PROGRAM VIR DIE TWEEDE PLEGTIGHEID

DIE FAKULTEITE NATUURWETENSKAPPE, AGRIWETENSKAPPE, INGENIEURSWESE, EN GENEESKUNDE EN GESONDHEIDSWETENSKAPPE

'n Vriendelike beroep word op alle aanwesiges gedoen om selfone af te skakel en nie die saal tydens die plegtigheid te verlaat nie en sodoende te verseker dat die verrigtinge sonder ontwrigting verloop.

1. Akademiese prosessie kom die saal binne. U word versoek om te staan terwyl hulle die saal binnekom en te bly staan vir die sing van die Nasionale Lied.
2. Sing van die Nasionale Lied (kyk binneagterblad). Neem asseblief daarna u sitplekke in.
   Begeleiding: Universiteit Stellenbosch Koperblaasensemble en Perkussie onder leiding van Pamela Kierman.
   Orrelis: Eon Malan. Voorsanger: Wendy-Joy Crowley.
3. Konstituering deur die Viserektor (Strategiese Inisiatiewe en Internasionalisering).
4. Verwelkoming deur die Viserektor (Strategiese Inisiatiewe en Internasionalisering).
5. Voorstelling van doktorandi deur die dekane van die betrokke fakulteite en toekenning van grade deur die Viserektor (Strategiese Inisiatiewe en Internasionalisering).
6. Sluiting deur die Viserektor (Strategiese Inisiatiewe en Internasionalisering).
7. Akademiese prosessie verlaat die verhoog.

Die aanwesiges word versoek om te bly staan totdat die akademiese prosessie uitgestap het.

PROGRAMME FOR THE SECOND CEREMONY

THE FACULTIES OF SCIENCE, AGRISCIENCES, ENGINEERING, AND MEDICINE AND HEALTH SCIENCES

To help ensure that the proceedings run their course without disruption, will all those present kindly keep their cell phones switched off, and refrain from leaving the hall, while the ceremony is in progress.

1. Entrance of academic procession into the hall. You are requested to stand while it enters, and then to remain standing for the singing of the National Anthem.
2. Singing of the National Anthem (see inside back cover). Thereafter, please be seated.
   Accompaniment: University of Stellenbosch Brass Ensemble and Percussion under the baton of Pamela Kierman.
   Organist: Eon Malan. Precentor: Wendy-Joy Crowley.
3. Congregation formally constituted by the Vice-Rector (Strategic Initiatives and Internationalisation).
4. Welcome by the Vice-Rector (Strategic Initiatives and Internationalisation).
5. Presentation of doctoral candidates by the deans of the respective faculties and conferment of degrees by the Vice-Rector (Strategic Initiatives and Internationalisation).
6. Closing by the Vice-Rector (Strategic Initiatives and Internationalisation).
7. The academic procession leaves the stage.

Those present are requested to remain standing until the entire academic procession has left the hall.

isiXhosa →

ISICWANGCISO-NKQUBO SOMSITHO WOKUQALA

IIFAKHALTHI EYEATHSI NEENZULULWAZI ZOBUNTLALONTLE, EYEZEMFUNDO, EYEZOMTHETHO, EYEZENKOLO NEYEZEENZULULWAZI KWEZOQOQOSHO NOLAWULO

Ukuqinisekisa ukuba umsitho uqala ngaphandle kwesiphazamiso, bonke abakhoyo bayacelwa ukuba bacime iiselfowuni zabo, kwaye bangaphumi eholweni ngeli xesha umsitho uqhubekayo.

1. Kungena umkhosi wemithika eholweni. Niyacelwa ukuba nime ngeenyawo xa ungena, nihlale nime njalo ukuze kuculwe uMhobe weSizwe.
2. Kuculwa uMhobe weSizwe (Jonga kumphakathi weqweqwe lokugqibela). Emva koko, ningahlala phantsi.
   Umculo: yi-University of Stellenbosch Brass Ensemble and Percussion.
   Phantsi kwentonga yombhexeshi: uPamela Kierman. Umdlali wohadi: uEon Malan.
   Umhlabeli: nguWendy-Joy Crowley.
3. UMsitho uvulwa ngokusesikweni nguSekela-Nqununu (wezoPhando, izinto ezintsha neZifundo zaBasele beneZidanga).
4. Ulwamkelo lwenziwa nguSekela-Nqununu (wezoPhando, izinto ezintsha neZifundo zaBasele beneZidanga).
5. Ukunikezelwa kwabafundi bezidanga zobugqirha ziintloko zeefakhalthi (iidin) ezichaphazelekayo nokuthweswa kwezidanga nguSekela-Nqununu (wezoPhando, izinto ezintsha neZifundo zaBasele beneZidanga).
6. Ukuvalwa koMsitho nguSekela-Nqununu (wezoPhando, izinto ezintsha neZifundo zaBasele beneZidanga).
7. Umkhosi wemithika uyalishiya iqonga.

Bonke abakhoyo bayacelwa ukuba beme ngeenyawo de umkhosi wemithika ube uphume wonke eholweni.

KANDIDATE WAT KWALIFIKASIES ONTVANG

Hier volg 'n lys van graduandi met hul studierigtings, proefskriftitels en opsommings van die navorsing.
Die grade van graduandi wat nie by die gradeplegtigheid teenwoordig kan wees nie, word in hulle afwesigheid toegeken.

CANDIDATES RECEIVING QUALIFICATIONS

Here is a list of graduands with their fields of study, dissertation titles and summaries of research.
The degrees of graduands who are unable to attend the graduation ceremony are awarded in absentia.

ABAFUNDI ABAFUMANA IZINGQINI ZEZEMFUNDO

Apha kulandela uluhlu lwabathweswayo kwiinkalo zesifundo, izihloko zeedizetheyishini kunye nezishwankathelo zophando.
Izidanga zabathweswayo abangakwazanga ukubakho ubuqu kumsitho wothweso-zidanga bathweswa bengekho benjalo.

Fakulteit Natuurwetenskappe

Faculty of Science

IFakhalthi yezobuNzululwazi kwezobuGqi

PhD

BESTER, Rachelle (Genetics)

Small RNA profiling of grapevine leafroll-associated virus 3 infected grapevine plants

Grapevine leafroll-associated virus 3 (GLRaV-3) is the leading causative agent of grapevine leafroll disease. The molecular interaction between the virus and the plant was investigated using next-generation sequencing to identify differentially expressed small RNAs and genes associated with GLRaV-3 infection in symptomatic and asymptomatic cultivars. Differentially expressed genes with strong associations with cell wall biosynthesis and signalling during pathogen recognition were identified as a potential universal molecular response against GLRaV-3. This study has significantly extended the sRNA knowledge base of grapevine and identified possible mechanisms to exploit for engineering viral tolerance in grapevine.
Supervisor: Dr HJ Maree
Co-supervisor: Prof JT Burger

BLANCKENBERG, Angelique (Chemistry)

Preparation and characterisation of novel palladacycles and their evaluation as anticancer agents

A suite of novel mononuclear as well binuclear palladacycle complexes which incorporated various hydrophilic functionalities were developed and fully characterised. These complexes were subjected to *in vitro* testing as anticancer agents against various types of breast cancer cell lines. Several of the complexes showed promising biological activity with some of the binuclear complexes exhibiting activity which far exceeds that of the well-known anticancer agent cis-platin. Investigations using DNA binding studies have provided some further insight into the mode of action of the new metallodrugs developed.
Supervisor: Prof SF Mapolie

CASTELL, Dominic Christian (Chemistry)

Inherently chiral calixarenes: methodology and applications

The synthetic methods towards inherently chiral calixarenes, employing both chiral sulfoxide and oxazoline auxiliaries in an asymmetric ortholithiation reaction, have been further developed. This strategy was used to synthesise a small library of inherently chiral phosphine oxazoline ligands for the first time. Their application to both the asymmetric Tsuji-Trost and Suzuki coupling reactions suggest a significant contribution, as well as a definitive matched and mismatched relationship between the inherent and central chirality of these ligands, on the overall stereochemical outcome. These findings pave the way for inherently chiral calixarenes to be used in asymmetric catalysis.
Supervisor: Dr GE Arnott

CHRISTENSEN, Carl (Biochemistry)

Development of an integrated metabolic analysis toolbox

Metabolic pathways consist of numerous reactions that convert chemicals obtained from food into the building blocks of life in a manner similar to a production line. The overall behaviour of these pathways (e.g. their rates or responses to environmental changes) depends on the properties of their components and can be replicated using computer models. Software is presented that analyses such models using published theoretical frameworks. Each method of the software tackles a different problem, together providing an integrated view of metabolic pathways. Additionally, we use this software to uncover and explain previously unknown properties of models of two metabolic pathways.
Supervisor: Prof JM Rohwer
Co-supervisor: Prof J-HS Hofmeyr

DAVIS, Tanja Andrea (Physiological Sciences)

The role of AHNAK protein in breast cancer: implications for tumour metastasis and chemoresistance

Treatment failure in breast cancer is one of the major reasons why the disease continues to have a significant burden on society. In this study it was found that the human AHNAK protein plays an important role in how breast cancer cells respond to the chemotherapeutic drug doxorubicin, specifically with regard to the regulation of apoptotic cell

death and the cell cycle. AHNAK performs these functions only in cells that are resistant to doxorubicin. By understanding how breast cancer cells respond to treatment, it can be adjusted to prevent treatment failure and improve patient outcome.
Supervisor: Prof A-M Engelbrecht
Co-supervisor: Dr B Loos

DE BEER, Danielle Marguerite (Biochemistry)

Winery wastewater treatment using a high rate biofilm contact reactor

A pilot scale biofilm reactor was designed, constructed and implemented for winery wastewater treatment. The system was tested at a winery in Stellenbosch and showed effective treatment of winery wastewater of varying strengths with minimal solid waste production, consistently neutralising pH, reducing chemical oxygen demand, nitrogen, sulphate, phosphate and solids to meet prescribed regulations for irrigation. The mechanism of action of the biofilm was investigated by studying biofilm microbial community structure, distribution of microorganisms and metabolic capabilities of biofilm samples from the system. The technology was patented, licensed and released commercially.
Supervisor: Prof TE Cloete
Co-supervisor: Dr M Botes

DE KLERK, Arno Reed (Zoology)

A comparative ecotoxicological study of two major South African river systems: a catchment scale approach for improved risk assessment and environmental management through the integration of abiotic, biotic and molecular endpoints

The Mokolo River is at the centre of plans to exploit the largest remaining coalfield in South Africa. Thus, this study aimed to improve our understanding of the range of impacts that may occur by comparatively studying the upper Olifants River system, which has been impacted by coal mining for over a century. Whilst important ecosystem drivers and indicators were identified, the benefit of rehabilitating ecological infrastructure to mitigate coal mining-associated pollution was also proven. This comparative study was a unique opportunity as few studies have the opportunity to assess the likely impacts of future land use change.
Supervisor: Prof A-M Botha-Oberholster
Co-supervisor: Prof JH van Wyk

ENGEL, Emile Richard (Chemistry)

Guest effects on the solid-state dynamics of selected inclusion compounds

Inclusion compounds involve at least two chemical species, where one acts as a host and another as a guest. A series of such compounds was identified where unusual thermal expansion behaviour, including shrinkage along one axis upon heating, was highly dependent on the choice of guest molecule. In addition, a framework-type inclusion compound was studied that absorbs carbon dioxide at high pressure, but only when the guest molecule is exchanged and subsequently removed. These results expand our relatively limited understanding of anomalous thermal expansion and contribute to the exploration of metal-organic frameworks as potential materials for gas storage and separation.
Supervisor: Prof LJ Barbour

LAUBSCHER, Mariska Riana (Microbiology)

Mycotoxin contamination of abalone feed: health and safety considerations for the abalone aquaculture industry

The abalone farming industry in South Africa uses artificial feed on most commercial farms. The current study showed that natural toxigenic fungi and their associated mycotoxins are present in artificial abalone feed. There are currently no limits for allowable mycotoxin concentrations in abalone feed. Toxigenic fungi isolated represented the genera *Fusarium, Aspergillus* and *Penicillium*. Results showed that artificial abalone feed favours mycotoxin production in toxigenic fungi and that fumonisins leach into the seawater. Recommendations were made to abalone farmers to lower the overall risks of fungal and mycotoxin contamination in abalone feed.
Supervisor: Prof K Jacobs
External Co-supervisor: Dr GJ Marais

LOOTS, Ruenda (Biochemistry)

Biofilms as multifunctional surface coating and adaptive systems: a biomimetic approach

A biomimetic approach was used to study microbial biofilms. The common survival strategies of biofilms were reviewed using biomimetic principles to create a novel framework for biofilm research. Biofilm responses to environmental changes were interpreted within this biomimetic framework. Microscopic and spectroscopic studies demonstrated that microorganisms use life-friendly chemistry to create self-organised, resource-efficient systems. Responses in whole-biofilm metabolism and planktonic cell yield showed that biofilms adapt rapidly to environmental changes and exposure to antimicrobial compounds, thereby acting as proliferation sites that ensure survival. The biomimetic framework can be used to inform new anti-biofilm strategies and explain complex microbial ecological phenomena.
Supervisor: Prof TE Cloete
Co-supervisor: Prof P Swart

MULIDZI, Azwimbavhi Reckson (Geology)

The effect of winery wastewater irrigation on the properties of selected soils from the South African wine region

The large volumes of wastewater produced annually by the South African wine industry create a disposal problem. This study assessed the changes to soils frequently irrigated with winery wastewater. Soil cation balances were negatively influenced in all soils. Sandy soils retained less salts, creating a pollution risk to groundwater. Clayey soils retained more salts, but breakdown in soil structure was an issue for certain soils. In dry climates, winter rainfall was insufficient to leach salts out of the rooting zone and will result in soil degradation. Thus

land application of winery wastewater negatively impacts soil and groundwater quality.
Supervisor: Dr CE Clarke
Co-supervisor: Prof AN Roychoudhury

NDEBEKA, Wilfrid Innocent (Physics)

Charge carrier effects in free-standing Si membranes investigated by linear and second harmonic techniques

The Si/SiO_2 interface is technologically important, playing a vital role in Si-based microelecytronics. Characteristics of this interface were investigated using a low average power, high intensity laser. Non-linear absorption of laser light in Si was observed and attributed to free charge carrier absorption (FCA). The electric field induced second harmonic (EFISH) light generated at the front and back Si/SiO_2 interfaces of an Si membrane was measured simultaneously and it is shown that the signal in transmission is higher than conventional theories predict, indicating that the interfacial electric field is affected by the FCA.
Supervisor: Prof EG Rohwer
Co-supervisors: Dr CM Steenkamp and Dr PH Neethling

NDLOVU, Ntombizikhona Beaulah (Physics)

Elemental analysis of mosses and lichens from the Western Cape (South Africa) using NAA and ICP-MS

Moss and lichen biomonitors from around the Cape Peninsula were analysed using neutron activation analysis (NAA) and inductively coupled mass spectrometry. The study also involved exposing samples collected in a pristine area in a controlled manner at various locations. The NAA involved the exposure of these biological materials and reference materials to neutrons in a research nuclear reactor, resulting in atomic nuclei becoming radioactive. The use of gamma-ray measurements of the irradiated materials then allowed the elemental content to be determined. New data on, amongst others, moss/lichen elemental content, air pollution levels inferred and biomonitor element accumulation efficiency were generated.
Supervisor: Prof RT Newman
External Co-supervisors: Dr P Maleka and Prof M Frontasyeva

NGODWANA, Lonwabo (Chemistry)

Resorcinarene-based n-heterocyclic carbenes: synthesis and reactivity

Resorcin[4]arenes (3-dimensional 'bowl-shaped' macrocyclic compounds) were distally equipped with *N*-heterocyclic carbene moieties which are well-known for their outstanding catalytic properties. It was envisaged that the combination of the host-guest properties of resorcin[4]arenes and the catalytic properties of *N*-heterocyclic carbenes would lead to a new class of catalysts with unique properties. To this end, three diverse libraries of resorcin[4]arene-based *N*-heterocyclic carbenes were prepared and found to be active catalysts in the Suzuki-Miyaura and Tsuji-Trost reactions, managing moderate to high conversion of starting materials to products. The results represent a significant step forward in resorcinarene-carbene chemistry.
Supervisor: Dr GE Arnott
Co-supervisor: Prof WAL van Otterlo

POSTMA, Anneke (Microbiology)

Soil microbial communities associated with two commercially important plant species indigenous to the fynbos region of South Africa: Cyclopia *spp. (honeybush) and* Aspalathus linearis *(rooibos)*

Two commercially important fynbos plant species, *Aspalathus linearis* and *Cyclopia* spp., are used to prepare rooibos and honeybush tea respectively. Soil microorganisms associated with these plant species play an important role in nutrient acquisition in the nutrient-poor fynbos soils. Agricultural activities can greatly affect the structure and function of the soil microbiome. Using these plant species as model systems, this study aimed to evaluate the effect of agricultural activities on the fynbos soil microbiome. We found that soil microbes associated with these two commercially important plant species were resilient to agricultural activities, but were greatly influenced by seasonal change.
Supervisor: Prof K Jacobs
Co-supervisor: Dr E Slabbert

RAJAONA, Solofomampionona Fortunat (Mathematics)

An algebraic framework for reasoning about privacy

Control of "who can see what" in distributed systems requires formalisms for specifying what a system must satisfy, and for reasoning that it does so. Such a formalism is proposed, consisting of algebraic laws, which is structured, and can in principle be automated and so the reason is done by computer. The laws were shown to be sound with respect to a model of independent interest. A relationship of "correct implementation" between computations is defined to preserve "who can see what" whilst enabling implementations to be related to their specifications. The theory is substantial and original, and is brought alive by examples, including the cocaine protocol and the muddy children.
Supervisor: Prof JW Sanders

RAMIHARIMANANA, Nantsoina Cynthia (Mathematics)

Solving embedding problems with bounded ramification

A result from number theory obtained by Juergen Neukirch has been significantly improved. An effective upper bound on the number of ramified primes that are required in the solution of each finite embedding problem over a finite Galois extension of local fields K/K_O with a solvable kernel has been given, provided local weak solutions exist, and under the condition that no root of unity whose order divides the order of the kernel belongs to K. In this situation it is proven that the number of ramified primes in question is bounded from above by the number of the rational prime divisors (counted with multiplicity) of the order of the kernel.
External Supervisor: Prof M Jarden
Co-supervisor: Prof BW Green

SABAN, Waheed (Chemistry)

Ligand design for the selective removal of metal ions from industrial streams and wastewater

New solvent extractants for the recovery of base metal ions were designed and synthesised. The ligand design features, needed to control the strength, transport efficiency and selectivity of these extractants, were addressed. The extractants showed varying percentages of selectivity for copper(II) and lead(II), and the ditopic extractants showed varying percentages of selectivity for the nitrate anion. Copper(II) was the only metal ion transported by all extractants. The ditopic extractants could be used to selectively extract copper(II) nitrate from a mixture of base metal ions and the anions chloride, sulphate and nitrate in industrial streams and wastewater.
Supervisor: Dr RC Luckay
External Co-supervisor: Dr R Malgas-Enus

SCHLÜNZ, Evert Barend (Operations Research)

Multi-objective in-core fuel management optimisation for nuclear research reactors

The candidate designed a decision support framework for constrained multi-objective nuclear research reactor in-core fuel management, with a particular emphasis on the SAFARI-1 research reactor in South Africa. The framework provides an optimal set of trade-off solutions satisfying various utilisation and safety requirements simultaneously. Each solution corresponds to a specific loading arrangement of fuel assemblies in the reactor core. Apart from proposing an enhanced scalarisation-based optimisation methodology for in-core fuel management decisions, a comprehensive investigation was performed in respect of the relative effectiveness of several metaheuristic techniques in support of making such decisions. This investigation culminated in the proposal of a hyperheuristic solution technique, yielding superior results in the majority of test instances during numerical experiments.
Supervisor: Prof JH van Vuuren
Co-supervisor: Dr PM Bokov

TRUTER, Johannes Christoff (Zoology)

Testing for endocrine disruptors in South African waters: a comparative study employing in vitro and in screening approaches

Environmental chemicals may interfere with the endocrine systems of wildlife and humans. Although research in this field has proliferated globally, limited research and monitoring have been performed in South Africa. This study assessed molecular, cellular and organismal testing approaches, which were applied in several case studies (marine and freshwater ecosystems). By using Mozambique tilapia fish as model organism, the application of gene expression-based biomarkers, as screening tool for endocrine disruptive potential, was illustrated. This study indicated the risk of reproductive impairment in aquatic vertebrates due to chemical exposure in various South African surface water bodies. To determine health risk, screening should include all levels of testing and use multiple species as bio-indicators.
Supervisor: Prof JH van Wyk
Co-supervisor: Prof PJ Oberholster

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IFakhalthi yezeeAgrisayensi

PhD

ALLSOPP, Elleunorah (Entomology)

Developing an integrated management system for western flower thrips, Frankliniella occidentalis *(Pergande), on deciduous fruit, using semiochemicals in a push-pull strategy*

This study aimed to determine the control failure of thrips in orchards, and to investigate the development of a push-pull system to minimise economic damage. Field trials confirmed that thrips enter plum blossoms before the petals open and lay eggs in the flower parts. Bioassays showed that the plant essential oils thymol, methyl salicylate and carvacrol can reduce egg-laying by thrips significantly when applied to plum blossoms (acting as the push), and that white clover could be used as a trap crop (acting as the pull) in a push-pull strategy to manage thrips in plum orchards.
Supervisor: Dr P Addison
External Co-supervisor: Dr S Dewhirst

BALOYI, Mahlatse Annabella (Plant Pathology)

Inoculum ecology of Petri disease fungi in grapevines of South Africa

Petri disease is one of the most important grapevine trunk diseases affecting the productive lifespan of vineyards worldwide. The study detected for the first time in South African vineyards aerial fungal inocula of *Phaeomoniella chlamydospora* and 14 Phaeoacremonium species, as well as fruiting structures of *P. chlamydospora* and Pm. minimum. Spore release coincides with traditional winter and spring pruning practices, emphasising the need for pruning wound protection. Pathogenicity studies confirmed Phaeoacremonium species as grapevine pathogens. A population genetics study identified infected propagation material as a major means of spread, whilst sanitation practices in vineyards and surrounding orchards are required to reduce pathogen inoculum.
Supervisor: Dr F Halleen
Co-supervisor: Dr L Mostert

IDUN, Irene (Horticultural Science)

Preference of South African consumers for the eating quality and appearance of apples

The purpose of this research was to ascertain the taste and appearance preferences for apples amongst two consumer groups in South Africa. The results show that younger (18-25) consumers had a higher preference for firmness, sourness and green peel colour than older (26+) consumers. Therefore, firm, sour cultivars should preferentially be targeted at younger consumers. However, most South Africans tend to prefer sweeter apples. Marketing opportunities, therefore, exist for sweet tasting cultivars such as 'Fuji' that are less familiar to

South African consumers. Retailers should design apple sale strategies in accordance with their consumer profile.
Supervisor: Prof WJ Steyn
Co-supervisors: Ms M Muller; Prof KI Theron and Prof T Naes (External)

KERR, Tanya Jane (Conservation Ecology)

*Investigating the molecular epidemiology and the evolution of Feline Immunodeficiency Virus (FIV) in African lions (*Panthera leo*) and leopard (*Panthera pardus*) from South Africa*

Feline Immunodeficiency Virus (FIV) closely resembles Human Immunodeficiency Virus (HIV). It is hypothesised that FIV can be used as a molecular marker to track host dispersal. Phylogenetic analysis of FIVPle in lions (*Panthera leo*) differentiated lion populations at larger geographic scales and also showed the ability to predict pride interactions. Vertical transmission was identified as the primary mode of viral spread. Further phylogenetic analysis of viral sequences isolated from lions and leopards (*Panthera pardus* – FIVPpa), and the detection of cross-species transmission, contributed new evolutionary insights into the evolutionary factors that shape FIV, including multiple infections and recombination.
Supervisor: Prof S Matthee
Co-supervisors: Prof S Engelbrecht and Prof CA Matthee

KOOPMAN, Trevor Ashley (Plant Pathology)

Molecular characterisation and pathogenicity of the South African Venturia inaequalis *(apple scab) population*

Apple scab, caused by the fungus *Venturia inaequalis*, can cause significant crop losses in South African orchards. The genetic diversity, virulence, and races of the South African pathogen population were determined, and found to be genetically diverse, with isolates from Elgin differing significantly from other regions. High gene flow was observed between the regions. Apple scab races 1, 10 and 12 were found to be present in South Africa, and the resistance gene, *Rvi6*, effective against the pathogen. A qPCR method reliably detected fungal DNA in asymptomatic host tissue and can be used in screening cultivars for resistance.
Supervisor: Dr CL Lennox
Co-supervisors: Dr JC Meitz-Hopkins and Dr K Tobutt (External)

KOTZEE, Ilse (Conservation Ecology)

Applying a resilience approach to flood management in rapidly changing landscapes

The world as we know it is changing at a rapid pace. Although flooding is not a new phenomenon, the risks it poses have increased significantly in recent years, prompting the use of new ways to effectively manage flood events. The research presented focuses on developing improved systems approaches and knowledge on floods, flood regulation services and impact on people and infrastructure to inform a more integrated flood management. The results have immediate applicability to landscape managers in areas where data for process-based models and the capacity to interpret model outputs may be limited.
Supervisor: Prof B Reyers
Co-supervisor: Prof KJ Esler

MENSAH, Sylvanus (Forest Science)

Selected key ecosystem services, functions and the relation with biodiversity in natural forest ecosystems

The topic of this dissertation is globally on the forefront of forestry and ecologic research. Ecosystem services are defined as all goods and services obtained from ecosystems and thus put the environment in an ecological-social context. With his study the candidate was able to obtain novel information of how Mistbelt forests in Limpopo province contribute to the livelihood of local people and how local communities make use of the different ecosystem services. A focus was on the forests' carbon sequestration and honey production potential. An important finding was the significant correlation between biodiversity and the capacity of providing carbon storage, which was previously not analysed for forests in South Africa.
Supervisor: Prof T Seifert
Co-supervisor: Dr R Veldtman

MUNTIFERING, Jeffrey Robert (Conservation Ecology)

*A quantitative model to fine-tune tourism as a black rhinoceros (*Diceros bicornis*) conservation tool in north-west Namibia*

The study aimed to describe in theory and practice tourism's potential as a rhinoceros conservation tool in Namibia. It found that community-based conservation and tourism strategies are a good foundation for effectively combating rhinoceros poaching. The key factors that drive rhinoceros disturbance directly during encounters with tourists and indirectly from other tourism-related activity and infrastructure outputs were modelled. Application of these models yielded an evidence-based encounter protocol that reduced rhinoceros disturbance events from 26% to 5% in just two years. The study produced a clear, transferable set of prototypical elements that will help ensure sustainable expansion of rhinoceros tourism ventures.
Supervisor: Dr A Knight
Co-supervisors: Dr S Jacobs; Dr R Naidoo (External) and Dr W Linklater (External)

VAN ZYL, Carolina (Entomology)

Status of the invasive wasp species Vespula germanica *and* Polistes dominula *in South Africa, and the feasibility of various management strategies*

The invasive wasp species *Vespula germanica* and *Polistes dominula,* pose a potential threat to biodiversity and agriculture in the Cape Floristic Region. In an effort to identify suitable biocontrol agents, the pathogenicity of entomopathogenic nematode and fungal species was tested. Geometric morphometric analyses were used to identify the potential origin of introduced wasps and to determine the possible route of invasion followed in South Africa. The attractiveness of a range of lures and baits were tested with the aim to find effective baits/lures that could be used to monitor and control wasp populations in the Western Cape Province.
Supervisor: Dr R Veldtman
Co-supervisor: Dr P Addison

WANG, Margretha Diane (Animal Science)

Copy number variations in South African Nguni cattle: prevalence, characterisation and genetic diversity

Copy number variations are a type of mutation specifically consisting of deletions or duplications in the genome that are larger than 1 kb. The distribution and significance of these variations in the DNA of South African Nguni cattle was for the first time determined. The contribution this variation makes towards differences evident between animals, populations and breeds was also ascertained. These variations were demonstrated to be non-random events that target specific locations in the DNA that are important for functions involved in an animal's ability to adapt. Suitable protocol for identifying these mutations was also determined.
External Supervisor: Dr F Muchadeyi
Co-supervisor: Prof K Dzama

Fakulteit Ingenieurswese
Faculty of Engineering
IFakhalthi yezobuNjineli

PhD

ALAUD, Salhin Mohamed (Civil Engineering)

Durability of concrete under combined action – mechanical load and alkali-silica reaction

Alkali-silica reaction, a chemical deterioration process, affects concrete structures worldwide and in Stellenbosch. The performance of plain and reinforced concrete was studied under combined action of alkali-silica reaction and mechanical loading. Concretes containing reactive and non-reactive Greywacke and granite aggregates, with and without remedial partial cement replacement with local slagment from the Saldanha Corex steel plant, were exposed to accelerated test environments in specially designed test chambers. The reaction accelerated under the combined action. The observation and proposed model of mechanical crack width reduction by the continued process hold significant value for the design of intervention strategies for affected structures.
Supervisor: Prof GPAG van Zijl

BOTHA, Jacques (Civil Engineering)

Probabilistic models of design wind loads in South Africa

The formulation of design wind loads on structures is subject to multiple uncertainties. Reliability modelling of this process is required to ensure that the desired safety margin is achieved for structures subject to wind. The uncertainties inherent in the three primary wind load components in the design wind load formulation were quantified. A new probabilistic wind load model was developed based on a rational and transparent reliability framework. It was used to assess the reliability performance of the South African wind load stipulations. The current stipulations do not provide adequate reliability performance. Suitable recommendations to address shortcomings were made.
Supervisor: Dr C Viljoen
Co-supervisor: Prof JV Retief

BRINK, Daniek (Electronic Engineering)

Using probabilistic graphical models to detect dynamic objects for mobile robots

Dynamic object detection is essential for collision-free navigation of autonomous mobile robots. Existing approaches either require known robot poses or a predominantly stationary environment. The candidate avoided both assumptions by developing a novel feature-based probabilistic graphical model (PGM) approach that carefully models the uncertainties involved. The design choices lead to a hybrid PGM, in which tractable inference can be challenging. She addressed this issue by pre-computing messages sent from continuous variables to discrete variables and performing loopy belief propagation over the discrete variables. Experiments on the KITTI benchmark datasets indicate that this approach often outperforms a state-of-the-art feature-based algorithm.
Supervisor: Dr CE van Daalen
Co-supervisor: Prof BM Herbst

BUSCH, Regardt (Electronic Engineering)

Optimised active fault detection for an open-loop stable system

Active fault detection for an open-loop stable linear time invariant system is considered. The optimal setup is developed around an estimator-based architecture, with the auxiliary signal and estimator designed to maximise performance. This architecture is extended to arrive at a solution without the nominal performance penalty normally associated with active fault detection. The effect of the excitation signal frequency on detector performance is investigated, and a minimum targeted detection time parameter is introduced. This set of equations is then used to minimise the fault detection time for fixed performance constraints and minimum targeted detection time.
Supervisor: Prof T Jones
Co-supervisor: Dr IK Peddle

COLMANT, Alexandre (Industrial Engineering)

Decision support for response selection in maritime law enforcement

In the context of maritime law enforcement, a human operator is typically required to make a variety of counter-threat decisions following the detection and evaluation of threats at sea. These decisions reside within a so-called response selection process during which maritime law enforcement vessels have to be dispatched to intercept maritime vessels that are deemed potential threats (e.g. partaking in illegal fishing, piracy or human trafficking). Because the nature of this decision process is complex, the quality of these

resource assignment decisions can be improved significantly by providing maritime operators with computerised support in the form of a semi-automated response selection decision support system. The candidate designed, demonstrated and tested such a computerised decision support system.
Supervisor: Prof JH van Vuuren

DLAMINI, Zinhle Zandile (Electronic Engineering)

Robust-fly-by-wire under horizontal tail damage

The effect of horizontal stabiliser damage on a large transport aircraft was investigated. A comparison of the effect was made between fly-by-wire and non-fly-by-wire aircraft. It was proven that the fly-by-wire system improves robustness against damage. With 50% horizontal stabiliser loss the fly-by-wire aircraft is controllable, but unsafe to fly. An optimisation-based analysis was carried out to establish a strategy to improve the generic longitudinal fly-by-wire system. It was shown that the addition of carefully structured pitch angle feedback improves the system such that it is stable and has acceptable handling qualities with 50% horizontal stabiliser loss.
Supervisor: Prof T Jones

ENGELBRECHT, Jacobus Adriaan Albertus (Elektroniese Ingenieurswese)

Automatic flight envelope recovery for large transport aircraft

Hierdie proefskrif beskryf die ontwerp van 'n outomatiese vlugherstelstelsel vir groot kommersiële passasiersvliegtuie. Twee nuwe benaderings word voorgestel en bevestig. Die eerste benadering herstel die vliegtuig op 'n passiewe manier van staak en tolvlug deur middel van die natuurlike vlugstabiliteit, en gebruik dan die konvensionele vlugbeheerwette met hulle beskermingsfunksies om die vliegtuig te herstel na gelyk vlug. Die tweede benadering herstel die vliegtuig op 'n aktiewe manier van staak en tolvlug deur 'n Lyapunov-beheerwet te gebruik wat die beheervlakke aktueer, en gebruik 'n optimale beheerwet om die vliegtuig te herstel na gelyk vlug met die minimum hoogteverlies.
Promotor: Prof T Jones

GAUCHÉ, Paul (Mechanical Engineering)

Spatial-temporal model to evaluate the system potential of concentrating solar power towers in South Africa

A state-of-the-art concentrating solar power (CSP) central receiver system uses mirrors to reflect sunlight to a tower where a working fluid is heated, then stored as thermal energy and ultimately converted to electricity in a steam turbine. A novel model is presented that predicts the performance of these plants suitably in an electricity system, within available means, to 7% accuracy. The value of CSP was studied in various scenarios, demonstrating its potential and value leading to the 2030 timeframe. Dependent on many factors, a large CSP capacity allocation arguably benefits the South African electricity system significantly.
Supervisor: Prof TW von Backström
Co-supervisor: Prof AC Brent

LOUW, Jeanne (Chemical Engineering)

Supercritical water gasification of wood-related products: a thermodynamic and experimental study

A method, based on thermodynamic equilibrium calculations and the feedstock elemental composition, was developed to aid in the selection of suitable feed material and operating conditions for supercritical water gasification (SCWG). An improved understanding of the possible kinetic effects, including catalyst type, catalyst loading and reaction time, was provided using wood-related products sourced at three different stages of the wood utility cycle, including wood chips, paper sludge and wood-based pyrolysis char. New insights into the effect of the elemental composition and volatile matter content of the feed material on the experimental gasification efficiencies and yields were also provided.
Supervisor: Prof AJ Burger
Co-supervisor: Prof C Schwarz

MUIYSER, Jacques (Mechanical Engineering)

Investigation of large-scale cooling system fan vibration

Air-cooled condenser fans operate under conditions that may lead to high levels of blade vibration. Research was therefore conducted to satisfy an industrial requirement for additional design criteria due to a lack of published work regarding the dynamics of cooling system fans. Full-scale measurements were recorded, after which the expected causes of fan blade loading were further investigated experimentally. An aerodynamic model was then implemented based on these findings and coupled to a flexible multibody simulation of the complete fan system. The effects of changes in structural and operational parameters were investigated to generate meaningful design recommendations.
Supervisor: Dr DNJ Els
Co-supervisor: Prof SJ van der Spuy

MUTONKOLE, Ngoy (Electronic Engineering)

Modelling of antenna responses

This dissertation presents surrogate modelling techniques for the radiation patterns and scattering parameters of antennas. The main contribution is a method that allows, for the first time, multivariate parametric modelling of the full radiation patterns of general antenna structures. An adaptive sampling technique is also presented which allows the models to be set up using the minimum number of samples in frequency as well as the geometric parameter space, while maintaining a user-controllable modelling accuracy. Models are very fast to evaluate, and represent a significant step towards general antenna design automation.
Supervisor: Prof DIL de Villiers

ONDIAKA, Mary Nelima (Chemical Engineering)

Prediction of behaviour kinetics and toxicity of engineered nanomaterials in aqueous environment using neural networks

Flow analysis models fail to accurately predict behaviour and toxicity of engineered nanomaterials (ENMs) in aquatic systems because of reliance on market information as inputs. The study used a multilayer

perceptron neural networks approach that utilised both qualitative and quantitative published data to develop aggregated models that predicted behaviour and toxicity of nano-titanium dioxide, a model ENM, on organisms in aqueous environment. Sensitivity analysis independently performed on aggregated models showed accurate prediction of the interaction between the predictor and response variables. This is a novel tool applicable in environmental modelling to manage the risks of ENMs in the aquatic systems.
External Supervisor: Dr N Musee
Co-supervisors: Prof C Aldrich and Dr AFA Chimphango

VAN VUUREN, Brian John (Industrial Engineering)

An agent-based simulation model of Eldana saccharina *Walker*

An agent-based simulation model is formulated in order to simulate the population dynamics of *Eldana saccharina* Walker in sugarcane. The simulation model comprises four distinct building blocks, namely a graphical user interface, the implementation of the life cycle *E. saccharina*, the mating process of *E. saccharina* and the oviposition and dispersal of *E. saccharina.* These building blocks are based on literature, as well as expert opinion collected in the form of an expert panel discussion. The simulation model is also equipped with functionality which allows Geographic Information System (GIS) data importation as a platform on which to run the simulation model.
Supervisor: Dr L Potgieter
Co-supervisor: Prof J Bekker

WALLS, Richard Shaun (Civil Engineering)

A beam finite element for the analysis of structures in fire

This dissertation presents a customised beam finite element and simplified methodology for analysing buildings to ensure that they can withstand severe fires (a must for all SA university buildings). Using the proposed formulation engineers can ensure structural fire safety more readily in comparison to existing advanced methods, whilst still considering global structural behaviour, which simplified methods do not. Buildings are modelled as skeletal frames and the effects of fire are applied using equivalent thermal forces. A single, resultant bending and axial stiffness is calculated for beams about an updated neutral axis position. The objective of the research is to make rational structural fire design more accessible to consulting engineers.
Supervisor: Dr C Viljoen
Co-supervisor: Dr H de Clerq

XIANG, Daopu (Electronic Engineering)

Fast mesh-based physical optics for large-scale electromagnetic analysis

The asymptotic, physical optics (PO) approximation can be employed to reduce the computational cost of electromagnetic scattering analysis for electrically large, conducting objects. This work significantly accelerates the mesh-based, multiple-reflection PO (MRPO) method. Firstly, an optimal, adaptive, multi-level, buffer-based incident field shadowing determination algorithm is developed. Secondly, the multi-level, fast multipole method (MLFMM) is used to accelerate internal, reflected field calculations. Inter-group shadowing is efficiently incorporated. The resulting fast MRPO method's runtime scales as quasi-O (N log N), where N denotes the number of mesh elements. MRPO results are presented for electrically larger objects than ever before.
Supervisor: Prof MM Botha

DEng

VAN ZIJL, Gideon Pieter Adriaan Greeff (Civil Engineering)

Contributions to structural mechanics and durability in Structural Engineering

Contributions to Structural Engineering have been made in the categories: advanced cement-based construction materials, crack formation and durability towards durability design, renovation and retrofitting towards extended life span and sustainable energy-harvesting structures. The contributions have laid the link between construction material properties, structural behaviour and durability. Through the fundamental experimental research, structural mechanics and computational mechanics, it has been made possible to utilise the particular characteristics of advanced construction materials to improve structural performance and durability. An ensuing international conference series with a leadership role by the candidate is testament to the national and international relevance, importance and impact of this work.
Supervisor: Prof WP Boshoff

Fakulteit Geneeskunde en Gesondheidswetenskappe

Faculty of Medicine and Health Sciences

IFakhalthi yezamaChiza neeNzululwazi kwezeMpilo

PhD

ARCHER, Elize (Health Professions Education)

Engaging patient-centeredness in the undergraduate medical curriculum

There is evidence that medical students' inclination towards patient-centredness decline during undergraduate training. Patient-centredness focuses on patients rather than on their diseases and has been identified as an important core competence. The aim of this study was to understand the factors that influence the learning of patient-centredness in the undergraduate medical curriculum at Stellenbosch University. An explorative programmatic case study design was done, in which final-year students and their lecturers participated. The study revealed that important factors in the learning are background

characteristics, attitudinal factors, acquired skills and knowledge, subjective norms, self-efficacy, assessment and the environment where the learning occurs.
Supervisor: Prof EM Bitzer
Co-supervisor: Prof BB van Heerden

BEKKER, Adrie (Paediatrics)

Prevention and treatment of perinatal and infant tuberculosis in the HIV era

In settings with high prevalence of HIV and tuberculosis (TB), women of childbearing age are disproportionately affected by TB. Infants born to women with TB are at high risk of exposure and TB disease. The aim of this dissertation was to comprehensively investigate TB prevention and treatment strategies during the perinatal period and infancy in a high-burden setting. This study yielded important data on epidemiological and clinical aspects of maternal-infant TB at a referral hospital; identified barriers and solutions to delivery of isoniazid preventive therapy to newborns; and generated rigorous pharmacokinetic data to guide the dosing of first-line antituberculosis drugs in infants.
Supervisor: Prof AC Hesseling
Co-supervisor: Prof HS Schaaf

BOTHA, Ursula Alexandra (Psychiatry)

Establishing modified mental health assertive treatment programmes in a developing country

The candidate reported on the first South African assertive mental health intervention, showing that a programme modified for a low-resource setting remained effective in reducing days in hospital as long as home visits were included. These findings are critical for future development of efficient and cost-effective community-based mental health services. The examiners concurred that this represented an original and important body of work.
Supervisor: Prof DHJ Niehaus
Co-supervisor: Prof L Koen

DE SWARDT, Dalene (Medical Virology)

Blood dendritic cells in chronically HIV-infected individuals in South Africa: phenotype, function and immune modulation

The research confirmed that both myeloid and plasmacytoid dendritic cells (mDCs and pDCs) were significantly depleted in chronic HIV infection. Antiretroviral (ARV) therapy was unable to completely restore these cell populations. The presence of active TB co-infection further hindered ARV-induced DC restoration. HIV infection upregulated expression of CD86 in mDCs and TNFR2 in both mDCs and pDCs. Functionally, TLR-induced TNF-α production in both DC subsets and IFN-α production by pDC was increased in HIV. IL-12 production by mDCs was decreased. This study highlights important changes in DCs in chronic HIV which may inform novel immunotherapeutic approaches to augment current treatment.
Supervisor: Dr RH Glashoff

DLUDLA, Phiwayinkosi Vusi (Medical Physiology)

Compounds specific to Aspalathus linearis *protects the diabetic heart against oxidative stress: a mechanistic study*

The rising incidence of diabetes has been associated with an increase in cardiovascular mortality. Insulin and metformin remains the leading first-line anti-hyperglycemic therapies. However, these drugs have a limited capacity to protect the myocardium. An important feature of the diabetic heart is the observed shift in mitochondrial substrate preference that precedes the onset of oxidative damage, lipid toxicity and subsequent myocardial cell apoptosis. This study provides evidence that ASP co-treatment was able to prevent such shift and enhances endogenous antioxidant defenses, while decreasing lipid toxicity. This is an important finding for the diabetic at risk of developing heart failure.
External Supervisor: Dr R Johnson
Co-supervisor: Prof B Huisamen

DU PLESSIS, Stefan (Psychiatry)

Blood oxygen level dependant functional magnetic resonance imaging responses in human immunodeficiency virus infected subjects with and without apathy

HIV infection remains a major global health challenge despite the widespread implementation of effective prevention and treatment strategies. Of particular importance is the impact of HIV on the brain, and minor neurocognitive impairment remains a common feature. This series of functional magnetic resonance brain-imaging studies conducted by the candidate and co-workers explored underlying mechanisms of this disorder and provides new information regarding the neurobiology. These studies provide compelling evidence that fronto-striatal dysfunction is a core feature of HIV infection and needs to be considered in the assessment and management of all patients afflicted by this still prevalent illness.
Supervisor: Prof RA Emsley
External Co-supervisor: Prof M Vink

GEBHARDT, Gabriel Stefanus (Obstetrics and Gynaecology)

A critical evaluation of health care reform in maternity services in the Western Cape Province of South Africa, 2007-2012

This study was a critical evaluation of service delivery shifts within maternity care in a well-defined geographical service delivery area during 2007 to 2012. The impact of these service shifts on the regional maternity service in Tygerberg Hospital was investigated, specifically on caesarean section rates, maternal and perinatal mortality, patient and provider satisfaction and protocol compliance. The study concluded with a root-cause analysis of all the obstetrics and gynaecology medico-legal cases within the Western Cape and demonstrated that regionalisation of maternity care using well-defined levels of care can provide safe management of pregnancies in a large metropolitan district hospital.
Supervisor: Prof GB Theron

GOOSEN, Wynand Johan (Molecular Biology)

The evaluation of novel biomarkers and antigens for the diagnosis of Mycobacterium bovis *infection in African buffaloes (*Syncerus caffer*)*

This dissertation included studies focusing on the detection of biomarkers and their potential diagnostic use for *Mycobacterium bovis* infection in naturally exposed African buffaloes. African buffaloes are recognised hosts for bovine tuberculosis and currently available tests are suboptimal. The candidate has identified a novel biomarker (IP-10) in stimulated blood samples that could accurately distinguish between uninfected and *M. bovis*-infected buffaloes with greater sensitivity than currently used assays. This protein is stable to heat and dry storage, which facilitates transport from remote areas. These findings are a significant contribution to knowledge and management of animal TB.
Supervisor: Prof MA Miller
Co-supervisor: Dr SDC Parsons

HAMUNYELA, Roswita Hambeleleni (Nuclear Medicine)

Evaluation of small molecule inhibitors of HER2, PI3K, mTOR and Bcl-2 for their radiomodulatory effects in human breast cancer cell lines

Development of new approaches for treating breast cancer requires the identification of pro-survival signalling pathways, the perturbation of which would render cancer cells more vulnerable to the effects of radiation. In this PhD study, small molecule inhibitors of the human epidermal growth factor receptor 2 (HER2), phosphoinositide 3-kinase (PI3K), mammalian target of rapamycin (mTOR), and the pro-survival gene (Bcl-2) were evaluated for their radiomodulatory effects in human breast cancer cells. Two of the inhibitors, targeting PI3K, mTOR and Bcl-2, showed strong cellular radiosensitisation and, therefore, could potentially be developed further for multi-modality breast cancer treatment when used concomitantly with radiotherapy.
Supervisor: Prof JM Akudugu
Co-supervisor: Dr AM Serafin

JACK, Babalwa Unice (Medical Physiology)

An investigation into the anti-obesity properties of Cyclopia

The candidate investigated the anti-obesity properties of *Cyclopia* species, commonly known as honeybush tea. Polyphenolic content and anti-obesity activity varied according to *Cyclopia* species; therefore, bioactivity guided fractionation was used to identify bioactive compounds. Molecular biology techniques were used to investigate mechanisms whereby the anti-obesity effects were mediated. The presence of the flavanone, neoponcirin, was confirmed in *C. intermedia* for the first time and may itself also present anti-obesity properties. These results add to the growing body of evidence of the medicinal properties of this indigenous South African plant, supporting its commercialisation as a health-promoting nutraceutical against obesity.
External Supervisor: Dr C Pheiffer
Internal Co-supervisor: Prof B Huisamen
External Co-supervisor: Dr C Malherbe

MALHERBE, Stephanus Theron (Molekulêre Biologie)

Evaluating TB treatment responses by [18F] FDG-PET/CT imaging

Die studie toon verbasende heterogeniteit in PET/CT-beeldingsresponse na behandeling van pulmonale tuberkulose. Slegs 'n minderheid se pulmonale inflammasie klaar op teen die einde van behandeling en mikobakteriële mRNA is gevind in respiratoriese monsters, wat persistering van mikobakterieë in die meerderheid van pasiënte voorstel en op 'n belangrike rol vir die immuunsisteem dui om hervatting te voorkom.
Promotor: Prof G Walzl
Medepromotors: Prof K Ronacher-Mansveldt en prof J Warwick

MAPONGA, Tongai Gibson (Medical Virology)

Hepatitis B virus-associated hepatocellular carcinoma in South Africa: epidemiology and impact of HIV-1 coinfection and immune dysregulation

This study addressed the question of the impact of HIV on the evolution of hepatocellular carcinoma (HCC) from two approaches: epidemiological and immunological. The study showed a higher than expected prevalence of HIV amongst patients with HCC, suggesting HIV may be a risk factor for the evolution of this malignancy. Importantly it appears that HIV-infected women present at a much younger age compared to those without HIV. The immune data shows persistent T-lymphocyte dysregulation and delayed immune recovery in ART-experienced HBV/HIV coinfected patients. These pathways may be important in the development of HCC.
Supervisor: Dr MI Andersson
Co-supervisor: Dr RH Glashoff

MASCONI, Katya Laura (Chemical Pathology)

Methodological issues around the validation of models for predicting diabetes risk in developing countries

Multivariable prediction models using non-invasively measured predictors can improve diabetes risk screening strategies, but remain largely untested in developing countries. We assessed the methodological issues relating to the validation and performance of prevalent diabetes prediction models in Coloured South Africans. The five Caucasian population-derived diabetes prediction models tested had low discriminatory power, and provided prevalent diabetes rates not in agreement with those observed in Coloured South Africans. Implementating model improvement strategies did not affect discrimination, and only non-optimally improved calibration. The disappointing performance of Caucasian models in this study highlights the importance of population-specific models in diabetes risk screening strategies.
External Supervisor: Prof AP Kengne
Internal Co-supervisor: Prof RT Erasmus
External Co-supervisor: Prof TE Matsha

MATSASENG, Thabo (Obstetrics and Gynaecology)

The cost-effective IVF strategies in assisted reproduction technology programmes (ART)

The candidate studied low-cost IVF in an attempt to make the treatment available to a larger population. He identified a number of cost drivers. Personnel, stimulation protocols (medication), theatre cost and laboratory procedures were all addressed. With the assistance of the governmental infrastructure and the private sector, a model was developed that operated at a lower cost that could be implemented in other governmental institutions. This dissertation opens new avenues towards cost-effective IVF.
Supervisor: Prof TF Krüger

McGRATH, Marieta (Molecular Biology)

The extensive drug resistant Mycobacterium tuberculosis *proteome*

This is the first proteomics study of XDR tuberculosis using sensitive mass spectrometry technology. It showed that XDR strains differ physiologically from susceptible strains. Particularly, XDR strains may exhibit increased tolerance to other antibiotics. The study also showed potential for synergy between iron metabolism inhibitors and fluoroquinolones. Other findings include the feasibility of treatment of fluoroquinolone-resistant tuberculosis with a late-generation fluoroquinolone, moxifloxacin; an increased propensity of the Beijing lineage to acquire high-level fluoroquinolone resistance mutations; and no impact of nucleoside analogue antiretrovirals on acquired TB drug resistance. This work contributes to knowledge of optimal drug targets and treatment regimens.
Supervisor: Prof RM Warren
Co-supervisor: Prof NC Gey van Pittius

MOYO, Sikhulile (Medical Virology)

HIV-1 subtype C dynamics and evolutionary trends in Botswana

Botswana has one of the highest adult HIV 1 prevalence rates. The ability to accurately estimate HIV-1 incidence or the recency of infection, is an essential component of monitoring the transmission dynamics of HIV-1 and to evaluate prevention efforts. Incidence assays as well as multi-assay approaches were assessed. A novel cross-sectional biomarker, based on HIV-1 viral diversity, was used to characterise the recency of HIV-1 infection. The innovative use of pairwise diversity and the time to the most recent common ancestor (tMRCA) were further explored as potential approaches for identifying recent infections in the context of a heterosexual HIV 1 subtype C epidemic.
Supervisor: Prof S Engelbrecht
External Co-supervisor: Prof T de Oliveira

MPHAHLELE, Matsie Theodora (Molecular Biology)

Molecular characterisation and drug susceptibility of isolates from MDR-TB patients in the Eastern and Northern Cape Provinces of South Africa

In this study, the acquisition of second-line drug resistance among MDR-TB patients was determined to assess the impact of a standardised TB treatment in these two provinces of South Africa. High rates of poor outcomes and acquisition of drug resistance to second-line drugs during treatment were observed. Spoligotyping showed that almost half of patients in a sub-cohort of MDR-TB patients were reinfected with a second strain. This led to the conclusion that use of inadequate standardised MDR-TB treatment increased the risk of amplification of resistance, which was compounded by hospitalisation that also facilitated nosocomial spread in this setting.
Supervisor: Prof RM Warren

SMIT-VAN SCHALKWYK, Michelle (Medical Physiology)

Rooibos and melatonin: putative modulation of nicotine-induced effects of vascular function

Nicotine, an addictive ingredient of tobacco, is associated with cardiovascular injury. The candidate investigated whether rooibos, an indigenous plant with antioxidant properties, protected the cardiovascular system against nicotine-induced effects, and compared its effects with the hormone, melatonin. Nicotine resulted in vascular endothelial injury in rats and rat vascular tissue, associated with increased oxidative stress and reduced antioxidant activity. Fermented rooibos and melatonin both exerted beneficial effects on the vascular endothelium in nicotine-injured models. Protection was associated with increased release of nitric oxide, as well as up-regulation of antioxidant enzyme systems which could underlie the modulating actions observed with rooibos and melatonin.
Supervisor: Prof H Strijdom
Co-supervisor: Dr S Windvogel

WHITFIELD, Michael Gordon (Molecular Biology)

Pyrazinamide resistance in Mycobacterium tuberculosis

This study investigated the prevalence of pyrazinamide resistance globally and locally as well as across different resistant profiles. Pyrazinamide resistance was shown to be strongly associated with resistance to other anti-tuberculosis drugs, especially extensively drug-resistant tuberculosis. Targeted DNA sequencing of the *pncA* gene was shown to be an excellent surrogate for phenotypic drug susceptibility testing (DST) despite the presence of non-resistance causing mutations. A novel virtual sequencing technique was developed and evaluated for rapid pyrazinamide DST. This study added significantly to the current understanding of drug resistance in *Mycobacterium tuberculosis*.
Supervisor: Prof RM Warren
Co-Supervisor: Prof SL Sampson and Dr EM Streicher

WILLEMSE, Danicke (Molecular Biology)

Regulation of iron-sulphur cluster biogenesis in Mycobacterium tuberculosis

Iron-sulphur clusters are protein cofactors essential for the functioning of multiple proteins in *Mycobacterium tuberculosis*. This study aimed to investigate the role of a possible transcriptional regulator, Rv1460, in regulating iron-sulphur cluster biosynthesis. Loss of Rv1460 in *M. tuberculosis* was associated with impaired growth, increased susceptibility to oxidative stress and elevated expression of the iron-sulphur cluster biosynthesis system. Recombinant Rv1460 protein was shown

to bind an iron-sulphur cluster, and to bind directly to two predicted DNA binding sites. This study provides the first insights into the mechanism by which Rv1460 regulates iron-sulphur cluster biosynthesis in *M. tuberculosis*, and demonstrated its importance in mycobacterial physiology.
Supervisor: Dr MJ Williams
Co-Supervisor: Prof RM Warren

ZEMLIN, Annalise (Chemical Pathology)

HbA1c as a screening tool for diabetes mellitus and its use with traditional and novel biochemical parameters to predict cardiovascular risk in a local urban community

The global obesity epidemic fuelling an increased prevalence of type 2 diabetes mellitus has reached Africa. A high prevalence of diabetes mellitus and cardiovascular disease has been found in the mixed ancestry-population of the Western Cape. We challenged the recently proposed HbA1c cut-offs to diagnose diabetes mellitus and pre-diabetes and found that these levels were not suitable for this population and underestimate the true numbers. Furthermore, we investigated levels of adiponectin and E-selectin, novel markers of cardiovascular dysfunction. We found that these biomarkers were not of value for risk screening and emphasises the need for evidence-based population-specific cut-offs.
Supervisor: Prof RT Erasmus
External Co-supervisors: Prof A Kengne and Prof T Matsha