

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 ontwinging 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. Perkussie, Orrel: Francisco Salies.
Voorsanger: Lunathi Ncumani.
3. Konstituering deur die Viserektor (Leer en Onderrig).
4. Gebed deur prof Nico Koopman.
5. Verwelkoming deur die Viserektor (Leer en Onderrig).
6. Voorstelling van doktorandi deur die dekane van die betrokke fakulteite en toekenning van die grade deur die Viserektor (Leer en Onderrig).
7. Sluiting deur die Viserektor (Leer en Onderrig).
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. Percussion, Organ: Francisco Salies.
Precentor: Lunathi Ncumani.
3. Congregation formally constituted by the Vice-Rector (Learning and Teaching).
4. Prayer by Prof Nico Koopman.
5. Welcome by the Vice-Rector (Learning and Teaching).
6. Presentation of doctoral candidates by the deans of the respective faculties and conferment of degrees by the Vice-Rector (Learning and Teaching).
7. Closing by the Vice-Rector (Learning and Teaching).
8. The academic procession leaves the stage.

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

ISICWANGCISO-NKQUBO SOMSITHO WOKUQALA

IIFAKHALTHI EYEZOBUNZULULWAZI KWEZOBUGQI, EYEZEEAGRISAYENSI, EYEZEENZULULWAZI KWEZOQOQOSHO NOLAWULO NEYEZOBUNJINELI

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. Umdlali wohadi nephekheshini: nguFrancisco Salies.
Umhlabeli: nguLunathi Ncumani.
3. UMsitho uvulwa ngokusesikweni nguSekela-Nqununu (wezeMfundo nokuFundisa).
4. Umthandazo wenziwa nguNjing Nico Koopman.
5. Ulwamkelo lwenziwa nguSekela-Nqununu (wezeMfundo nokuFundisa).
6. Ukwaziswa kwabafundi bezidanga zobugqirha ziintloko zeefakhalthi (iidin) ezichaphazelekayo nokuthweswa kwezidanga nguSekela-Nqununu (wezeMfundo nokuFundisa).
7. Ukuvalwa koMsitho nguSekela-Nqununu (wezeMfundo nokuFundisa).
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 zeedizethyishini kunye nezishwankathelo zophando. Izidanga zabathweswayo abangakwazanga ukubakho ubuqu kumsitho wothweso-zidanga bathweswa bengekho benjalo.

Fakulteit Natuurwetenskappe

Faculty of Science

IFakhalthi yezobuNzululwazi kwezobuGqi

PhD

ANDREOTTI, Sara (Zoology)

The conservation of South African white sharks: population numbers, genetic distinctiveness and global connections

To help the conservation of white sharks a unique categorisation system to manage large databases of dorsal fin images was developed. Fin recognition, mark recapture and genetic techniques had shown that the number of white sharks are dwindling along the South African coastline. The genetic evidence further suggests that the sharks along the coastline form one mixed population and are the remnants of either a recent founder event or have recently experienced a severe bottleneck. For the first time, data is also presented revealing a non-random association between individual white sharks, possibly pointing to a complex social behaviour.

Supervisor: Prof CA Matthee

Co-supervisor: Dr S von der Heyden

BIERMAN, Anandi (Genetika)

Mapping and survey sequencing of Dn resistance genes in Triticum aestivum L.

Russiese koringluis is 'n belangrike pes van broodkoring wat tot oesverlies lei en voedselsekuriteit bedreig. Die Dn-gene wat luisweerstand verleen is gelokaliseer op koringchromosome 1B, 1D en 7D. Tot dusver was die posisie van die Dn-gene op 7D, hetsy 7DS of 7DL, onseker. Die ligging van Dn1 op 7DS is bevestig, asook dat 7DS, en nie 7DL nie, morfologies die langer chromosoom-arm is. Daar is verder getoon dat die 17000 MB-genoom van broodkoring deur die gebruik van 'n nuwe, innoverende aanslag tot 80-voudig verminder kan word, wat 'n nuwe generasie basisvolgordebepalings en bio-informatiese analises van die genoom vergemaklik.

Promotor: Prof AM Botha-Oberholster

BLANCKENBERG, Jacobus Petrus (Physics)

Skyrme model description of heavy baryons with strangeness

Baryons are particular subatomic particles subject to the nuclear force. They are catalogued by the quantum numbers of their constituents that come in groups with light, moderate and large masses. Each group is subject to specific properties of the nuclear force. The subset of baryons with constituents from either group were studied. A consistent description was needed to capture various properties of the nuclear force. The masses of known baryons were reproduced and theoretical predictions for masses of baryons that have yet to be discovered were made.

Supervisor: Prof H Weigel

Co-supervisor: Prof FG Scholtz

BROECKHOVEN, Chris (Zoology)

Causes and consequences of body armour in the group-living lizard, Ouroborus cataphractus (Cordylidae)

A comparative and integrative approach was used to investigate the conditions under which body armour evolved and the consequences thereof on life-history traits in the armadillo lizard, *Ouroborus cataphractus*. The terrestrial predation pressure experienced by lizards during visits to termite foraging ports has resulted in heavy armour and a high bite force associated with a defensive tail-biting strategy. These adaptations, in turn, led to the evolution of a unique prey prehension mode and a shift in activity patterns. Moreover, group-living behaviour appears to have evolved to lower the impact of an increased aerial predation risk.

Supervisor: Prof P le FN Mouton

CLOETE, William Joseph (Polymer Science)

Strategies for antibiofouling membranes

Biofouling poses a serious problem on the operation of water purification membranes. The attachment of bacteria and the formation of an associated biofilm lead to reduced life span of the membranes and increased costs. Different strategies were investigated to overcome the initial attachment of bacteria, as well as to degrade the extracellular polymeric substance that forms the largest part of the biofilm. The

introduction of hydrophilic and/or zwitterionic polymers as grafts on the membrane largely inhibited attachment of bacteria. Protease and amylase enzymes were successfully immobilised on a nanofibrous membrane with retention of their activities.

Supervisor: Prof L Klumperman

Co-supervisor: Prof TE Cloete

DAVID, Andrew (Zoology)

Larval development and population genetics: an integrated approach for predicting the establishment and dispersal potential of a recently introduced polychaete (Annelida: Spionidae) in southern Africa

The study aimed to predict the establishment and dispersal potential of *Boccardia proboscidea*, a non-indigenous worm which is a recent pest of farmed abalone in South Africa using the established pest, *Polydora hoplura*, as a predictor species. An integrated approach, combining aspects of reproduction (fecundity and larval type, duration, and survival) under different temperature regimes and molecular techniques, suggests that the recent invader could become established across a wider distribution range than the established pest. *Boccardia proboscidea* benefits from a versatile reproductive strategy which may aid in its invasion of our coast but anthropogenic dispersal could facilitate its widespread dispersal.

Supervisor: Dr CA Simon

Co-supervisor: Prof CA Matthee

DE WAAL, Caroli (Botany)

Dispersal, dormancy, life history and breeding systems of southern African asteraceae: risk-reducing strategies in unpredictable environments

Unprecedented climate change makes it important to understand how organisms cope with environmental unpredictability. Traits and life history strategies of African daisies such as longevity, dispersal ability, dormancy and mating system were investigated, which act to reduce the consequences of climatic unpredictability. In daisies, these traits seldom act in isolation, and complex correlational patterns and trade-offs underpin how they operate. The associations between these traits offer some of the first empirical insights into how these traits mitigate the effects of environmental unpredictability.

Supervisor: Prof B Anderson

Co-supervisor: Prof AG Ellis

DU TOIT, Francois (Biochemistry)

Modelling glycolysis in Plasmodium-infected erythrocytes

A mathematical model for glycolysis of *Plasmodium falciparum*-infected erythrocytes was constructed. The model was first constructed for the trophozoite stage, and subsequently this model was extended to include all blood stage forms of the parasite, based on experimentally measured intracellular volumes. The model was successfully validated with inhibitor titrations of the glucose transporter, rendering this a potential drug target, since the inhibitor only affected glucose uptake in infected red blood cells. Finally, erythrocyte lysis, leading to the release of *Plasmodium* merozoites and their subsequent re-invasion in new red blood cells, was added to the mathematical model.

Supervisor: Prof JL Snoep

EINHORN, Mark David (Operations Research)

Self-organising traffic control algorithms at signalised intersections

Three novel, robust, self-organising traffic signal control algorithms were designed and implemented. These algorithms assume the use of local radar detection technology to provide all the data necessary to inform signal switching policies. The first algorithm was inspired by the theory of inventory control, while the second algorithm was inspired by the chemical process of osmosis. The third algorithm is a hybrid of the first two. All three algorithms were tested in a purpose-built, microscopic traffic simulation framework in terms of their ability to reduce total vehicle delay time and facilitate natural coordination among adjacent intersections. These tests demonstrated that the algorithms produce traffic signal switching policies that are superior to existing self-organising and centralised traffic control techniques.

Supervisor: Prof JH van Vuuren

Co-supervisor: Dr AP Burger

HOLTZHAUSEN, Petrus Jacobus (Applied Mathematics)

Securing perimeters with the use of video analytics

Ideally any video surveillance system should be able to detect an intruder at the time and point of intrusion. This real-time requirement poses a significant challenge to the development of automated systems. Since it has to operate in adverse weather conditions when visibility is poor, and need to deal with all sorts of environmental issues that can easily confuse the system, sophisticated algorithms are required. However, more sophisticated algorithms require more processing power, which is often not available. Robust, real-time algorithms for video surveillance were developed and implemented on static and pan-tilt-zoom cameras.

Supervisor: Prof BM Herbst

Co-supervisor: Dr WH Brink

ILCHEV, Alexander Assenov (Polymer Science)

Amine end-functional Poly(N-vinylpyrrolidone) as a macroinitiator for L-lysine N-carboxyanhydride polymerization – towards the preparation of pH-responsive micelles for drug delivery

It is commonly known that chemotherapy drugs for cancer exhibit very serious side effects. These side effects are caused by the high cytotoxicity of the drugs and their distribution throughout the body. One way to overcome the side effects is by targeting the anti-tumour drugs specifically to the tumour tissue and by releasing the active compound only at the target site. A block copolymer was synthesised that allows reversible attachment of known anti-tumour drugs. These drugs are bound to the polymer via a link that is exclusively hydrolysed under conditions specific for tumour tissue.

Supervisor: Prof L Klumperman

Co-supervisor: Dr R Pfukwa

JOHNSON, Christopher Michael (Botany)

Flowers with style: the role of pollinators in the origin and maintenance of proteaceae diversity with a focus on the genus Leucospermum

The overarching hypothesis was that the diversity of flowering plants can be explained by adaptation to pollinators. Pollinator observations, in combination with a molecular phylogeny for *Leucospermum* (Proteaceae), were used to test the role of pollinators in driving floral adaptation and speciation. This macroevolutionary perspective was complemented by microevolutionary studies of population divergence and adaptation for pollination by rodents, birds and long-proboscid flies. Finally, the role of pollinators in allowing a diversity of plant species to live together harmoniously in one community was explored. The work contributes greatly to our understanding of the origin and maintenance of plant diversity.

Supervisor: Prof A Pauw

KOTZÉ, Hendrik de Vries (Chemistry)

Immobilised Ru(II) catalysts for transfer hydrogenation and oxidative alkene cleavage reactions

New protocols for the immobilisation of several novel ruthenium catalysts based on arene and chelating N-donor ligands were developed. These immobilised catalysts were applied in the oxidative cleavage of alkenes as well as in transfer hydrogenation reactions. Investigations into the effect of several reaction parameters on the catalytic reactions provided some useful insight into the behaviour of these catalyst systems on a molecular level. This will facilitate the development of highly effective catalysts for the aforementioned processes, as well as for other organic transformations.

Supervisor: Prof SF Mapolie

KROUKAMP, Heinrich (Microbiology)

Improving the protein secretion capacity of Saccharomyces cerevisiae with strain engineering

Baker's yeast is frequently used for the production of industrial and biopharmaceutical proteins. Improving the production and secretion of recombinant proteins has the benefit of reducing the production costs and promoting accessibility to these technologies. This also holds true for second generation biofuel production, where high levels of hydrolytic enzymes are required to break down the complex carbohydrates in agricultural waste. The successful application of yeast strain engineering approaches was demonstrated to increase the secreted yields of several types of cellulolytic proteins, identifying potential genetic elements that promote secretion in yeast and some of the mechanisms responsible for this enhanced protein secretion were elucidated.

Supervisor: Prof WH van Zyl

External Co-supervisor: Dr R den Haan

NAIDOO, Darryl (Physics)

High brightness lasers

Various approaches to controlling spatial modes inside a laser cavity were considered. The problem of designing a high brightness laser that simultaneously maximises both the power extraction and the laser beam quality was considered. Both theoretical and experimental

evidence that this is possible are proved. A laser cavity that produces a Gaussian beam as the output with a seven times improvement on brightness as compared to standard lasers was demonstrated. The control of modes that carry orbital angular momentum was demonstrated.

External Supervisor: Prof A Forbes

Co-supervisor: Prof EG Rohwer

NEMULODI, Fhumulani (Physics)

Investigation of the 2^+ Hoyle state candidates in ^{12}C

The Hoyle state is arguably the most important energy level in atomic nuclei. It is referred to as the state behind life because of its importance in nucleosynthesis processes of all heavy elements beyond ^{12}C . This state has been extensively investigated. However, its structural properties remain a mystery. One of the open questions involves the existence of a rotational band built on the Hoyle state configuration. Several theories predict the existence of such a band. In this experimental investigation the 2^+ excitation of the Hoyle state was confirmed at $E_x = 9.690 \pm 0.110$ MeV and the decay modes were characterised.

Supervisor: Prof P Papka

External Co-supervisor: Dr R Neveling

NICOLI, Gautier (Geology)

The metamorphic and anatectic history of Archaean metapelitic granulites from the Southern Marginal Zone, Limpopo Belt, South Africa

The Southern Marginal Zone of the Limpopo Belt in South Africa is an exceptional laboratory to investigate the evolution of the earth's crust. It is a well-exposed Neoproterozoic terrain. This study is a combination of field geology, analytical work and numerical modelling. The results drawn from this work demonstrate that partial melting of the lower crust and differentiation mechanisms are controlled by disequilibrium processes from the scale of the outcrop to the scale of the mineral. The findings of this study also argue for modern-style plate tectonic mechanisms during the early stage of the evolution of the earth.

Supervisor: Prof G Stevens

ODENDAL, James Arthur (Chemistry)

What is the possible origin of the ^{195}Pt NMR shielding in the solid state? X-ray diffraction, solid-state NMR studies of deceptively simple $\text{C}_2[\text{PtX}_6]$ salts (C= various cations, X = Cl and Br)

For the first time direct experimental solid-state ^{195}Pt Nuclear Magnetic Resonance (NMR) evidence of a reasonable linear relationship between extremely small Pt-Cl bond extensions in simple salts of the hexachloridoplatinum complex and their ^{195}Pt NMR chemical shifts has been obtained. This idea was predicted more than four decades ago, and has been verified from the temperature dependence of the solid-state ^{195}Pt NMR chemical shift for and single crystal X-ray diffraction studies over a temperature range from minus 170°C to 130°C . Preliminary theoretical calculations have provided some corroboration of these phenomena.

Supervisor: Prof KR Koch

Co-supervisor: Prof L Barbour

OKOTH, Isaac Owino (Mathematics)

Combinatorics of oriented trees and tree-like structures

Tree enumeration is one of the most classical topics in combinatorics, going back to Cayley's work in the 19th century. Amongst other things, trees occur as data structures in computer science, or as models of acyclic molecules in chemistry. The candidate, motivated by questions stemming from algebraic geometry, studied labelled trees with an orientation induced by the labels. He proved a number of elegant combinatorial formulas for counting trees by statistics such as degree sequences, number of sources or sinks. Moreover, similar results for different tree-like structures were obtained and connections to other combinatorial objects were found.

Supervisor: Prof S Wagner

ROBERTSON, Divann Dale (Polymer Science)

Solution crystallisation analysis of polymers

Biopolymers like poly(lactic acid) (PLA) are increasingly replacing fossil fuel-based polymers. Slow crystallisation rates limit the application of these biopolymers. Solution crystallisation analysis by laser light scattering was used, for the first time, to study the crystallisation of a PLA. It was found that crystallising selected blends of the pure D and L enantiomers of PLA results in the formation of a stereocomplex that significantly increases the rate and extent of the crystallisation of this polymer. Similarly, it was shown that blending poly(butylene succinate) with PLA could enhance or retard crystallisation, depending on the amount of the PBS used.

Supervisor: Prof AJ van Reenen

SANDENBERGH, Lise (Genetics)

Identification of SNPs associated with robustness and greater reproductive success in the South African Merino sheep using SNP chip technology

Reproduction and robustness traits are integral in ensuring sustainable, efficient and profitable sheep farming in South Africa. By using novel, whole-genome single nucleotide polymorphism (SNP) genotyping technology, genomic regions associated with reproduction and robustness traits were identified in South African Merino sheep. Several traits determine reproduction potential and are influenced by numerous genes throughout the genome. SNP genotype information could be used to increase profitability and efficiency of sheep farming by enabling the accurate selection of superior breeding stock.

Supervisor: Prof S Cloete

Co-supervisor: Prof R Roodt-Wilding

SCHLOMS, Lindie (Biochemistry)

The inhibition of adrenal steroidogenic enzymes and modulation of glucocorticoid levels in vitro and in vivo by Aspalathus linearis (Rooibos)

Abnormal cortisol levels are associated with metabolic diseases such as hypertension and diabetes, affecting one in four adults. The study showed that the consumption of Rooibos reduced cortisol in humans and corticosterone in rats. The reduction was due to the inhibition of

adrenal steroidogenic enzymes by Rooibos and its flavonoid compounds. These enzymes catalyse the biosynthesis of cortisol, corticosterone and other adrenal hormones. Rooibos also inhibited the activation of cortisone, the inactive form of cortisol. The inhibition favours the maintenance of cortisol in its inactive form, which would contribute to the cortisol lowering effects of Rooibos.

Supervisor: Prof AC Swart

Co-supervisors: Prof C Smith and Dr K-H Storbeck

SONIBARE, Wasiu Adedayo (Geology)

Structure and evolution of basin and petroleum systems within a transform-related passive margin setting: data-based insights from crust-scale 3D modelling of the western Bredasdorp Basin, offshore South Africa

The impact of crust-mantle dynamics on subsidence patterns and its influence on petroleum prospectivity at a transform-related passive continental margin was studied. A multi-disciplinary workflow combined isostatic, 3D gravity, 3D thermal and petroleum system modelling. Offshore multi-scale datasets from the western Bredasdorp Basin, South Africa, were integrated, yielding the first 3D crust-scale model of the basin. Syn-rift subsidence, typical of a transtensional pull-apart setting and post-rift heat flow events, controlled the timing of petroleum generation and migration and showed that the basin was more mature than previously believed. Early maturation and late stage tertiary migration in the syn-rift setting dictate the extent of petroleum accumulation and loss in the basin.

External Supervisor: Prof D Mikëš

Co-supervisor: Prof A Rozendaal

SPANGENBERG, Dirk-Mathys (Physics)

Time domain ptychography

Direct measurement of the amplitude and phase of electric fields in the order of femto- and pico-seconds is not possible as no detector is fast enough. Indirect optical methods which utilise ultrafast lasers are used in order to do so by intensity measurement which results in losing the phase information. A spatial phase recovery technique called ptychography was migrated to the temporal domain. It was shown for the first time that domain ptychography can recover the lost phase. Time domain ptychography was then extended to pulse characterisation.

Supervisor: Prof EG Rohwer

Co-supervisors: Dr PH Neethling and Prof A Forbes

TROLLOPE, Kim Mary (Microbiology)

Engineering a fungal β -fructofuranosidase

Random and semi-rational protein engineering approaches were used to improve the *Aspergillus japonicus* β -fructofuranosidase enzyme for fructooligosaccharide (FOS) synthesis from sucrose. Improved enzyme variants were identified showing enhanced FOS, production efficiency, specific activity and thermostability. The study detailed a new method to rapidly quantify FOS, using mid infrared spectroscopy and a bio-informatics tool for *in silico* functional subclassification of β -fructofuranosidases. The improved

enzymes, combined with enzyme structure-function insights, will benefit future industrial production of FOS, a health-promoting dietary supplement for humans and animals.

Supervisor: Dr H Volschenk
Co-supervisor: Prof J Görgens

VAN ROOY, Milton William (Physics)

An investigation of a possible effect of reactor antineutrinos on the decay rate of ^{22}Na

Reported claims of a solar neutrino influence on radioactive β^- -decay rates prompted a series of three long-term measurements that were carried out at the Koeberg nuclear power plant to investigate the mirror reaction of reactor antineutrinos with a β^+ -source. The β^+ -emitter ^{22}Na was exposed to a changing reactor antineutrino flux of the order of $10^{12} - 10^{13} \text{ cm}^{-2}\text{s}^{-1}$ through the various phases of reactor operation and an upper limit of $0.2 \cdot 10^{-25} \text{ cm}^2$ was estimated for the cross section of antineutrinos interacting with ^{22}Na . Considering the systematic effects, no significant evidence for antineutrinos affecting β^+ -decay in ^{22}Na was found.

Supervisor: Prof P Papka
Co-supervisors: Dr FD Smit and Prof RJ de Meijer

VAN STADEN, Anton du Preez (Microbiology)

In vitro and in vivo characterisation of amyloliquecin, a novel two-component lantibiotic produced by Bacillus amyloliquefaciens

Antimicrobial resistance is one of the major problems faced by the medical industry. Two antimicrobial-producing bacteria, *Bacillus clausii* AD1 and *Bacillus amyloliquefaciens* AD2, were isolated from Fynbos soil in the Western Cape. Both strains produced lantibiotics, i.e. ribosomally synthesised cationic antimicrobial peptides, with extensive post-translational modifications. The lantibiotics were active against a number of pathogenic bacteria. Amyloliquecin, produced by strain AD2, is a novel two-peptide lantibiotic active against *Staphylococcus aureus*. The peptide was extremely effective in the treatment of skin infections and stimulated wound healing. The two operons encoding the production and secretion of the lantibiotics were sequenced and annotated.

Supervisor: Prof LMT Dicks
Co-supervisor: Dr SM Deane

WILLEMSE, Chandré Monique (Chemistry)

Comprehensive 2-dimensional liquid chromatographic analysis of anthocyanins

Anthocyanins are natural pigments which have been recognised for their nutritional value and play an important role in the aesthetic perception and quality of red wine. Due to the large structural diversity of wine pigments, the accurate analysis of these compounds, as required to study wine colour evolution, is extremely challenging. The potential of comprehensive 2-dimensional liquid chromatography (LC \times LC) was explored as a powerful approach for the separation of complex anthocyanin mixtures. Application to the analysis of natural products and wine shed new light on the pigment composition of these samples.

Supervisor: Prof AJ de Villiers
Co-supervisor: Dr MA Stander

WRIGHT, Trevor Gavin (Polymer Science)

Advanced analytical methods for the analysis of complex polymers prepared by RAFT and RITP

Living radical polymerisation is a very useful technique for preparing well-defined complex polymers. These polymers have multiple distributions of molecular structure including molar mass, chemical composition, functionality and molecular architecture. The molecular complexity of these compounds can only be characterised successfully using a combination of advanced analytical methods. Complex polymers, based on different monomers, were prepared by living radical polymerisation techniques and analysed using nuclear magnetic resonance and high-performance liquid chromatography. Using these advanced analytical methods, the analyses provided important insights into the mechanism and the reaction kinetics of various living radical polymerisation techniques.

Supervisor: Prof H Pasch

Fakulteit Agriwetenskappe

Faculty of Agrisciences

IFakhalthi yezeeAgrisayensi

PhD

GHOSH, Soumya (Wine Biotechnology)

Metagenomic screening of cell wall hydrolases, their antifungal activities and potential role in wine fermentation

The focus of this study was to tap into the wine microbial diversity for novel hydrolytic enzymes of oenological interest. Yeast isolates obtained from grape juice were screened for the production of hydrolases and antifungal compounds. The basidiomycetous yeast *Pseudozyma fusiformata* was found to exhibit growth-inhibitory activity against the wine spoilage yeast *Brettanomyces bruxellensis*, while several other yeasts displayed glucanase and chitinase activities. The current study also employed metagenomics (shotgun sequencing and fosmid library construction) to screen for these enzymes in the wine metagenome. Several potentially novel glucanases and chitinases with low sequence identity to known genes were revealed.

Supervisor: Dr ME Setati
Co-supervisor: Dr B Divol

HENGARI, Simeon Ngaitungue (Horticultural Science)

Effect of heat, ultraviolet-B and photosynthetic active radiation stress on apple peel photosystems in relation to sunburn

The study analysed the response of apple peel photosystems to ultraviolet-B (UV-B) radiation, photosynthetic active radiation (PAR) and heat stress under laboratory conditions in relation to sunburn development. Sun-exposed peel was resistant while shaded peel incurred photodamage under high UV-B dosage. All development stages were equally sensitive to heat stress at moderate PAR. Heat stress appears to cause the greatest damage to photosystems, while

UV-B and PAR enhance this effect. Xanthophyll cycle dependency for photoprotection under heat and PAR stress differed between cultivars. The appearance of sunburn symptoms may not necessarily relate to peel stress sensitivity.

Supervisor: Prof WJ Steyn

Co-supervisors: Prof SJE Midgley and Prof KI Theron

KANENGONI, Arnold Tapera (Animal Science)

Exploring proteomic and microbiome profiling in pigs fed high-fibre diets

The study evaluated a readily available by-product of maize, i.e. cob, as a pig feed ingredient. It applied metagenomics and proteomics to deepen understanding of two divergent pig breeds in utilising high-fibre diets. The unique aspects employed in the study were: ensiling the maize cobs to reduce fibre levels making way for the cob to be used in a diet and improving palatability; mapping the pig gut microbiome using metagenomics; and developing a proteomics proof of concept to identify biomarkers. The findings have strong implications on profitability of pig farming.

Supervisor: Prof K Dzama

External Co-supervisors: Prof B Ndimba and Prof M Chimonyo

KANSKY, Ruth (Conservation Ecology)

Towards understanding tolerance to damage-causing mammalian wildlife

Factors driving tolerance of stakeholders living with damage-causing mammalian wildlife were reviewed. A Wildlife Tolerance Model (WTM) is proposed that was tested using a case study of human-baboon conflict on the Cape Peninsula, South Africa. The WTM hypothesises that exposure to a species and experiences (positive or negative) determine perceptions of costs and benefits of living with a species. This in turn drives tolerance. A second component predicts 11 variables (e.g. values, interest in animals, empathy and anthropomorphism) that may further drive perceptions of costs and benefits. The case study showed support for the WTM.

Supervisor: Prof MJ Samways

Co-supervisor: Dr AT Knight

KARANGWA, Patrick (Plant Pathology)

Diversity and population structure of Fusarium oxysporum f. sp. cubense in central and eastern Africa

Banana is among the most important crops in east and central Africa (ECA), but is affected by banana Fusarium wilt, caused by the fungus *Fusarium oxysporum* f. sp. *cubense* (Foc). The distribution and incidence of Fusarium wilt in ECA were related to cropping systems, edaphoclimatic and socio-economic factors. Ninety percent of Foc strains belonged to Foc Lineage VI, for which a molecular marker was developed. Disease management strategies should target this lineage, particularly considering the high level of gene flow among ECA countries because of an extensive exchange of planting materials.

Supervisor: Prof A Viljoen

External Co-supervisors: Dr G Blomme and Dr F Beed

MAOELA, Malebajoa Anicia (Conservation Ecology)

Tree health in near pristine, heavily invaded, and restored riparian zones: the role of pests and fungal pathogens

The impact of invasive species on native ecosystems are widely acknowledged and have justified large-scale control programmes. Riparian zones are particularly threatened by invasives, and extensive control efforts focus on these habitats. This work examined the role that pests and fungal pathogens play in tree health of riparian tree communities, linked to the success of these control efforts. The study found that although plant communities and associated arthropods often recover after removal of invasive species, native plants continue to be damaged by pests and fungal pathogens, resulting in damage levels in excess of that at invaded sites.

Supervisor: Prof K Esler

Co-supervisors: Dr F Roets and Dr S Jacobs

MEHLOMAKULU, Ngwekazi Nwabisa (Wine Biotechnology)

Genetic investigation and characterization of killer toxins secreted by non-Saccharomyces yeasts

The study focused on the potential of killer toxins secreted by two strains of the yeast *Candida pyralidae* to inhibit the growth of the wine spoilage yeast *Brettanomyces bruxellensis*. These toxins showed killer activity against several strains of *B. bruxellensis*, but not against the fermentative yeast *Saccharomyces cerevisiae*. Furthermore, they were found active under conditions occurring in grape juice and wine, thereby demonstrating their potential application in controlling the development of *B. bruxellensis* in wine. Finally, the yeast cells exposed to the killer toxins displayed cell morphology damage. Hypotheses regarding the possible mode of action were put forward.

Supervisor: Dr B Divol

Co-supervisor: Dr E Setati

SCHOEMAN, Aneen (Plant Pathology)

The diversity and population structure of Fusarium verticillioides in South Africa

Fusarium verticillioides is a fungus that causes maize ear rot and deposits toxic fumonisins in maize grain. Individual isolates collected from the ears, stems and roots of maize plants in South Africa were found to be highly diverse. This diversity is attributed to recombination as its mode of reproduction. When evaluated at different localities, over different seasons and on different maize cultivars, the most virulent and toxigenic strains caused most disease and produced most fumonisins despite a significant location x isolate interaction. The variation in *F. verticillioides* should be considered when developing strategies to manage the disease and reduce fumonisins in maize grain.

Supervisor: Prof A Viljoen

Co-supervisor: Prof BC Flett

PhD (Agric)

CLOETE, Marie (Plant Pathology)

Characterisation of basidiomycete species associated with esca disease in South African grapevines

Esca is one of the grapevine trunk diseases which cause decline and loss of productivity in grapevines worldwide. One of the symptoms of esca is the white rot of the wood caused by ten basidiomycetes taxa. In this study the finding of the fruiting bodies of three taxa allowed the description of *Fomitiporia capensis*, *Phellinus resupinatus* and *Fomitiporella viticola*. The spore release patterns from *Fomitiporella viticola* fruiting bodies were monitored and it was found that spores are released from winter to early summer. All ten taxa produced white rot on field-inoculated grapevines. Novel findings regarding the aetiology and epidemiology of the basidiomycetes involved in esca were made.

Supervisor: Dr L Mostert

Co-supervisor: Dr F Halleen

ZIETSMAN, Johanna Jacoba (Wine Biotechnology)

Investigating grape berry cell wall deconstruction by hydrolytic enzymes

The cell walls of grape berry skin cells were studied to understand the changes that occur during ripening, wine fermentation and when hydrolytic enzymes are added during wine-making or valorisation of grape waste (pomace). Cell wall profiling tools demonstrated differential polysaccharide accessibility in the cell walls, as well as synergistic enzyme effects with important implications for future development of enzyme preparations as wine-making processing aids, or pomace valorisation tools. The information gained and the methods and tools developed will contribute to a knowledge-based design of effective processing steps in wines and grape by-products.

Supervisor: Prof MA Vivier

Co-supervisor: Dr JP Moore

PhD (Bosb)

ODHIAMBO, Benedict Oithe (Forest Science)

The effect of fire damage on the growth and survival mechanisms of selected native and commercial trees in South Africa

Fire is a major factor limiting the distribution of indigenous forests and is impacting substantially on the viability of commercial forest plantations. Current fire research has neglected to reveal the mechanisms and structural components governing the tree-fire interaction. Empirical tests of the bark insulation of different tree species revealed marked differences with bark thickness being the most important explanatory variable. However, it was found that the bark surface structure modulates this relationship between bark thickness and heat resistance more than bark density, moisture content or chemical composition. Tree ring analysis showed a marked influence of surface fires on tree growth.

Supervisor: Prof T Seifert

Co-supervisor: Prof M Meincken

PhD (Voedselwet)

GUELPA, Anina (Food Science)

Maize endosperm texture characterisation using the Rapid Visco Analyser (RVA), X-ray microcomputed tomography (μ CT) and micro-near infrared (microNIR) spectroscopy

Maize is a staple food in many countries. In South Africa it is industrially processed into maize meal using dry-milling. A maize kernel of desired hardness, often measured as kernel density, is required for optimal yield and quality. X-ray micro-computed tomography was used to quantify kernel density as well as vitreous-to-floury endosperm ratio. These, in association with physical and indirect hardness measurement methods, could be used to accurately select maize hybrids with good milling quality. Methods such as microNIR spectroscopy and NIR hyperspectral imaging were illustrated to be effective as rapid, non-destructive methods of maize milling quality classification.

Supervisor: Prof M Manley

Co-supervisors: Prof P Geladi and Dr A du Plessis

Fakulteit Ekonomiese en Bestuurswetenskappe

Faculty of Economic and Management Sciences

IFakhalthi yezeeNzululwazi kwezoQoqosho noLawulo

PhD

AKOTEY, Joseph Oscar (Development Finance)

The impact of microinsurance on household welfare in Ghana

The study examines the link between microinsurance and welfare of low-income households in Ghana using data from the 2010 FINSCOPE survey. It employs Heckman sample selection, instrumental variable and treatment effect models to control for selection bias and endogeneity bias. The results, compiled into four empirical essays, together show the following: microinsurance – prevents households' asset pawning and liquidation, reduces asset inequality, is a better option for managing consumption smoothing among low-income households and when combined with microcredit has more significant welfare benefits. Microinsurance should therefore be a part of poverty reduction policies in Ghana and other developing countries.

Supervisor: Prof C Adjasi

ARMSTRONG, Paula Louise (Economics)

Teachers in the South African education system: an economic perspective

Teacher quality is a key element in improving student performance. The weak state of South African education renders it crucial to understand the mechanics determining who enters teaching, how to encourage and manage teacher effort, and how to identify effective teachers. The dissertation first investigates the attractiveness of teaching by com-

paring the wage structures facing teachers and non-teachers. It then explores the theoretical underpinning of teacher incentives and prospects for successfully using such incentives as policy tool. Finally, empirical analysis using an education production function framework of the relationship between teacher characteristics and student performance finds evidence that teachers trained in the post-transition period may be more effective than those trained earlier.

Supervisor: Prof S van der Berg

MTHIMKHULU, Alfred Mbekezeli (Business Management and Administration)

Small enterprise development in South Africa: an exploration of the constraints and job creation potential

This dissertation demonstrates and conceptualises the constraints to the development of small, micro and medium enterprise (SMME) development in South Africa. This is a very important topic and has been widely acknowledged as vital to economic growth, generation of much-needed employment and poverty alleviation. Various growth diagnostic models have been identified and proposed to SMMEs according to ownership, race and the geographic location.

Supervisor: Prof M Aziakpono

OLIVIER, Anton Jacobus (Public and Development Management)

Closing the strategy execution gap in the public sector – a conceptual model

The importance of strategy execution to achieve organisational objectives is increasingly recognised. However, successful execution seems to remain problematic in government and in business settings. Because of the gap between strategy, planning and execution, the required benefits stated and aspired towards in strategic planning are often not realised. A conceptual model, the MERIL-DE Model, for strategy execution in the public sector was developed and validated in a number of cases within the Namibian public sector. It is believed that the use and application of this model will significantly contribute to close the strategy execution gap in the public sector.

Supervisor: Prof E Schwella

SPAULL, Nicholas Andrew (Economics)

Education quality in South Africa and sub-Saharan Africa: an economic approach

This dissertation applies econometric techniques to education data to measure learning. Quantifying learning deficits shows that the mathematics learning gap between the poorest 60% and wealthiest 20% of students grows from three to four grade levels between grades 3 and 9. Data where students were tested twice in different languages on the same test shows that the 'cost' for non-English home language students of having to write a test in English is much smaller than the effect of home background and school factors. Finally, a composite measure of education access and quality using household data on grade completion and survey data on cognitive outcomes demonstrates that improved access to learning indeed improved literacy and numeracy in 11 African countries. Girls and relatively poor children benefited most.

Supervisor: Prof S van der Berg

VON FINTEL, Marisa (Economics)

Social mobility and cohesion in post-apartheid South Africa

This dissertation examines social mobility and cohesion in post-apartheid South Africa by considering three related topics. Firstly, attending a historically white school significantly increases numeracy and literacy scores of black children. Secondly, people still mainly compare their subjective well-being to others from the same race (An improved economic standing of close others such as neighbours affects well-being positively, but the opposite applies to strangers). However, individuals from other races are now also considered. Finally, separating structural income trends (based on assets) from shocks and measurement error provides no evidence of an asset-based poverty trap or threshold where structural income bifurcates. Instead, the results seem to point to a threshold beyond which structural income remains more persistent.

Supervisor: Prof S van der Berg

WESSON, Nicolene (Business Management and Administration)

An empirical model of choice between share repurchases and dividends for companies in selected JSE-listed sectors

Share repurchases were allowed in South Africa as from 1 July 1999. This study compiled the first comprehensive share repurchase database for companies in selected JSE-listed sectors for reporting periods 1999 until 2009. Share repurchases were found to be a popular means of distributing excess cash as from 2005. The results of this study showed that investors would benefit over the long term when investing in companies which repurchased shares – especially if the shares were repurchased in the open market by value companies. The significant determinants which affect the choice between open market share repurchases and special dividend payments were found to be: ownership structure, the size of the payout and the level of company undervaluation. This study concluded that the South African regulatory environment possesses many characteristics of a developing economy's financial systems. Suggestions are given on how to improve and better align the South African repurchasing environment to those of developed economies.

Supervisor: Prof WD Hamman

Co-supervisors: Prof BW Bruwer and Prof E vd M Smit

Fakulteit Ingenieurswese

Faculty of Engineering

IFakhalthi yezobuNjineli

PhD

BABAFEMI, Adewumi John (Civil Engineering)

Tensile creep of cracked macro-synthetic-fibre-reinforced concrete

Fibres are known to bridge cracked planes in concrete, thereby controlling crack opening and leading to increased toughness and energy absorption capacity. However, the time-dependent crack widening

response of cracked macro-synthetic-fibre-reinforced concrete under sustained tensile loading is still uncertain. An investigation of this behaviour and the mechanisms responsible has been carried out under varying stress levels. Mechanisms causing the crack widening were also investigated. Results have shown significant crack widening under sustained loading and mechanisms responsible are fibre creep and time-dependent fibre pullout.

Supervisor: Prof WP Boshoff

BEUKMAN, Theunis Steyn (Electronic Engineering)

Modal-based design techniques for circular quadruple-ridged flared horn antennas

This dissertation presents a modal-based technique for the systematic design of quadruple-ridged flare horns (QRFHs) as reflector feeds for radio astronomy applications. The technique uses no optimisation and allows the designer to selectively suppress or eliminate higher-order modes in the horn. The elimination of these unwanted modes is shown to reduce beamwidth narrowing, beamwidth variation over the upper bandwidth, high-cross polarisation levels, high co-polar sidelobes and the variation of the phase centre over a wide bandwidth. A prototype, which offers a potential solution for the planned SKA reflector array, is designed using the proposed technique.

Supervisor: Prof P Meyer

BEYERS, Ryno Dawid (Elektroniese Ingenieurswese)

Circuit model design of conical transmission line power combiners and isolation of reactive combiners

Huidige ontwerptegniese vir koniese lynkombineerders benodig volgolf-simulasies, wat dit moeilik maak om die ontwerpe te optimeer. 'n Nuwe ontwerptegniese word in hierdie projek ontwikkel wat die ontwerper toelaat om verskeie dimensies van koniese kombineerders te optimeer teen 'n beduidend laer koste, en sodoende te verbeter op vorige ontwerpe. Reaktiewe kombineerders, insluitend koniese kombineerders, is bekend vir hulle swak intreepoort-isolasie. 'n Nuwe metode word in hierdie projek ontwikkel wat die intreepoort-isolasie van, teoreties, enige tipe kombineerder kan verbeter sonder om die wederkerigheid daarvan te beïnvloed, terwyl terminasies vir isolasielaste gebruik kan word.

Promotor: Dr DIL de Villiers

BILEY, Christopher Alan (Extractive Metallurgical Engineering)

Thermodynamic and kinetic modelling of iron (III) reduction with sulfur dioxide gas

An engineering model based on fundamental solution chemistry that describes the rate and extent of iron (III) reduction with SO₂ under aggressive hydrometallurgical conditions was developed. This system is important for novel, industrially developed, nickel laterite treatment technologies. Spectroscopic techniques (Raman and UV-vis) and computational chemistry calculations were used to acquire previously unavailable solution speciation data in acidic iron (II)-iron (III)-sulfate solutions and formed the basis of a thermodynamic framework for this system. By integrating a kinetic model of the rate-limiting processes

into this framework, the model is able to capture complex observed kinetic behaviour in a structured and natural way.

Supervisor: Prof SM Bradshaw

Co-supervisor: Dr JDT Steyl

CLOETE, Gert Christiaan (Civil Engineering)

Risk-based dam safety in Namibia: a quantitative approach

The rational quantitative optimal risk model assesses risk over a portfolio of dams, guiding the decision makers on a maintenance strategy. The model is based on principles of risk, but an assessment of a portfolio of dams provides discrete optimal results, not expressed in terms of probability. Employing techniques of palaeoflood hydrology, the Regional Maximum Flood (RMF) model of Namibia is updated, improving confidence in probabilities allocated to extreme flood events: palaeoflood results confirmed that the RMF has an annual recurrence interval of approximately 10 000 years. These flood probabilities have direct bearing on the outcome of the risk model.

Supervisor: Prof GR Basson

Co-supervisors: Prof JV Retief and Dr C Barnardo-Viljoen

HINDLEY, Michael Philip (Mechanical Engineering)

Next generation high temperature gas reactors: a failure methodology for the design of nuclear graphite components

This dissertation presents a failure evaluation methodology for nuclear graphite components used in high-temperature gas reactors. Nuclear graphite shows a large scatter in strength tests. Subsequently, the method is a probabilistic failure methodology and has been developed and implemented numerically in conjunction with finite element analysis. The method can be used on any three-dimensional geometry and load configuration. The method has been incorporated into AMSE code and standards for the design of nuclear graphite reactor components since 2010.

Supervisor: Dr DC Blaine

Co-supervisors: Prof A Groenwold

MacHUTCHON, Keith Robert (Civil Engineering)

An introduction to the multifractal geometry of wave sea states

All of the ports around the South African coastline are subject to hazardous infragravity wave action to a greater or lesser degree. This research provides a method, based on the non-stationary properties of time series, for the identification and quantitative comparison of these sea states by means of their singularity distributions. Different fractal analysis methods are reviewed to identify which ones would be most applicable for the identification of the required distributions. Further, the multifractal properties of non-hazardous and hazardous sea states at two harbours are compared to confirm that they are clearly different and able to be used to describe the conditions.

Supervisor: Prof GR Basson

Co-supervisor: Mr G Toms

MBARAGA, Alex Ndiku (Civil Engineering)

Shrinkage characterisation, behavioural properties and durability of cement-stabilised pavement materials

Cement-stabilised materials provide cost-effective solutions for road pavement structures. However, cemented layers are prone to shrinkage cracking, which leads to a reduction in the effective resilient modulus under trafficking, resulting in a decrease in stress distribution capacity of the pavement structure. The objective of this research was to develop reliable laboratory shrinkage evaluation techniques for cement-stabilised materials, as well as the assessment of methods and additives for shrinkage reduction. The laboratory results were used to model the predicted shrinkage crack patterns and identify effective mix designs combined with a nano-polymer to improve performance.

Supervisor: Prof KJ Jenkins

MENSAH, Kenneth Kwesi (Civil Engineering)

Reliability assessment of structural concrete with special reference to stirrup design

Shear resistance is a notorious issue in structural concrete, lacking a unified design approach. Structural reliability methodology was therefore employed to investigate performance uncertainties associated with the standard analogy for shear design. Rational representation of shear resistance for reliability analysis was based on model uncertainty statistics for shear resistance derived from an experimental database comprising representative tests, together with internationally accepted models adopted for basic variables. The reliability assessment revealed that standard procedures are potentially unsafe, driven by systematic sensitivities to concrete strength and stirrup reinforcement. Reliability performance declines significantly with increasing stirrup reinforcement, but increases somewhat with concrete strength.

Supervisor: Prof JV Retief

Co-supervisor: Dr C Barnardo-Viljoen

MOHASI, Lehlohonolo Gloria (Electronic Engineering)

Prosody modelling for a Sesotho text-to-speech system using the Fujisaki model

Accurate modelling of pitch is key to the synthetic production of intelligible and natural speech in tonal languages such as Sesotho. The effectiveness of the Fujisaki model as a computation model for pitch in Sesotho is demonstrated. Fujisaki parameters were determined by heuristics derived from data analysis, as well as by machine learning with regression trees. While both approaches were demonstrated to synthesise highly natural speech, the output of the machine learning algorithm was judged to have 'almost mother tongue' quality by human listeners. The proposed techniques indicate the potential for automatic synthesis of Sesotho speech with natural prosody.

Supervisor: Prof TR Niesler

Co-supervisor: Prof H-J Mixdorff

MÜLLER, Louis Crouse (Electronic Engineering)

RSFQ digital circuit design automation and optimisation

Rapid single flux quantum (RSFQ) devices are novel electronic circuits that have the ability to operate at frequencies far beyond current state-of-the-art semiconductor electronics. The design of these circuits is complex and cumbersome. For this dissertation, various methods were developed to reduce the complexity of designing RSFQ circuits. This includes automated analysis methods which lead to the ability to create high-level circuit models as well as various methods to reduce the computational time required for yield analysis techniques. Various yield optimisation techniques were also applied to RSFQ circuits and compared in a novel manner.

Supervisor: Prof CJ Fourie

PRINSLOO, David Schalk van der Merwe (Electronic Engineering)

Multi-mode antennas for hemispherical field-of-view coverage

This dissertation proposes a multi-mode antenna element consisting of co-located crossed dipoles and a monopole antenna, excited through a multiconductor feed. It is shown that each of the excitation modes supported by the antenna feed results in a unique radiated far-field pattern that collectively allows for near-hemispherical field-of-view coverage. A new analysis technique in terms of combinations of excitation modes is presented in order to make analysis of the element possible. The element offers a potential solution for the proposed SKA Mid-Frequency Aperture Array, as it can allow for array scan angles down to the horizon.

Supervisor: Prof P Meyer

Co-supervisors: Prof M Ivashina and Dr R Maaskant

SAWADOGO, Ousmane (Civil Engineering)

Coupled fully three-dimensional mathematical modelling of sediment deposition and erosion in reservoirs

The key objective of the research was to develop a coupled fully three-dimensional (3D) numerical model based on Navier-Stokes equations, which includes both the sediment transport component and hydrodynamic parameters. A physical model was set up in a laboratory flume in order to investigate the bottom outlet sediment flushing under pressure in a controlled environment. The proposed coupled fully 3D numerical model was used to simulate the experimental tests. Results from these simulations were in good agreement with the measurements in terms of the geometric features of the scour hole as well as the velocity field upstream of the bottom outlet. The proposed numerical model also successfully predicted both sediment deposition and entrainment processes under turbulent suspended sediment transport condition in reservoirs.

Supervisor: Prof GR Basson

SNYDERS, Cornelius Albert (Extractive Metallurgical Engineering)

The adsorption and elution of Pt, Pd and Au cyanide using activated carbon

Leaching of platinum and palladium with cyanide from low-grade ores is considered to be an alternative process option to the conventional

use of flotation and smelting, but a process for the subsequent upgrading and recovery of valuable metals from the dilute leach solution has been lacking. An upgrading process using adsorption onto and elution from activated carbon was studied and found to be technically feasible, but less robust to changing operating conditions than the equivalent process used in the gold recovery process. The knowledge gained will assist in future development of the technology.

Supervisor: Prof SM Bradshaw

Co-supervisor: Prof G Akdogan

VENTER, Martin Philip (Mechanical Engineering)

The development of a design process for woven dunnage bags using numerical prototyping

Dunnage bags are an inflatable dunnage variant, positioned and deployed between goods in multi-modal containers to restrain and protect goods while in transit. A new numerical prototyping methodology was developed for dunnage bags that are suitable for simulating operational loading of the bags and predicting the performance of new dunnage bags. The numerical prototype accounts for the non-linear material response of plain-woven polypropylene reinforcing material, arbitrary moving constraining voids, the compressible nature of the inflation medium and a spring-membrane hybrid element is proposed. The model was found to predict the failure of the inflated bag within 10%.

Supervisor: Prof G Venter

WISE, John Nathaniel (Mechanical Engineering)

Inverse modelling and optimisation in numerical groundwater flow models using proportional orthogonal decomposition

Proper orthogonal decomposition (POD) is applied to groundwater flow problems. The standard application of POD allows for model speed-up times greater than 500 for saturated flow, or linear problems. The application is demonstrated on a complex real-life problem. For unsaturated flow, or non-linear problems, new POD-based methods are developed that result in speed-up times greater than 70. Using the new POD-based method, a local updating optimisation approach is developed. This approach capitalises on the excellent interpolation properties inherent to POD, using support vector classification to define a confidence region in which the POD model is accurate.

Supervisor: Prof G Venter

Co-supervisor: Prof M Batton-Hubert

ZANG, Jin (Civil Engineering)

Developing non-heat treated ultra-high performance concrete (UHPC) in South Africa

The candidate developed ultra-high performance concrete, an advanced construction material for durable infrastructure. A non-heat treated version was developed to reduce environmental impact. With the exception of imported high-strength steel fibres, local ingredient materials were used. Through chemical and physical characterisation and comparison with internationally available ingredient materials a novel, alternative strengthening mechanism was devised to overcome deficiencies of crude local ingredients. High autogenous shrinkage, a perceived weakness of this class of cement-based materials, was exploited to enhance fibre-matrix interfacial bond in an optimised skeleton structure. Hereby, additional cost of special remedial ingredients for shrinkage-induced damage was avoided.

Supervisor: Prof GPAG van Zijl

