spread of more than 5%.

Most of South Africa is expected to get drier in the future due to climate change. Future climatic conditions are predicted to accelerate the rate at which alien plants will spread.

Response

The first objective of the study was to compare the water use of deep-rooted tree species, which include invasive Prosopis (sp) trees (alien) and the co-occurring indigenous V. karroo (indigenous). These trees were in a flood plain of a groundwater dependent catchment in the Northern Cape Province. Both species are dependent on groundwater and compete with local communities for this resource. The second objective was to determine the sources of water that the trees were using in order to understand the impacts of each species on groundwater resources. Transpiration was measured using the heat ratio method of the heat pulse velocity sap flow technique while the volumetric soil water content was monitored at several depths down the soil profile using automated capacitance soil water content probes. Weather data was collected using an automatic weather station. Stable isotopes of oxygen and hydrogen from plant, soil and groundwater samples were analysed to determine the sources of water used by the trees.

Progress

The study shows that individual V. karroo plants use more water than Prosopis. However, Prosopis used three times more water than the co-occurring V. karroo at the entire monitored site (approximately three hectares). This is because of the high plant density that Prosopis invasions form compared with the indigenous species. At this study site, there was approximately six times more Prosopis than V. karroo and this substantially raised the stand level water use of the invasive plants.

The isotopes studies showed that Prosopis derived most of their water from the saturated soil zone during the peak transpiration period in summer while V. karroo derived about half of its water from the groundwater.

Outputs

Student trained – 1
Peer-reviewed conference paper – 1

Most of South Africa is expected to get drier in the future due to **climate change.** Future climatic conditions are **predicted to accelerate the rate at which alien plants will spread.**

Ecotoxicity of silver nanoparticles

*Chavon Walters, CSIR • **Supervisors:** Dr Vernon Somerset, CSIR • Prof Edmund Pool, UWC*

Background

There has been a drastic increase in the production and use of nanoparticles (NPs) in the last decade. Metal NPs, such as silver NPs (AgNPs), are already being used in several commercial and domestic applications, including textiles, cosmetics and personal hygiene. Concurrently, the risk of environmental contamination by NPs continuously increases.

The behaviour of AgNPs is influenced by inherent (nanoparticle size, shape, surface area, surface charge, crystal structure, coating and solubility or dissolution) and environmental factors (temperature, pH, ionic strength, salinity and organic matter). Climate change predictions indicate that the frequency, intensity and duration of extreme natural events (such as temperature elevations) will increase in the future.

Response

Some studies have linked the predicted climate change with contaminant release, which could have a negative impact on ecosystems. Similarly, a small number of studies have analysed the behaviour of NMs in the environment based on these predicted changes in mean temperatures. The main aim of this research was to evaluate the ecotoxicological properties of AgNPs and to assess if environmental variables are able to modulate its ecotoxicity.

Most of this work was performed at laboratories at the UWC. Experiments of nanoparticle characterisation were carried out at SU.

Progress

The use of traditional biomarkers of oxidative stress, metal exposure and tissue distribution were combined to evaluate the effects of AgNPs exposure. NP characterisation in experimental media was also done to link NPs properties and behaviour to toxic responses. Given the capacity of AgNPs to generate oxidative stress and induce oxidative damage, as well as the ability of temperature to modulate these effects, it was concluded that although oxidative stress is a predictable outcome for NP toxicity, several factors are responsible for determining their modes of action. Overall, these findings have contributed to understanding the field of nanotoxicology and improved understanding of risk assessment of metal NPs using the data collected in this project.

Outputs

Peer-reviewed journal articles – 4
Book chapters – 1

Some studies have **linked the predicted climate change** with contaminant release, which **could have a negative impact on ecosystems.**

Detailed indicators of collaboration

Collaborative research projects implemented

CSIR researchers	UWC researchers	Name of project	2013	2014	2015	Research area
Dr Nebo Jovanovic	Dr Dominic Mazvimavi	Earth observation and water resources management		•	•	Environmental management
Dr Mark Gush		Water footprint of selected vegetable and fruit crops produced in South Africa		•	•	
Dr Paul Oberholster; Dr Keith Kennedy	Dr Thokozani Kanyerere	Using IWRM best practices to develop appropriate capacity and training for the benefit of sub-Saharan Africa water security	•	•	•	
Dr Nebo Jovanovic; Dr Richard Bugan	Prof Dominic Mazvimavi	ACCESS – Water theme	•	•		
Dr Vernon Somerset	Prof Emanuel Iwuoha	Mercury estimation Index		•	•	
Dr Jean-Marc Mwenge-Kahinda; Dr Evison Kapangaziwiri; Nompumelelo Mandlazi	Dr Dominic Mazvimavi	Identification of wetland processes impacting water resources at a catchment scale	•	•		
Prof Kenneth Ozoemena	Prof Ben Bladergroen	Development of cathode materials	•	•		Material science & manufacturing
Dr Matshawe Tukulula	Dr Admire Dube	Nanotechnology applied to drugs for tuberculosis infection		•	•	Biosciences
Dr Tsepo Tsekoa	Dr Bongani Diba	Antibodies for use in reagents in life science R&D and diagnosis	•	•		
Dr Mmalewane Modibedi	Dr Lindiwe Khotseng	Synthesis of crystalline thin films by electrochemical atomic layer deposition technique for energy application	•	•	•	Energy

Joint publications

Authors	Title of paper	Publication
Peer-reviewed journal articles		
Mguda Z; Faltenbacher A; Van der Heyden K; Gottlöber S; Cress C; Vaisanen P; Yepes G	Ram pressure statistics for bent tail radio galaxies	Monthly Notices of the Royal Astronomical Society, Vol. 446(4), pages: 3310-3318, Jan 2015
Zongo S; Kerasidou AP; Sone B; Diallo A; Mthunzi P; Iliopoulos K; Nkosi M; Maaza M; Sahraoui B	Nonlinear optical properties of poly(methyl methacrylate) thin films doped with Bixa Orellana dye	Applied Surface Science, Vol. 340, pages: 72-77, Jun 2015
Chamier J; Wicht M; Cyster L; Ndindi NP	Aluminium (Al) fractionation and speciation: getting closer to describing the factors influencing Al(sup3+) in water impacted by acid mine drainage	Chemosphere, Vol. 130, pages: 17-23, Jul 2015
Ramond J-B; Lako JDW; Stafford WHL; Tuffin MI; Cowan DA	Evidence of novel plant-species specific ammonia oxidizing bacterial clades in acidic South African fynbos soils	Journal of Basic Microbiology, pages: DOI: 10.1002/jobm.201400933, Feb 2015
Melariri P; Kalombo L; Nkuna P; Dube A; Hayeshi R; Ogutu B; Gibhard L; De Kock C; Smith P; Wiesner L; Swai H	Oral lipid-based nanoformulation of tafenoquine enhanced bioavailability and blood stage antimalarial efficacy and led to a reduction in human red blood cell loss in mice	International Journal of Nanomedicine, Vol. 2015(10), pages: 1493-1503, Feb 2015
Van der Horst C; Silwana B; Iwuoha E; Somerset V	Synthesis and characterization of bismuth-silver nanoparticles for electrochemical sensor applications	Analytical Letters, Vol. 48(8), pages: 1311-1332, Jun 2015
Somerset V; Van der Horst C; Silwana B; Walters C; Iwuoha E	Biomonitoring and evaluation of metal concentrations in sediment and crab samples from the North-West province of South Africa	Water Air and Soil Pollution, Vol. 226(43), pages: DOI: 10.1007/s11270-015-2329-2, Feb 2015
Zongo S; Sanusi K; Britton J; Mthunzi P; Nyokong T; Maaza M; Sahraoui B	Nonlinear optical properties of natural laccaic acid dye studied using Z-scan technique	Optical Materials, Vol. 46, pages: 270-275, Aug 2015

Tukulula M; Hayeshi R; Fonteh P; Meyer D; Ndamase A; Madziva MT; Khumalo V; Lubuschagne P; Naicker B; Swai H; Dube A	Curdlan-conjugated PLGA nanoparticles possess macrophage stimulant activity and drug delivery capabilities	Pharmaceutical Research, pages: DOI: 10.1007/s11095-015-1655-9, Feb 2015
Van der Horst C; Silwana B; Iwuoha E; Somerset V	Bismuth–silver bimetallic nanosensor application for the voltammetric analysis of dust and soil samples	Journal of Electroanalytical Chemistry, Vol. 752, pages: 1-11, Sep 2015
Silwana B; van der Horst C; Iwuoha E; Somerset V	Synthesis, characterisation and electrochemical evaluation of reduced graphene oxide modified antimony nanoparticles	Thin Solid Films, Vol. 592, Part A, pages: 124-134, Oct 2015
Machaka P; Bagula A	An investigation of scalable anomaly detection techniques for a large network of Wi-Fi hotspots	Scalable Information Systems, pages: 71-79, Sept 2015
Walters C; Pool E; Somerset V	Ecotoxicity of silver nanomaterials in the aquatic environment: A review of literature and gaps in nano-toxicological research	Journal of Environmental Science and Health Part A: Toxic/Hazardous Substances and Environmental Engineering, Vol. 49(13), pages: 1588-1601, Aug 2014
Silwana B; Van der Horst C; Iwuoha E; Somerset V	Screen-printed carbon electrodes modified with a bismuth film for stripping voltammetric analysis of platinum group metals in environmental samples	Electrochimica Acta, Vol. 128, pages: 119-127, May 2014
Oliphant CJ; Arendse CJ; Camagu ST; Swart H	EBSD analysis of tungsten-filament carburization during the hot-wire CVD of multi-walled carbon nanotubes	Microscopy and Microanalysis, Vol. 20(1), pages: 4-13, Feb 2014
Cunnama D; Andrianomena S; Cress CM; Faltenbacher A; Gibson BK; Theuns T	The environmental dependence of neutral hydrogen in the gimic simulations	Monthly Notices of the Royal Astronomical Society, Vol. 438, pages: 2530–2537, Jan 2014
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Staff studying

Name of CSIR Staff	Degree programme	CSIR Supervisor	UWC Supervisor	2013	2014	2015
Zanele Ntshidi	MSc (Environmental Water Management	Dr Sebinasi Dzikiti	Prof Dominic Mazvimavi	•	•	•
Nompumelelo Mandlazi	MSc (Environmental Management)	Dr Jean-Marc Mwenge Kahinda; Dr Evison Kapangaziwiri	Prof Dominic Mazvimavi		•	•
Chantel Petersen	PhD (Environmental Science)	Dr Nebo Jovanovic	Dr Michael Grenfell	•	•	•
Chavon Walters	PhD (Environmental Science)	Dr Vernon Somerset	Prof Edmund Pool	•	•	•
Bongani Thabethe*	MSc (Physics)	Dr Gerald Malgas	Prof Christopher Arendse	•		
Sibongiseni Thabethe*	MSc (Physics)	Dr Bonex Mwakikunga	Prof Christopher Arendse	•	•	
Pheeha Machaka	PhD (Computer Science)	Prof Fulufhelo Nelwamondo	Prof Antoine Bagula			•
Priya Annamalai	MSc (Chemistry)	Dr Nicholas Musyoka	Prof Leslie Petrik			•

Students supported by the scholarship programme

Name of student	Degree programme	2013	2014	2015
Kim Smeda-Pienaar*	BSc Honours (Medical Biosciences)	•		
Dewald Schoeman*	BSc Honours (Medical Biosciences)	•		
Clint Mercuur*	BSc Honours (Medical Biosciences)	•		
Micheal Berry*	PhD (Medical Biosciences)	•	•	
Anovuyo Jonnas*	BSc Honours(Chemistry)	•		
Roz Magabjane Madihlaba*	BSc Honours (Chemistry)	•		
Mduduzi Preston Radebe*	PhD (Chemistry)	•		
Asanda Vincent Busa	PhD (Chemistry)	•	•	
Hakundwi Mandende	PhD (Applied Geology)			•
Moses Mogoba	PhD (Applied Geology)			•
Luyolo Myolisi	MSc (Pharmaceutical Science)			•
Lorensha Naidoo	BSc Honours (Biotechnology)			•
Gadija Abdullah	BSc Honours (Biotechnology)			•

**= graduated*

CSIR researchers lecturing/supervising students

Name of researcher	Type of collaboration	2013	2014	2015	Research area
Dr Anwar Vahed	Supervising, examining	•	•	•	Information & communication technology
Dr Daniel Moeketsi	Lecturing, supervising	•	•	•	
Dr Bonex Mwakikunga	Supervising	•	•	•	Materials science & manufacturing
Dr Mmalewane Modibedi	Supervising, examining	•	•	•	
Dr Gugu Mhlongo	Supervising	•	•		
Dr Hongze Luo		•	•		
Dr David Motaung		•	•	•	
Prof Kenneth Ozoemena	Supervising, lecturing, examining	•	•	•	
Dr Matshawe Tukulula	Supervising		•	•	
Dr Gerald Malgas		•			
Dr Nicholas Musyoka				•	
Dr Vernon Somerset	Supervising	•	•	•	Natural environment
Dr Sebinasi Dzikiti		•	•	•	
Dr Jean-Marc Mwenge Kahinda			•	•	
Dr Evison Kapangaziwiri			•	•	
Dr Nebo Jovanovic		•	•	•	
Prof Fulufhelo Nelwamondo	Supervising			•	Modelling

CSIR researchers holding extraordinary professorships

Name of researcher	Area of expertise	2013	2014	2015
Prof Kenneth Ozoemena	Chemistry	•	•	•
Dr Nebo Jovanovic	Environmental management	•	•	•

UWC researchers serving on CSIR advisory panel

Name of researcher	Area of expertise	2013	2014	2015
Prof Dirk Knoesen	Nanoscience	•	•	•

NRF-rated researchers - Collaboration areas in CSIR/UWC MoU

Researcher rating	Name	Research specialisation	
Internationally acclaimed	Prof AE Channing	Amphibians, Biodiversity, Taxonomy, Biosystematics	Biosciences
	Prof MT Davies-Coleman	Natural products - Isolation characterisation, Natural products chemistry, Natural products - Biological evaluation, Organic synthesis	
	Prof RR Henkel	Spermatozoa, Andrology, Human reproduction, Male reproduction, Reactive intermediates, Traditional herbal medicines	
	Prof D Sanders	Education, Infectious diseases, Environmental health, Development studies	
Established	Prof GJ Amabeoku	Pharmacology, Ethnopharmacology, Behavioural pharmacology, Experimental neuropharmacology, Experimental psychopharmacology, Phytopharmacology	
	Dr R Bauer	Metagenomics, Biotechnology	
	Prof AG Christoffels	Bioinformatics, Genomics, Host-pathogen interaction	
	Prof DD Cooper	Sexual and reproductive health, Women's health policy and services, HIV and AIDS - care, Health services - integration	
	Dr ME D'Amato	Forensic genetics, Population genetics, Evolutionary genetics	
	Prof S Davison	DNA forensics, Population genetics, Forensic DNA fingerprinting	

Established	Dr R Den Haan	Fungal biotechnology, Yeast fungi - genetic engineering, Biofuels, Yeast expression, Yeast biotechnology, Yeast fermentation, Biofuels	Biosciences
	Prof BC Fielding	Molecular biology, Protein protein interaction, Proteomics, Cell culture, Molecular virology, Coronavirology, Molecular oncology	
	Prof DM Gibson	Medical anthropology, anthropology, science and technology	
	Prof MD Hofmeyr	Herpetology, Ecophysiology, Animal reproduction, Population ecology, Haematology, Evolutionary genetics	
	Prof GD Hughes	Public health, Phytomedicine, Pharmaco-epidemiology, Chronic diseases of lifestyle, Chronic diseases, Epidemiology, AIDS	
	Prof D Jackson	Mother to child HIV transmission, Infant feeding, Perinatal epidemiology	
	Prof NN Ludidi	Plant biotechnology, Plant biology, Plant biochemistry, Plant molecular biology, Genetic engineering	
	Prof SF Malan	Drug design, Drug development, Medicinal chemistry	
	Prof GS Maritz	Physiology, Physiological chemistry, Developmental biology, Biomedical sciences	
	Dr AAH Mohammed	Natural products chemistry	
	Prof TK Monsees	Male reproduction, Reproductive toxicology, Reproductive health, Biomaterials, Biocompatibility	
	Prof A Oelofse	Micronutrient malnutrition, Children - nutrition, Community nutrition, Food - nutrition, Mineral nutrition, Nutrition and health, Nutrition and metabolism, Nutritional epidemiology	
	Prof TR Puoane	Global public health, Chronic diseases - nutritional aspects, Paediatrics and child health	
	Prof H Schneider	Public health, Health systems, Health policy	
	Prof IM Tuffin	Extremophiles, Plant-microbe interactions, Genetic engineering, Biotechnology, Bacterial biotechnology, Metagenomics, Gene discovery, Biomining micro-organisms, Marine biotechnology	
	Prof G van der Horst	Sperm biology, Male reproduction, Andrology, Cell biology, Wildlife reproduction, Sperm competition	
	Prof VM Linkov	Applied chemistry, Catalysis, Ceramics, Electrochemistry, Hydrogen economy, Hydrogen prod/utilisation, Fuel cells	Energy

Established	Dr MV Lototskyy	Metal hydrides, Hydrogen storage, Hydrogen economy, Fluid/solid processes, Nanostructured materials	Energy
	Prof BJ Bladergroen	Clean and renewable energy, Membrane technology, Gas separation, Fuel cell technology, Catalysis	
	Dr S Halindintwali	Solar energy (Photovoltaics)	
	Prof PGL Baker	Electrochemical sensors, Electrochemical synthesis, Analytical chemistry	
	Dr SJJG Titinchi	Catalysis, Homogeneous catalysis, Heterogeneous catalysis, Carbon capture and storage	
Internationally acclaimed	Prof EI Iwuoha	Electrochemistry, Sensors, Nanomaterials	Nanoscience
Established	Dr EM Antunes	Nanomaterials, Macromolecular chemistry, Nanosciences, Natural products chemistry, Photochemistry, Organic synthesis	
Internationally acclaimed	Prof MJ Gibbons	Zooplankton ecology, Taxonomy, Biological oceanography	Natural environment
Established	Prof MM Hara	Coastal and fisheries co-management, Fisheries management, Small-scale fisheries development, Gender and development, Rural development, Integrated coastal development, Integrated environmental management, Development management and theory	
	Prof GW Maneveldt	Science and technology, Botany, Taxonomy and Systematics, Mariculture, Ecology and environmental science, Morphology	
	Prof AJ Smit	Phycology, Stable isotope ecology, Marine ecophysiology, Phytoplankton ecophysiology, Biological oceanography, Coastal ecology, Coastal oceanography, Satellite oceanography	

List of Abbreviations

AOR	Alcohol Oxidation Reaction
CAIR	Centre for Artificial Intelligence Research
CoE	Centre of Excellence
CMMI	Capability Maturity Model Integration
DBE	Department of Basic Education
EC-ALD	Electrochemical Atomic Layer Deposition
GIS	Geographical Information Systems
IAPs	Invasive Alien Plants
ICT	Information and Communication Technology
IT	Information Technology
IOP	Inherent Optical Properties
LC	Liquid Crystals
MEA	Membrane-Electrode Assembly
MoU	Memorundum of Understanding
NMs	Nanomaterials
NPs	Nanoparticles
NRF	National Research Foundation
ORR	Oxygen Reduction Reaction
PA	Parallel Aligned
PAL	Peptidl-alpha-hydroxyglycine Alpha-amidating Lyase
PAM	Peptidyl-glycine Alpha-amidating Monooxygenase
PHM	Peptidylglycine Alpha-hydroxylating Monooxygenase
R&D	Research and Development
SARChI	South African Research Chairs Initiative
SAZ	Sub-Antarctic Zone
SEM	Scanning Electron Microscopy
SLM	Spatial Light Modulator
SU	Stellenbosch University
TB	Tuberculosis
TN	Twisted Nematic
TTS	Text to Speech
UCT	University of Cape Town
UWC	University of the Western Cape
WfW	Working for Water
WRC	Water Research Commission

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a) Collaborative projects include - projects jointly funded by CSIR and collaborating universities; jointly implemented projects fully-funded by the CSIR; jointly-implemented projects funded by third parties. Student research work, contract work by one partner for the other, or any activity with a value less than R125,000 are excluded.
b) Joint publications include only peer-reviewed ones. Thesis and dissertations are excluded.

MoU areas of collaboration

	SU	UCT	UWC
Bioscience/Health	•	•	•
Environmental management	•	•	•
Defence & security	•	•	
Information & communications technology	•	•	
Materials science	•	•	•
Energy		•	•
Nano science			•
Laser technology	•		
Built environment	•		

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