

PROGRAM VIR DIE EERSTE PLEGTIGHEID

DIE FAKULTEITE NATUURWETENSKAPPE, AGRIWETENSKAPPE, EKONOMIESE EN BESTUURSWETENSKAPPE EN INGENIEURSWESE

'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 prosesie 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. Orrelis: Francisco Salies.
Voorsanger: Barend van der Westhuizen.
3. Konstituering deur die Visekanselier.
4. Gebed deur eerwaarde Austen Jackson.
5. Verwelkoming deur die Visekanselier.
6. Voorstelling van doktorandi deur die dekane van die betrokke fakulteite en toekenning van die grade deur die Visekanselier.
7. Sluiting deur die Visekanselier.
8. Akademiese prosesie verlaat die verhoog.

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

PROGRAMME FOR THE FIRST CEREMONY

THE FACULTIES OF SCIENCE, AGRISCIENCES, ECONOMIC AND MANAGEMENT SCIENCES AND ENGINEERING

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. Organist: Francisco Salies.
Precentor: Barend van der Westhuizen.
3. Congregation formally constituted by the Vice-Chancellor.
4. Prayer by Rev Austen Jackson.
5. Welcome by the Vice-Chancellor.
6. Presentation of doctoral candidates by the deans of the respective faculties and conferment of degrees by the Vice-Chancellor.
7. Closing by the Vice-Chancellor.
8. The academic procession leaves the stage.

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

ISICWANGCISO-NKQUBO SOMSITHO WOKUQALA

IIFAKHALTHI EYOBUNZULULWAZI KWEZOBUGQI, EYEZEEAGRISAYENSI, EYOBUNZULULWAZI KWEZOQOQOSHO NOLAWULO NEYOBUNJINELI

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. Kukulwa uMhobe weSizwe (Jonga kumphakathi weqweqwe lokugqibela). Emva koko, ningahlala phantsi.
Umculo: yi-University of Stellenbosch Brass Ensemble. Umdlali wohadi: nguFrancisco Salies.
Umhlabeli: nguBarend van der Westhuizen.
3. UMsitho uvulwa ngokusesikweni nguSekela-Tshansila.
4. Umthandazo wenziwa nguMfu Austen Jackson.
5. Ulwamkelo lwenziwa nguSekela-Tshansila.
6. Ukunikezelwa kwabafundi bezidanga zobugqirha ziintloko zefakhalthi (iidin) ezichaphazelekayo nokuthweswa kwezidanga nguSekela-Tshansila.
7. Ukuvalwa koMsitho nguSekela-Tshansila.
8. 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, proefskrifitels 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

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

Fakuliteit Natuurwetenskappe

Faculty of Science

IFakhalithi yezobuNzululwazi kwezobuGqi

PhD

BASSON, Dirk Johannes (Mathematics)

On the coefficients of Drinfeld modular forms of higher rank

While defined on a different number system than the usual real numbers, Drinfeld modular forms are functions which exhibit remarkable symmetry properties. The 1-dimensional Drinfeld modular forms are well understood and correspond closely to classical modular forms, which have a central position in the solutions of many important problems in modern mathematics. Recently, higher dimensional Drinfeld modular forms have been defined, but not much is known about them at present. Important progress has been made toward the understanding of these functions.

Supervisor: Prof F Breuer

BOTES, Angela (Microbiology)

*Insights into the lignocellulosic physiology of the yeast pathogen
Cryptococcus neoformans var. grubii*

It is hypothesised that *Cryptococcus neoformans* var. *grubii*, which is the leading cause of fungal meningitis among HIV/AIDS patients in sub-Saharan Africa, enters the body from the natural environment via the lungs. This pioneering study demonstrated that this pathogen was able to grow on wood while utilising novel cellulases. One of these enzymes was transcribed during the fungus growths on mucin, thereby providing a better understanding of the initial colonisation of the bronchial mucosae by the fungus. The study opens new avenues for research into treatment strategies for this clinically significant pathogen.

Supervisor: Prof A Botha

BOTHA, Linda (Polymer Science)

The effect of in-process ethylene incorporation on the evolution of particle morphology and molecular characteristics of commercial heterophasic ethylene propylene copolymers (HEPCs)

The development of particle morphology and chemical composition distribution during the commercial gas-phase production of polypropylene impact copolymers is responsible for the physical properties of the products produced from these materials. This research probed, for the first time, the evolution of these parameters during commercial production. Clear correlations between the catalyst technology and process parameters used and the development of properties were established. The research significantly advanced both fundamental understanding of the process and the control over final product properties.

Supervisor: Prof AJ van Reenen

BREDENHAND, Emile (Entomology)

The development of the Biotope Quality Index (BQI)

Conserving landscapes for the future requires a measure which enables us to determine whether these landscapes are deteriorating through improper use, or are improving through restoration. These landscapes support a diverse array of organisms which are indicative of the state of the landscape and can be used to develop such a measure. Here, a new measure of assessment, the Biotope Quality Index, was developed. It uses an array of insects, and the proportions of the different insect types indicate the state of the landscape. This Index is sufficiently flexible and sensitive that it can be used for practical conservation planning.

Supervisor: Prof MJ Samways

DE KOCK, Michiel Burger (Physics)

From stable priors to maximum Bayesian evidence via a generalised rule of succession

Probability in Bayesian analysis is based on information and logical statements. "Logical independence" assumes that individual data points have no logical connection so that their joint probability factorises. The more general case of "exchangeability" assumes only that the joint probability is invariant under permutation. Conventional statistical physics formulae were derived based only on logical independence and it was shown that exchangeability leads to a new statistical physics with new entropies and new extremum principles. A number of symmetry principles were employed to construct stable prior distributions which have the desirable property of being both integrable and noninformative.

Supervisor: Prof HC Eggers

HAUPT, Tanya Magdeleen (Zoology)

Wandering albatross, Diomedea exulans, and the flightless moth, Pringleophaga marioni, on sub-Antarctic Marion Island: a case of ecosystem engineering?

Recent work proposed that wandering albatrosses, *Diomedea exulans*, serve as thermal ecosystem engineers for caterpillars of the flightless tineid moth, *Pringleophaga marioni*, on sub-Antarctic Marion Island. A multidisciplinary approach, integrating physiology, ecology and behaviour, was used to test this idea. Thermal engineering by wandering albatrosses may indeed improve caterpillar growth and survival, but the situation is more complicated than originally suggested, demonstrating that interactions among marine and terrestrial systems in the Antarctic are more subtle than previously thought. As a result, the consequences of climate change, biological invasions and habitat change may be difficult to forecast.

Supervisor: Prof SL Chown

Co-supervisors: Dr BJ Sinclair and Prof T Wossler

JOSEPH, Danzil Eugene (Physiological Sciences)

Hyperglycaemia-mediated onset of myocardial insulin resistance – unravelling molecular mechanisms and identifying therapeutic targets

Since the prevalence of diabetes is rapidly increasing and placing an enormous burden on developed and developing nations, it is essential to delineate underlying mechanisms driving this process. The role of short-term elevations of glucose (acute hyperglycaemia) in the pathogenesis of type 2 diabetes was investigated. A unique cell-based model was established and data revealed that acute hyperglycaemia triggers oxidative stress (both mitochondrial- and cytosolic-derived) that in turn activates four non-oxidative glucose pathways. This series of events ultimately leads to impaired cardiac glucose uptake. Antioxidant treatment emerged as a potential therapeutic approach to counter the detrimental effects of pronounced, acute hyperglycaemic episodes.

Supervisor: Prof MF Essop

LEUSSA, Nyango-Nkeh Adrienne (Biochemistry)

Characterisation of small cyclic peptides with antimalarial and antilisterial activity

Listeria monocytogenes, a food-borne bacterium causing listeriosis, and the malaria parasite, *Plasmodium falciparum*, are two human pathogens causing major fatalities due to increasing resistance. Nine of eleven natural antibiotic peptides from the tyrocidine group were shown to have a much more potent activity against the two human pathogens than 15 designed arginine- and tryptophan-rich hexapeptides. The tyrocidine antilisterial activity was enhanced by calcium, inducing a lytic to non-lytic change in activity, while they had a non-lytic activity towards *P. falciparum*. The tyrocidines were observed to have multiple targets which limited the potential of resistance.

Supervisor: Prof M Rautenbach

MACUAMULE, Cristiano Joao (Biochemistry)

Coenzyme A biosynthesis and utilisation by Plasmodium falciparum: drug targets for antimalarial chemotherapy

Novel antimalarial drugs are needed since the most virulent parasite that causes malaria, *Plasmodium falciparum*, has become resistant to all chemotherapies. Several erythrocytic-stage antimalarials are currently under investigation. However, most of such compounds target similar parasite pathways and/or molecules and are based on limited chemical scaffolds. The antiplasmodial activity of pantothenamides, pantothenate (Vitamin B5) analogues, to identify potent antiplasmodial compounds, was investigated. Pantothenamides were chemically modified to confer resistance to pantetheinase-mediated degradation and tested against *P. falciparum*. Additionally, the mode of action of these compounds was investigated. A new inhibitor with sub-nanomolar potency which shows excellent potential for development as a new antimalarial was discovered.

Supervisor: Prof E Strauss

Co-supervisor: Dr KJ Saliba

MAIKO, Khumo Gwendoline (Polymer Science)

Multidimensional separation of complex polymers according to microstructure

Complex polymer systems have multiple distributions with regard to molecular parameters such as molar mass, functionality, chemical composition, molecular architecture and microstructure affecting their properties. To describe these distributions quantitatively, advanced methods of analytical polymer science are required. Novel multidimensional fractionation methods were developed that separate complex polymers according to their microstructure. The separation of these polymers based on the parameters of microstructure and molar mass was achieved by comprehensive two-dimensional liquid chromatography. The

identification and quantification of the different microstructural sequences were conducted by online coupling of liquid chromatography and nuclear magnetic resonance spectroscopy.

Supervisor: Prof H Pasch

MONGWAKETSI, Nametso Precious (Polymer Science)

Studies on porphyrin-based nanorods for artificial light-harvesting applications

Photosynthetic processes in plants rely on the efficient conversion of light, for which chlorophyll plays an important role. In the current search for renewable energy sources, mimics of such natural systems are being investigated. Porphyrins are structurally similar to chlorophyll and also absorb light from the solar spectrum. Under certain conditions, porphyrins can be stacked into nanorods that have the potential to guide light to the location where it is needed for conversion to a useful form of energy such as electricity. Porphyrin nanorods have been embedded in polymer matrices to make a first step towards this guidance of light.

Supervisor: Prof M Maaza

Co-supervisors: Prof L Klumperman and Dr R Sparrow

MUSVUUGWA, Tendai (Botany)

Biodiversity and ecology of ophiostomatoid fungi associated with trees in the Cape Floristic Region of South Africa

The Cape Floristic Region (CFR) is renowned for its botanical diversity, but its fungal diversity remains underexplored. A pioneering study on the ophiostomatoid fungi associated with native trees in the Afromontane forests of the CFR was undertaken. Results provide insight into the diversity, ecology and evolution of these globally important plant-pathogenic fungi. In total 18 ophiostomatoid species were discovered in this niche, ten of which were new to science. Very specific associations between ophiostomatoid fungi and diverse mite and subcortical beetle species were also elucidated. These results impact both future forestry and conservation management practices.

Supervisor: Prof LL Dreyer

Co-supervisor: Dr F Roets

NDIMANDE, Gordon Sandile (Plant Biotechnology)

Increasing cellulosic biomass in sugarcane

An animal-derived cellulose synthase encoding sequence were successfully expressed in the transgenic lines of sugarcane that the candidate had generated. The transgenic lines showed an increase in cellulose synthase activity, and consequently those lines contained an elevated level of cellulose and reduced levels of lignin in their cell walls. Bagasse derived from these transgenic lines was more amenable to enzymatic saccharification.

Supervisor: Prof J Kossmann

Co-supervisor: Dr JR Lloyd

PHIRI, Ethel Emmarantia (Zoology)

Molecular phylogeny and biogeography of the Afrotropical freshwater crab fauna

Evolutionary affinities among Afrotropical freshwater decapod fauna were examined with emphasis on relationships within the widely distributed sub-Saharan genus *Potamonautes*. DNA sequence data derived from multiple loci were used to explore systematic and phylogenetic affinities. These results led to the description of five novel species and the documentation of several cryptic lineages among widely distributed taxa. Phylogenetic relationships revealed a monophyletic Afrotropical freshwater crab fauna, with the West African genera (*Liberonautes*, *Sudanonautes* and *Potamonemus*) being basal. Within *Potamonautes* several species radiations were detected. Divergence time estimations for the group provide corroborative evidence for a post-Gondwanic evolution of the group.

Supervisor: Prof SR Daniels

RAMANANTOANINA, Andriamihaja (Mathematics)

Spreading waves of invasive species

The ability to predict the dynamics of range expansion in a timely and efficient manner is crucial for conservation planning, especially for controlling invasive species. The study used mathematical modelling of integro-difference equations to systematically investigate how different factors, including propagule size and diversity, habitat heterogeneity and behavioural strategies, influence the spread of an invasive species. This led to the development of general formulae which depict the rate of spread under a variety of scenarios. These general formulae can significantly improve our ability to depict and predict the complex behaviours of range expansion dynamics.

Supervisor: Dr C Hui

Co-supervisor: Dr A Ouhinou

ROHWER, Christian Matthias (Physics)

Combinatorics and dynamics in polymer knots

The conservation of the topological state of a polymer knot was investigated. Whereas many theoretical approaches have attempted to constrain polymer conformations by fixing explicit knot theoretic invariants, two different schemes were developed. A combinatoric scheme that produces topologically equivalent polymer chain configurations systematically was used to calculate properties of a polymer loop wound around a rod. A stochastic formulation for topologically permissible moves enabled the mapping onto a one-dimensional system of crossing dynamics via a particle operator formalism. Thus perspectives are opened for new routes in calculating and performing computer simulations in the statistical physics of knotted polymers.

Supervisor: Prof KK Müller-Nedebock

Co-supervisor: Prof FG Scholtz

ROHWER, Egmont Johann (Physics)

Ultrafast photodynamics of ZnO solar cells sensitised with the organic indoline derivative D149

Time-resolved absorption spectroscopy with femtosecond laser pulses was used to investigate the initial molecular processes following absorption of light in a modern organic solar cell. The results showed that a very rapid charge transfer process, necessary for current generation, between donor and acceptor layers in the cell was taking place. The surprising efficiency of the cell at wavelengths corresponding to the donor's absorption bands could be attributed to this. Competing processes that limit the cell performance were found to be slower in comparison and the back reaction could be inhibited by incorporating appropriate materials in the cell design.

Supervisor: Prof HPH Schwoerer

Co-supervisor: Prof D Schlettwein

ROUX, Adriana (Operations Research)

On the (r,s) -domination number of a graph

The combinatorial optimisation problem of determining the smallest number of facilities that can be placed on a network of n nodes was considered. Here the properties that node i receives at most r_i facilities and has at least s_i facilities in its immediate vicinity (closed neighbourhood), for all $i = 1, \dots, n$, where $r = [r_1, \dots, r_n]$ and $s = [s_1, \dots, s_n]$ are pre-specified vectors of integers. Asymptotic bounds on this minimum number facilities were established for various infinite classes of network structures or topologies, and a number of algorithms were designed, implemented and tested for determining this minimum number of facilities for any given network topology as efficiently as possible.

Supervisor: Prof JH van Vuuren

SAMODIEN, Mugammad Ebrahim (Plant Biotechnology)

The analysis of starch degradation in Solanaceae species

Starch is a product made by most plants that is used in many different industries. The only known naturally occurring covalent modification of starch is the presence of phosphate which occurs in starches from some plants, most notably potato. In this study it was possible to increase starch phosphate in potato up to fourfold by repressing the activity of proteins which remove it from the starch granule surface. These plants were also inhibited in starch degradation in their leaves. Increasing starch-bound phosphate will be very helpful for the potato industry and may help in its development.

Supervisor: Dr JR Lloyd

Co-supervisor: Prof J Kossmann

SWART, Belinda Louisa (Genetics)

*The evolutionary history of the genus *Seriola* and the phylogeography and genetic diversity of *S. lalandi* (yellowtail) across its distribution range*

A multidisciplinary genetic approach to investigate the marine fish genus *Seriola* and the commercially important yellowtail (*S. lalandi*) was used. This represents the first molecular phylogeny for all nine recognised *Seriola* species. The phylogeographic analyses provided the first detailed investigation into the global population structure of yellowtail, revealing three geographically and genetically distinct groups in the North-eastern Pacific, North-western Pacific and Southern Hemisphere. Population genetic analyses of yellowtail within the Southern Hemisphere found that the South African populations are genetically distinct from those of the South Pacific and that there is significant differentiation within South Africa between populations from the west and south coast.

Supervisor: Prof R Roodt-Wilding

Co-supervisors: Dr A Bester-Van der Merwe and

Dr S von der Heyden

SWARTS, Andrew John (Chemistry)

Novel transition metal complexes based on N,N and N,P ligands as catalysts for ethylene transformation reactions

A series of novel metal complexes based on N,N and N,P chelating ligands were developed and fully characterised. These were tested as catalysts in the oligomerisation/polymerisation of ethylene. A central part of this project was a detailed investigation into mechanistic aspects of these new catalyst systems. Significant insight was obtained into the kinetic behaviour of these catalysts. The results of this study will be useful in further improving the design of highly effective olefin transformation catalysts, allowing for these processes to be carried out optimally and in a more cost-effective manner.

Supervisor: Prof SF Mapolie

SWARTZ, Jacobus Andreas (Physics)

Search for low-spin states above the 5-alpha break-up threshold in ^{20}Ne

An experiment was conducted to investigate the structure of the ^{20}Ne nucleus via the $^{22}\text{Ne}(p,t)^{20}\text{Ne}$ reaction, with a proton beam from the iThemba LABS cyclotron at a beam energy of $E_{\text{lab}} = 60$ MeV. Triton ejectile particles were observed in the high-resolution focal plane of the K600 magnetic spectrometer. Six new low-spin states were discovered at excitation energies between 16 and 23 MeV. Theoretical calculations indicate that three of them may be isobaric analogue states of known states in ^{20}O . A candidate for the 5- α Hoyle-like state was identified at 3 MeV above the 5- α break-up threshold energy.

Supervisor: Prof P Papka

Co-supervisor: Dr FD Smit

TROSKIE, Anscha Mari (Biochemistry)

Tyrocidines, cyclic decapeptides produced by soil bacilli, as potent inhibitors of fungal pathogens

The tyrocidines, antibiotic peptides produced by the soil bacterium *Bacillus aneurinolyticus*, were observed to have significant antifungal activity against a range of phytopathogens which bodes well for their development as bio-fungicides in agriculture. The tyrocidines were also active against the human pathogen *Candida albicans* and exhibited overt synergistic activity with two key antifungal drugs, caspofungin and amphotericin B, highlighting their potential to serve as candidates for combinatorial antifungal treatment in medicine. In addition to membrane activity, evidence was also obtained for additional mode(s) of antifungal action, classifying the tyrocidines as potential drug and biocide lead compounds with low resistance potential.

Supervisor: Prof M Rautenbach

VISSER, Jacobus Albertus Koch (Biochemistry)

Phytoestrogenic extracts of Cyclopia modulate molecular targets involved in the prevention and treatment of breast cancer

Extracts of *Cyclopia*, a South African fynbos plant, modulate molecular targets involved in breast cancer. It was established that the extracts behave as estrogen-receptor-alpha (ER α) antagonists and estrogen-receptor-beta (ER β) agonists, while also down-regulating ER α protein levels and stabilising ER β protein levels. In addition, the extracts displayed cell cycle arrest, anti-proliferative and anti-inflammatory properties. Furthermore, *in vivo* the extracts were absorbed, not toxic, and displayed biological ER α antagonist activity in preventing uterine hyperplasia. Together these selective ER-subtype modulating attributes of the *Cyclopia* extracts may be beneficial for the prevention or treatment of breast cancer. Thus, *Cyclopia* could be developed as a nutraceutical.

Supervisor: Prof A Louw

Fakulteit Agriwetenskappe

Faculty of Agrisciences

IFakhalthi yezeeAgrisayensi

PhD

BRAND, Mariëtte Rieks (Conservation Ecology)

Pollination ecosystem services to hybrid seed crops in South Africa

This study addressed the importance of pollination by wild insects for the hybrid onion seed industry of the Karoo. Periodically hybrid onion seed farmers have severe crop failure owing to a lack of cross pollination. This study shows that the honeybee is the most important pollinator, whether from beehives or through

wild, natural populations. Honeybees carried the most pollen on their bodies and this was found to be important for pollination crossing between different parent onion hybrid lines. These results emphasise that conservation of natural areas and correct management of managed honeybees are paramount for optimal and reliable seed production.

Supervisor: Prof MJ Samways

Co-supervisors: Dr R Veldtman and Dr JF Colville

BUGAN, Richard Damian Hunter (Soil Science)

Modelling and regulating hydrosalinity dynamics in the Sandspruit River Catchment (Western Cape)

The presence and impacts of dryland salinity are increasingly becoming evident in the semi-arid Western Cape. This may have serious consequences for a region that has already been classified as water scarce. This research attempted to provide methodology for regulating the hydrosalinity dynamics in a catchment affected by dryland salinity, i.e. the Sandspruit catchment, through using hydrological modelling. The simulated hydrosalinity balance indicated a sensitivity to changes in land use with rooting depth and the spatial distribution of vegetation being identified as main factors. The revegetation strategy resulted in an almost 50% reduction in catchment salt build-up, providing possible mitigation solutions in the Berg River catchment.

Supervisor: Dr WP de Clercq

Co-supervisor: Dr N Jovanovic

DA SILVA, Jessica Marie (Conservation Ecology)

An investigation of the evolutionary diversification of a recent radiation of dwarf chameleons, Bradypodion, from KwaZulu-Natal Province, South Africa

The candidate investigated how a group of chameleons have adapted to their environments. She combined different lines of evidence, including data on genetics, morphology and performance. The main findings were that morphologically similar species do not necessarily have a shared ancestry. Instead, their morphological commonalities are due to convergence because they are adapted to similar environments. Conversely, species living in different habitats, for example forest and open grasslands, showed very different morphological features that are adaptive for that particular habitat. This work has led to a better understanding of how species respond to their environment.

Supervisor: Prof KA Tolley

Co-supervisors: Dr AT Knight and Dr SM Jacobs

GRANT, Paul Brian Charles (Conservation Ecology)

Acoustic profiling of the landscapes

There are today many adverse impacts on wildlife and the ecosystems that sustain them. It is important to assess how nature

around us is changing so as to put in place conservation measures. Yet there are so many species which simply cannot be seen, being hidden away in the undergrowth. In response, an exciting new method was developed which surveys the land using the sounds emitted by many of the animals. This method was so successful that it has huge potential for monitoring the success of our conservation efforts into the future, using a completely new technology.

Supervisor: Prof MJ Samways

JOUBERT, Lize (Conservation Ecology)

Disturbance factors related to conservation of biodiversity in large-scale ecological networks

With the high loss of biodiversity it is urgent that we find ways to stem this loss. In the context of South African forestry, measures are being put in place to conserve biodiversity by setting aside land in the form of large corridors between the plantation blocks. The challenge then is to manage these corridors and their connections to benefit both forestry and biodiversity. Successful management can be achieved by burning grasses in the corridors for plantation protection and by utilising grazing by cattle in the corridors. With such careful management there is a win-win situation for both forestry and biodiversity.

Supervisor: Prof MJ Samways

Co-supervisor: Dr J Pryke

LOUW, Leanie (Oenology)

Sensory analysis of brandy: the application of rapid profiling methodologies

Brandy has been defined as a compositionally complex grape-based spirit beverage containing at least 36% alcohol by volume. The combination of its high alcohol content and complex volatile structure makes sensory evaluation of brandy very difficult. Rapid sensory profiling methods have not been validated for spirit beverages and, prior to this study, it was not clear whether applying these methods to brandy would be feasible. The primary objective of this work was to determine whether rapid sensory profiling methods are feasible for brandy and other spirit products. The outcomes of this study extended the brandy sensory evaluation toolbox.

Supervisor: Prof P van Rensburg

Co-supervisors: Prof MG Lambrechts and Dr HH Nieuwoudt

MACUAMULE, Custodia Lina Sofar (Food Science)

Milk fermentation as a preventative intervention in the spread of tuberculosis in Southern and Central Africa

The candidate studied the effect of milk fermentation on the survival of *Mycobacterium bovis*, the bacterium that causes bovine

tuberculosis (bTB) in humans and many animal species. She developed various methods for the quantification of *M. bovis* in dairy products, determined the effect of the fermentation on the survival of the bacteria and evaluated ethyl pyruvate as an antimicrobial agent against *M. bovis*. Her results show that a fermentation period of 60 hours is required to eliminate the bacteria, with an increased mortality when ethyl pyruvate is added to the fermenting milk. These findings are important in the control of the spread of bTB through contaminated and unpasteurised milk.

Supervisor: Prof RC Witthuhn

Co-supervisor: Prof IJF Wiid

NIEUWOUDT, Melanie (Food Science)

Evaluation of LTPI and LOX1 as indicators of barley malt and beer quality

Selection of raw materials, in particular barley malts, for a consistent and high quality beer has been a challenge for brewers globally. Specific biochemical markers in barley malt, namely lipid transfer protein I (LTPI), an important foam and flavour protein, lipoxygenase-I (LOX-I) linked with off-flavours, anti-radical/oxidant potential (AROP) linked with flavour stability and free amino nitrogen (FAN), important for beer fermentation and intact protein, were correlated with malt and beer quality. Correlations between LTPI, LOX-I and FAN predicted the end product quality as determined, using sensory analysis, and could be important in selecting high quality malts.

Supervisor: Prof M Rautenbach

Co-supervisor: Prof M Manley

SALIE, Khalid (Aquaculture)

Aquaculture practices in irrigation reservoirs of the Western Cape Province of South Africa in relation to multiple resource use and socio-ecological interaction

Water is a limited resource in South Africa, including the Western Cape region, where winter rainfall combined with summer irrigation practices has led to the development of a large number of irrigation reservoirs. A multiple use approach provides an opportunity for the introduction of sustainable fish farming. The study investigated the impact of fish farming practices on the fitness-for-use of irrigation reservoirs as well as its contribution to socio-economic development. It identified factors that could contribute to eutrophication and proposed specific mitigation measures to enhance sustainability. Knowledge gained will contribute to improved, integrated water catchment management and socio-economic development in rural areas.

Supervisor: Prof K Rana

Co-supervisor: Prof D Brink

ZYLSTRA, Matthew Jozef (Conservation Ecology)

Exploring meaningful nature experience, connectedness with nature and the revitalisation of transformative education for sustainability

Humanity's growing separation from nature is central to the social-ecological crises facing earth. With a view towards sustainability education, this transdisciplinary research explored meaningful nature experience (MNE) and its potential role in mitigating our fading connectedness with nature (CWN). Using mixed methods to reveal the essence of MNE, the study found that MNE is commonly associated with CWN and can be a catalyst, motivation and predictor for environmentally responsible behaviour. MNEs were also considered highly influential in shaping respondents' life outlook. Research outcomes support an educational renaissance that incorporates appreciations of MNE, CWN and their potentials to cultivate an ecological consciousness.

Supervisor: Prof KJ Esler

Co-supervisor: Prof LL le Grange

PhD (Agric)

BOUGAS, Nina Valleska (Oenology)

Factors influencing the style of brandy

Brandy production is a multi-step process, with each step playing an important role in the overall organoleptic profile and characteristics of the product. There is little information regarding the factors that influence the style of brandy. By law brandy must be matured in oak barrels for a minimum of 3 years; therefore producers have to wait 3 years before they will know the style of brandy. This study is aimed at understanding the factors that influence the style of brandies. The information obtained in this study could be used to design a prediction tool, which can be used to deduce and ensure the outcome of a specific style of brandy.

Supervisor: Prof P van Rensburg

Co-supervisor: Prof MG Lambrechts

COETZEE, Carien (Oenology)

Oxidation treatments affecting Sauvignon blanc wine sensory and chemical composition

The candidate used both sensory and analytical techniques to investigate oxidation of Sauvignon blanc wine. The evolution of aromatic and non-aromatic compounds in the wine was monitored during a controlled, repetitive oxidation process. The concentration of antioxidants and various pleasant aroma compounds decreased, while an increase in compounds associated with oxidation was observed. The sensory evaluation of these wines also delivered novel results. She also investigated sensory interactions between oxidation-derived compounds and two Sauvignon blanc

impact aroma compounds in a model wine with a trained sensory panel. The presence of aldehydes drastically influenced the sensory perceptions of the impact compounds.

Supervisor: Prof WJ du Toit

Co-supervisor: Prof ASCD Ferreira

ERASMUS, Arno (Plant Pathology)

Optimisation of imazalil application and green mould control in South African citrus packhouses

Penicillium digitatum green mould is the major cause of postharvest decay on citrus fruit. Control is mostly done through application of fungicides in packhouses. Optimisation of imazalil application was studied, focussing on the commonly used dip application. Fruit exposure time, pH and temperature of fungicide mixtures, wound size and post-treatment brushing significantly affected residue loading and green mould control. Effective residue levels were determined that indicated the expected control of sensitive and imazalil-resistant isolates; those resistant to imazalil could not be effectively controlled. Outcomes from this study resulted in updated industry guidelines to improve fungicide application, disease control and food safety.

Supervisor: Dr P Fourie

Co-supervisor: Dr C Lennox

KNOETZE, Rinus (Nematology)

A molecular, morphological and biological characterisation of the genus Globodera (Nematode: Heteroderinae) in South Africa

Surveys were undertaken to determine the distribution of cyst nematodes in South Africa. Phylogenetic and morphological studies established the distinct phylogenetic positions of these populations relative to an array of other cyst nematode species and enabled the description of three new *Globodera* species. In order to gain a more complete understanding of the biology of the group as agricultural pests, investigations were made into the pathogenicity, survival potential and reproduction capacity of these nematodes in South African soils, enabling nematologists to make informed decisions regarding the management of these nematodes.

Supervisor: Dr A Swart

Co-supervisor: Dr P Addison

MUTAWILA, Cheusi (Plant Pathology)

Improving pruning wound protection against grapevine trunk disease pathogens

Grapevine trunk diseases are a major cause of decline and loss of productivity in grapevines. In this study a better understanding of the factors and mechanisms involved in using *Trichoderma* spp. as

biocontrol fungi on pruning wounds was obtained. The best application time was assessed as six hours after pruning. Fungicide-resistant isolates of *Trichoderma* showed promise to be used together with benzimidazole fungicides to protect pruning wounds. The main secondary metabolite produced by our *Trichoderma* isolates was 6-pentyl- α -pyrone, which inhibited mycelial growth and spore germination of the trunk pathogens. *Trichoderma* spp. could activate several of the grapevine defence genes, showing that this mechanism may play a role in wound bioprotection.

Supervisor: Dr L Mostert

Co-supervisor: Dr F Halleen

OLIVIER, Willem Johannes (Animal Science)

The evaluation of a South African fine wool genetic resource flock

Genetic parameters for trait complexes (growth, wool, reproduction and conformation) were derived for a fine wool resource flock. All traits were heritable and would respond to purposeful selection. Genetic correlations among traits were mostly favourable, notable exceptions being genetic correlations of fibre diameter with live weight, wool weight and reproduction. Animals from the flock were similar to or better than industry animals in economic terms, refuting allegations that fine wool animals are poorly adapted. Genetic parameters for traits with economic value were used to make inferences on the accuracy of selection at different levels of recording, as practiced by industry.

Supervisor: Prof SWP Cloete

Co-supervisors: Prof JB van Wyk and Dr MA Snyman

VON DIEST, Saskia Gudrun (Plant Pathology)

Responses of Venturia inaequalis to sanitation and regional climate differences in South Africa

The South African apple industry relies on fungicides to control apple scab. Alternative management strategies were tested for the first time in South Africa. Post-harvest leaf-shredding significantly reduced scab levels on fruit in the following spring. Sources of viable, asexual spores overwintering in orchards were found in inner-bud tissue and late-season apples. New information on the behaviour of the sexual winter phase of the fungus in different climatic winter regions was found. Evidence suggests that a population in one region may have adapted to a warmer winter climate. This study contributes to the sustainable, integrated management of apple scab.

Supervisor: Dr C Lennox

Co-supervisor: Prof WE MacHardy

PhD (For)

WESSELS, Coenraad Brand (Wood Product Science)

The variation and prediction of structural timber properties of standing Pinus patula trees using non-destructive methods

Pinus patula plantations are the main saw-log resource for structural lumber production in South Africa. In this study the within- and between-tree variation in wood properties of young, South African grown *Pinus patula* trees, known to have important impacts on the suitability of sawn lumber for structural purposes, were investigated. Empirical prediction models for the flexural lumber properties of standing *Pinus patula* were developed, based on variables that could be assessed non-destructively. The results from this study can be used by tree breeders, growers and processors to help manage the negative effects associated with faster growth and lower rotation ages of plantation-grown *Pinus patula*.

Supervisor: Prof T Rypstra

Co-supervisor: Dr FS Malan

Fakulteit Ekonomiese en Bestuurswetenskappe

Faculty of Economic and Management Sciences

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PhD

GUSTAFSSON, Martin Anders (Economics)

Education and country growth models

This dissertation is concerned with how economics can and should influence education policy making. The relationship between human capital and economic growth is empirically investigated through a novel way of expanding the number of African and Latin American countries whose educational quality can be compared. Enrolment and spending patterns since 1970 present a guide for prioritisation between education levels. Countries experiencing faster economic growth are shown to have had systematically different spending patterns. Spending on secondary education appears to play a larger role in growth than previously thought. International case studies of how economic advice can assist policy making are also presented.

Supervisor: Prof S van der Berg

HUNTER, William Frederick Johannes Richard (Industrial Psychology)

The role of integrity and personality in counterproductive work behaviour

The pervasiveness of counterproductive work behaviour (CWB), such as corruption and fraud, has large-scale financial implications for business and the economy. The goal of the study was to investigate the influence of selected personality dimensions and

integrity on CWB. A further objective was to develop a psychometrically sound instrument to assess integrity. Confirmatory factor analyses indicated reasonable model fit. Structural equation modelling (SEM) indicated general support for the postulated relationships between the constructs. The valid integrity test that was developed will make a meaningful contribution towards the selection of employees and the development of an ethical culture in organisations.

Supervisor: Prof AS Engelbrecht

KRUGER, Hannelie (Besigheidsbestuur en -administrasie)

Trademark and brand dilution: an empirical investigation

Die doel van die studie was om die aard en omvang van handelsmerkbesmetting en -verdoewing, waarna gesamentlik verwys word as handelsmerkverdunding, te ondersoek. Die studie het 'n empiriese benadering gevolg wat die aard of invloed van handelsmerkverdunding illustreer op sewe komponente van kliëntgebaseerde handelsmerkwaarde. Daar is bevind dat die aard en omvang van handelsmerkverdunding beïnvloed word deur die tipe verdunding, die tipe motivering sowel as die besluit wat handelsmerkingesteldheid bepaal. Die empiriese bevindinge het aangedui dat denke/kennis sowel as polariteit en stabiliteit van ingesteldheid afneem wanneer die handelsmerk besmet word en dat besmetting en verdoewing verskillende effekte op die handelsmerke het wanneer hulle gesamentlik beskou word. Besmetting verlaag gevoelsinhoud/emosie, denke/kennis sowel as polariteit en die stabiliteit van ingesteldheid van hoë betrokkenheid-handelsmerke, terwyl verdoewing gevoelsinhoud/emosie, denke/kennis en handelsmerklojaliteit van lae betrokkenheid-handelsmerke verhoog. Besmetting en verdoewing het dus verskillende effekte op handelsmerke, afhangende van die vlak van betrokkenheid by die handelsmerk eerder as die tipe besluit wat aangewend word. Die onderskeie effekte van besmetting en verdoewing was verskillend aangesien dit afgehang het van die tipe besluit en die tipe motivering wat ter sprake was.

Promotor: Prof HC Boshoff

MAHEMBE, Bright (Industrial Psychology)

The development and empirical evaluation of a structural model to determine the learning potential competencies of a previously disadvantaged group

In South Africa, selection from a diverse and unequal population, as a result of unequal exposure to developmental opportunities, poses a formidable challenge. The objective of the present study was to develop an explanatory model that explicates cognitive and non-cognitive variables that represent the learning potential of the learner which affects learning performance. A sample of students from previously disadvantaged groups took part in the study. The results indicated that the measurement and structural models

showed close fit. The results of the present study provide important insights for educators and training and development specialists on how to identify talent for affirmative development in organisations in South Africa.

Supervisor: Prof CC Theron

Co-supervisor: Prof DJ Malan

STEINBACH, Max Rudibert (Economics)

Essays on dynamic macroeconomics

Econometric models have been an important part of the toolkit available to economists to analyse macroeconomic questions since the 1930s. During the past two decades New Keynesian dynamic stochastic general equilibrium (DSGE) models have emerged as a new and increasingly prominent method of quantitative macroeconomic modelling. These models have also become the *modus operandi* of policy analyses and economic forecasting in a number of the leading central banks in recent years. The candidate has developed, tested and applied such a DSGE model for the South African economy and also amended the model to provide for the most recent innovations in introducing financial sector imperfections following the global financial crisis.

Supervisor: Prof BW Smit

Co-supervisor: Prof SA du Plessis

UCTU, Ramazan (Economics)

The reconstruction of regional innovation systems to allow the evolution of the biotechnology industry in non-high technology regions: the case of the Western Cape region in South Africa

This research sought to understand the reconstruction of the regional innovation system in the Western Cape to enhance the biotechnology sector, including legislation altering the role of universities in bridging the gap between research outputs and commercialisation through licensing and spin-offs. The crucial barriers spin-offs faced were a lack of skills and funding. The study suggests the reconstruction of the regional innovation system (RIS) and changes in the national innovation system did not generate the desired outcomes. A beam of light is the successful development of a bio-entrepreneurship training programme, which laid the foundation to build an effective bridge between science and commerce.

Supervisor: Prof RCC Jafta

Fakulteit Ingenieurswese

Faculty of Engineering

IFakhalthi yezobuNjineli

PhD

ALLEN, Kenneth Guy (Mechanical Engineering)

Thermal storage in packed beds of rock for concentrating solar thermal power generation

Beds of packed rock with air as heat transfer fluid offer a potentially low-cost thermal energy storage technology for concentrating solar power plants. Rock suitability and packed bed heat transfer characteristics were investigated. Pressure drop correlations for crushed rock beds were formulated for various packing directions. A method was devised to determine optimum bed design parameters for maximum net income from a packed bed used in a power plant. A cost estimate shows that rock beds compare favourably with molten salt energy storage. The work contributes to the understanding of rock bed characteristics and leads towards detailed techno-economic studies on rock beds.

Supervisor: Prof TW von Backström

Co-supervisor: Prof DG Kröger

BENJAMIN, Yuda Lyangalo (Chemical Engineering)

Sugarcane cultivar selection for ethanol production using dilute acid pretreatment, enzymatic hydrolysis and fermentation

Improving sugarcane properties for combined bio-ethanol production (from juice and fibre) requires cultivar development and selection of preferred varieties. Identification of the novel varieties for combined ethanol production from juice and fibre has not been incorporated into previous crop development programmes in South Africa. A novel scientific methodology for selection of varieties with advantageous traits including agronomic properties combined with high processability of the fibre was developed. By using dilute acid pretreatment, enzymatic hydrolysis and fermentation it was demonstrated that ethanol production from fibre could be improved significantly, using preferred varieties. Farmers and biofuels sectors can benefit from this methodology.

Supervisor: Prof JF Görgens

DAL BEN, Matteo (Civil Engineering)

Resilient response and performance of bitumen stabilised materials incorporating reclaimed asphalt

The increasing use of bitumen stabilised materials for road construction in the world and especially in Southern Africa necessitates research into their fundamental properties. The candidate investigated the feasibility and suitability of producing these materials with reclaimed asphalt and relatively high blending ratios of recycled, graded, crushed stone. The findings show that the reclaimed asphalt type and percentage influence the rutting resistance, indirect tensile strength, shear properties, resilient modulus and moisture susceptibility. A portion of this study has been dedicated to the characterisation of the permanent deformation behaviour, moisture damage simulation and temperature distribution analysis in the bitumen stabilised materials.

Supervisor: Prof KJ Jenkins

DE VILLIERS, Hendrik Adrianus Cornelis (Electronic Engineering)

A vision-based South African sign language tutor

E-tutoring systems for sign languages can contribute greatly when qualified teachers are relatively scarce. A hand-tracking system using the Earth Mover's Distance is proposed and optimised for speed, and is shown to substantially improve hand pose estimation accuracy relative to existing systems. A novel graphical model is created which, through statistical reasoning, automatically performs colour calibration, a function usually performed through laborious and brittle manual intervention. Finally, a unique feedback approach is developed which uses natural language to not only describe errors made by the user, but also how they should be corrected.

Supervisor: Prof TR Niesler

Co-supervisor: Prof L van Zijl

DU PREEZ, Louis Jacobus (Chemical Engineering)

Reactive absorption kinetics of CO₂ in alcoholic solutions of MEA: fundamental knowledge for determining effective interfacial mass transfer area

The reactive absorption of carbon dioxide into alcoholic solutions of mono-ethanolamine is a viable method for measuring effective interfacial mass transfer area of separation column internals. Knowledge of the liquid phase reaction kinetics is of great importance in order to improve on the accuracy of effective area measurements. A novel *in situ* Fourier transform infrared method of analysis was developed and used to study the homogeneous liquid phase reaction kinetics of CO₂ with MEA in alcoholic solvents. New fundamentally derived rate expressions were developed for use in a numerical, rate-based method to calculate effective area from absorption rate data.

Supervisor: Prof JH Knoetze

Co-supervisor: Dr LH Callanan

GROENEWALD, Jacobus Willem de Villiers
(Extractive Metallurgical Engineering)

A process performance monitoring methodology for mineral processing plants

Key to remaining competitive within the mineral industry is ensuring that processes are operated optimally as far as possible. To this end a methodical approach to plant-wide process performance monitoring for mineral processing plants was developed, based upon the integration of process causality maps with data-based systems. The application of process causality maps significantly simplified process monitoring and improved the interpretability of the results through a reduction in complexity. Moreover, extreme learning machines were identified as a promising algorithm for the data analytical techniques forming part of a process performance monitoring solution.

Supervisor: Prof C Aldrich

Co-supervisors: Prof G Akdogan and Prof SM Bradshaw

KARIMI, Moshen (Extractive Metallurgical Engineering)

CFD analysis of solid-liquid-gas interactions in flotation vessels

A computational fluid dynamics (CFD) model was developed for the prediction of flotation rate constants. After beginning with the single-phase modelling based on the solutions of the continuity and momentum balance equations, the modelling framework was extended to include the gas-liquid interactions. The time-varying values of the turbulent flow field were then incorporated into a kinetic model of flotation. The final CFD-kinetic model was evaluated for the flotation of quartz and galena particles at different operational conditions, which resulted in good agreement between the numerical predictions and experimental data. The new model was found to be suitable for the flotation modelling and optimisation practices.

Supervisor: Prof G Akdogan

Co-supervisor: Prof SM Bradshaw

POTGIETER, Johannes Hendrik Jacob (Electrical Engineering)

Optimal topology and critical evaluation of a slip-synchronous permanent magnet wind generator

In this study, a reliable and robust, direct-drive, directly grid-connected slip-synchronous permanent magnet wind generator is proposed as an alternative to other wind generator systems. Since no gearbox or power electronic converter is used, the maintenance requirements of this generator system are much lower. Several implementation issues are identified and addressed, such as correct parameter estimation, grid stability analysis and generator design, to comply with grid code specifications. Through extensive design optimisation, different generator topologies are considered. All the operational principles of the generator are verified by means of practical tests, both in the laboratory and in the field.

Supervisor: Prof M Kamper

RUGBANI, Ali Milud (Mechanical Engineering)

The design, kinematics and error modelling of a novel micro-CMM parallel manipulator

The candidate has invented a novel micro-CMM parallel kinematic manipulator. The machine is considered as a viable positioning device for micro measurement applications. It offers the advantages associated with parallel kinematic manipulators, such as light carrying weight, high stiffness and no accumulation of errors, while avoiding some of the traditional disadvantages of parallel manipulators such as the associated effects of angular errors (Abbé error), singularity problems, workspace limitation and the extensive use of spherical joints. The analytical modelling of this research has succeeded in estimating the machine accuracy, with promising results of achieving the ultimate goal of measuring 3D objects with accuracy in the submicron region.

Supervisor: Prof K Schreve

VILLET, Wikus Theo (Electrical Engineering)

Critical evaluation and application of position sensorless control techniques for reluctance synchronous machine drives

In this study the viability of controlling the reluctance synchronous electrical machine without angular shaft position measurement for different industry applications is investigated. The three industrial applications investigated are wind generators, variable gear electric vehicle drive motors and electric mine scraper winches. Several position sensorless control techniques are investigated, implemented and evaluated at different machine power levels. Finite element analysis is used to analyse the effect of the machine geometry on the saliency-based position sensorless controllability of the reluctance synchronous machine. It is shown that the position sensorless controlled reluctance synchronous machine can be considered for various industry applications.

Supervisor: Prof M Kamper

Co-supervisor: Prof R Kennel

ZAMUDIO, Michelle (Chemical Engineering)

The separation of detergent range alkanes and alcohols with supercritical CO₂

Process performance data are crucial when evaluating the viability of a separation process, but due to the time and costs associated with pilot plant scale experiments the use of predictive process models to generate such data is often preferred for industrial applications. In this work a working process model was established in Aspen Plus[®] that can be used to predict the separation performance of a supercritical fluid fractionation process. In a novel approach the model was used to prove that supercritical fluid fractionation is a feasible process to consider for the separation of mixtures of detergent range alkanes and alcohol isomers.

Supervisor: Prof JH Knoetze

Co-supervisor: Dr CE Schwarz