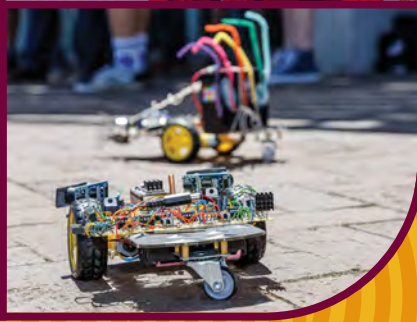
Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Engineering
Eyobunjineli
Ingenieurswese

2022 | ANNUAL REPORT JAARVERSLAG

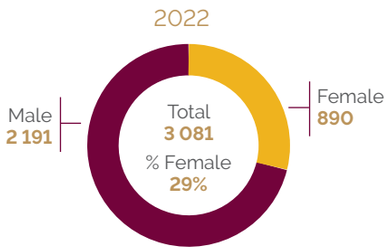


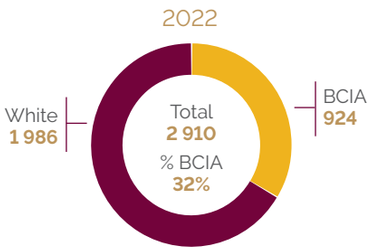
forward together
sonke siya phambili
saam vorentoe

Contents

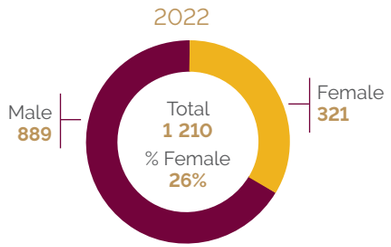
At a **glance**

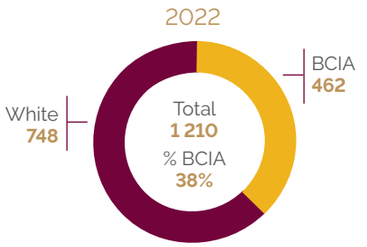
Undergraduate Student **Demographics**





Postgraduate Student **Demographics**

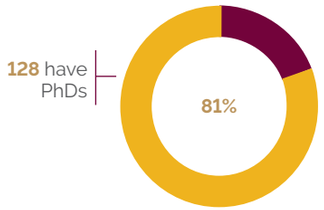


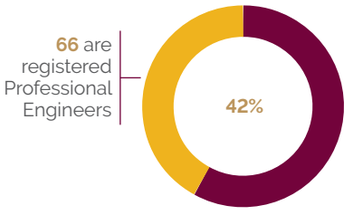


BCIA = Black African, Coloured, Indian and Asian

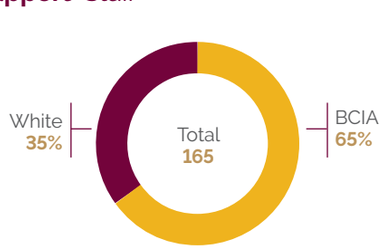
Academic Staff

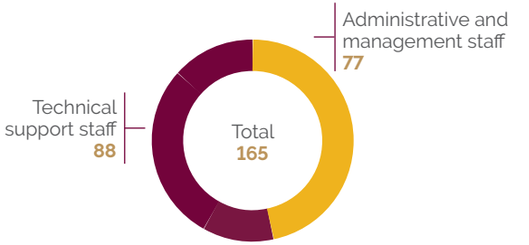
158 academic staff





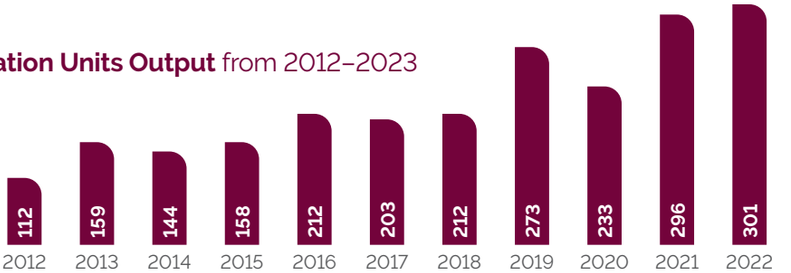
Support Staff





835 Graduates (Dec 2022 & Apr 2023)

Publication Units Output from 2012–2023



47 NRF-rated Academics 2022

From the Dean

Under the restrictions of the Covid-19 pandemic, Stellenbosch University (SU) enhanced student learning by adopting the hybrid teaching model Augmented Remote Teaching, Learning and Assessment (ARTLA) while prioritising student and staff safety. Although our undergraduate students became accustomed to online classes and contact tuition in smaller groups, students and teachers were excited to resume face-to-face learning and teaching in the second semester as the pandemic waned.

Completing the academic year successfully, the Faculty maintained a significant contribution to the engineering profession by adding 493 graduate engineers, 261 master's graduates and 53 doctorates. The University awarded an honorary doctorate to alumnus Andries (Andy) Calitz, who started his engineering career in 1981 with a degree in Electrical Engineering, recognising his remarkable contribution to the development of the global energy supply sector.

We have much to celebrate, as a few highlights below, organised according to the University's core strategic themes, demonstrate.

A thriving Stellenbosch University

The Department of Industrial Engineering welcomed its first student intake for the new hybrid, online structured master's programme in Engineering Management. Ideal for early to mid-career engineers and scientists, the programme equips them for management-related responsibilities.

The Engineering Campus Renewal Project upgrades all our facilities in phases to meet current teaching and research demands. Finalising the renovation of our Civil Engineering building and the Department of Electrical and Electronic Engineering's laboratories, construction could begin on the Dr Japie van Zyl Final-Year Area on top of the Electrical Machines Laboratory to add two electronic classrooms, a small kitchen and a third undergraduate laboratory for final-year lectures, practicals and tutorials.

A transformative, inclusive student experience

Visually redressing our physical spaces flows naturally from SU's endeavour to renew its institutional culture. A functional art piece placed in front of the Engineering complex, the THINK Bench, was donated by alumnus GT Ferreira as a visible prompt to inspire students to sit on it and think about making the world a better place instead of just absorbing information in class and regurgitating it in exams.

Networked and collaborative teaching and learning

To enable optimum student learning experiences, the Faculty invests in programme renewal and capacity-building through collaborative initiatives, as exemplified by our Recommended Engineering Education Practices (REEP) group. Led by in-house engineering-education advisor Prof Karin Wolff, REEP engaged in practice-sharing forums, projects and workshops, resulting in research publications and conference presentations. Prof Wolff is a core team member of the international Innovative Engineering Curriculum (IEC) project by Dr Lelanie Smith (University of Pretoria). Reaching out, key IEC members established the Engineering Education Research Network (EERN-Africa) of over 100 engineering academics across Africa, sharing practices and developing collaborative opportunities.

The Department of Chemical Engineering successfully hosted the Interinstitutional Chemical Engineering Postgraduate Symposium, where candidates presented and discussed their research.

The annual SU Engineering and Science Showcase presented research activities to appreciative colleagues in the industry at the Hilton Hotel in Sandton. We look forward to ongoing collaboration with our industry partners.

Research for impact

Real-world application is a strategic focus for the Faculty's research. With fuel prices at a historic high, a team of companies and research institutions – GoMetro, MiX Telematics, HSW, ACDC Dynamics and various entities within our Faculty – formed a partnership to examine the feasibility of electric minibus taxis to lower the cost of travelling for more than 70% of South Africa's commuters.

Building capacity in clean energy research at the Department of Mechanical and Mechatronic Engineering, the Faculty appointed Prof Josua Meyer, one of the few A-rated engineering researchers and a specialist in thermal sciences and fluid flow.

Purposeful partnerships and inclusive networks

Industry collaboration is a critical enabler to ensure the relevancy of our teaching and research programmes to the industry as a key stakeholder. Offering a unique opportunity to achieve these objectives, our collaboration with the BMW group saw the launch of the BMW ZA Hub. The group will create a pool of talented students through postgraduate bursaries to support BMW in growing and maintaining its IT software.

Likewise, the Stellenbosch Smart Mobility Laboratory's Memorandum of Understanding with the PTV Group, a German software company for traffic planning, simulation and real-time management, facilitated access to PTV's leading transport modelling and simulation software for realistic mobility studies.

Stellenbosch University as an employer of choice

Our staff's contributions were noted and recognised in various ways. Colleagues who received a Chancellor's Award for sustained excellence in their careers were Johan Booysen, departmental manager at Electrical and Electronic Engineering, Prof Steven Bradshaw, distinguished professor at Chemical Engineering, and Prof Jan Wium at Civil Engineering. Department of Electrical and Electronic Engineering members Profs Dirk de Villiers and Robert Lehmensiek received the Institute of Electrical and Electronics Engineers (IEEE) Harold A Wheeler Applications Prize Paper Award.

> *"Completing the academic year successfully, the Faculty maintained a significant contribution to the engineering profession.*

Five newly appointed professors presented inaugural lectures, namely Profs Annie Bekker and Corné Coetzee (Mechanical and Mechatronic Engineering), Thinus Booysen and Rong-Jie Wong (Electrical and Electronic Engineering) and Richard Walls (Civil Engineering). Prof Nico de Koker (PrEng, PrSciNat) became head of the Department of Civil Engineering.

Looking forward

The Faculty's six professional undergraduate engineering programmes are closely controlled and assessed by the professional body, the Engineering Council of South Africa (ECSA). All our programmes remain fully accredited until the next visit by ECSA in 2023. Under the capable leadership of Prof Celeste Viljoen, vice-dean teaching and quality assurance, the departmental chairs and programme coordinators, preparations are well underway to present to ECSA a refreshed, cost-effective, high-quality programme offering for accreditation.

A functional art piece placed in front of the Engineering complex, the THINK Bench, was donated by alumnus GT Ferreira.

Van die Dekaan

Tydens die COVID-19-pandemie se inperkings het die Universitieit Stellebosch (US) noodgedwonge oorgeskakel na die hibriede onderrigmodel Aangepaste Afstandsonderrig, -leer en -assessering (ARTLA) om studenteleer te bevorder. Hoewel ons voorgraadse studente goed aangepas het by aanlyn klasse en kontakonderrig in kleiner groepies, was lektore en studente baie opgewonde by die verswakking van die pandemie om weer aangesig-tot-aangesig leer en onderrig in die tweede semester te hervat.

Die Fakulteit het die akademiese jaar suksesvol afgehandel en 'n aansienlike bydrae tot die ingenieursberoep gehandhaaf met 493 gegradueerde ingenieurs, 261 magistergraduati en 53 gedoktoreerdes. Alumnus Andries (Andy) Calitz, wat sy ingenieursloopbaan in 1981 met 'n BIng-graad in Elektriese Ingenieurswese afgeskkop het, ontvang 'n US-eredoktorsgraad uit erkenning vir sy merkwaardige bydrae tot die globale energievoorsieningsektor.

Ons het baie om te vier. Vervolgens word 'n paar hoogtepunte kortliks aangebied, ingedeel onder die Universiteit se kern strategiese temas.

Dr Andries Calitz het 'n eredoktorsgraad van die Universiteit Stellenbosch ontvang in April 2022.

Dr Andries Calitz received an honorary doctorate from Stellenbosch University in April 2022.

'n Florerende Universiteit Stellenbosch

Die Departement Bedryfsingenieurswese het sy eerste kohort studente vir die nuwe hibriede, aanlyn, gesturktureerde magisterprogram in Ingenieursbestuur ingeneem. Die program rus vroeë- tot middelloopbaan-ingenieurs en -wetenskaplikes toe vir bestuursverantwoordelikhede.

Die Ingenieurswese-Kampusvernuwingsprojek gradeer al ons fasiliteite in fases op om aan die hedendaagse onderrig- en navorsingseise te voldoen. Die herinrigting van die Siviele Ingenieurswese-vleuel en die Department Elektriese en Elektroniese Ingenieurswese se laboratoriums is gefinaliseer. Ons kon die Dr Japie van Zyl Finalejaarsarea bo-op die Elektriesemasjienelaboratorium begin bou, wat twee elektroniese klaskamers, 'n klein kombuisie en 'n derde voorgraadse laboratorium vir finalejaarslesings, -praktika en -turotiale toevoeg.

'n Transformerende, inklusiewe studente-ervaring

Visuele regstelling van ons fisiese omgewing vloei natuurlikerwys uit die US se strewe om sy institusionele kultuur te hernu. 'n Funksionele kunswerk, die THINK-bank, voor die Ingenieurskompleks is deur alumnus GT Ferreira geskenk as aansporing vir studente om daarop te sit en dink oor hoe hul die wêreld 'n beter plek kan maak, instede daarvan om bloot inligting in lesings te absorbeer en by eksamens terug te gee.

Genetwerkte en samewerkende onderrig en leer

Om optimale leerervarings vir studente moontlik te maak, belê die Fakulteit in programvernuwing en kapasiteitsbou deur samewerkende inisiatiewe soos ons groep vir aanbevole ingenieursweseopvoedingspraktyke (REEP). Aangevoor deur ons in-huis ingenieurswese-opvoedkundige adviseur prof Karin Wolff, was REEP betrokke by forums, projekte en werkswinkels waar inligting oor praktyke gedeel is en navorsingspublikasies en konferensieaanbiedings gevolg het. Prof Wolff is 'n kernlid van die internasionale projek Innovative Engineering Curriculum (IEC) gelei deur dr Lelanie Smith (Universiteit van Pretoria). Sleutellede van die IEC het die Engineering Education Research Network (EERN-Africa) van meer as 100 ingenieursakademici vanoor Afrika gestig. EERN-Afrika deel inligting oor onderrigpraktyke met mekaar en ontwikkel samewerkingsgeleenthede.

Die Departement Chemiese Ingenieurswese het die jaarlikse Interinstitusionele Chemiese Ingenieurswese Nagraadse Simposium gehou, waar kandidate hul navorsing kon aanbied en bespreek.

Die jaarlikse US-tentoonstelling vir Ingenieurswese en Natuurwetenskappe het navorsingsaktiwiteite aan waarderende kollegas in die bedryf by die Hilton Hotel in Sandton voorgelê om toekomstige samewerking te inspireer.

Navorsing vir impak

Werklike toepassing is 'n strategiese navorsingsfokus vir die Fakulteit. Met brandstof duurder as ooit, het die besighede GoMetro, MiX Telematics, HSW, ACDC Dynamics 'n vennootskap met verskeie entiteite in die Fakulteit aangegaan. Hulle oogmerk is om die lewensvatbaarheid van elektriese minibustaxi's te ondersoek om reiskoste vir meer as 70% van Suid-Afrika se pendelaars te verlaag.

Die Fakulteit het kapasiteit in skoonenergienavorsing gebou met die aanstelling in die Departement Meganiese en Megatroniese Ingenieurswese van prof Josua Meyer, een van min A-gegradeerde ingenieursnavorsers en 'n spesialis in termiese wetenskappe en fluïede stroming.

Doelgerigte vennootskappe en inklusiewe netwerke

Bedryfsamewerking is 'n kritieke instaatsteller om die toepaslikheid van ons onderrig- en navorsingsprogramme op die industrie as sleutelbelanghebber te verseker. Ons samewerking met die BMW-groep het 'n unieke geleentheid geskep om hierdie oogmerke te bereik met die opening van die BMW ZA Hub. Deur nagraadse beurse bewerkstellig die groep 'n invloei van talentvolle studente om BMW se IT-sagteware te help ontwikkel en onderhou.

Insgelyks maak die Stellenbosch Slim Vervoerlaboratorium se Memorandum van Verstandhouding met die PTV-groep, 'n Duitse sagtewaremaatskappy vir verkeersbeplanning, -simulasie en intydse bestuur, toegang tot hul voorpunt-vervoersagteware vir realistiese mobiliteitstudie moontlik.

> *"Die Fakulteit het die akademiese jaar suksesvol afgehandel en 'n aansienlike bydrae tot die ingenieursberoep gehandhaaf.*

Universiteit Stellenbosch as voorkeurwerkgewer

Ons personeel se bydraes is op verskeie maniere raakgesien en erken. Kollegas wat 'n US-Kanselierstoekenning vir volgehoue uitnemendheid in hul loopbane ontvang het, was Johan Booysen, departementele bestuurder by Elektriese en Elektroniese Ingenieurswese, prof Steven Bradshaw, uitgelese professor by Chemiese Ingeneiurswese, en prof Jan Wium by Siviele Ingenieurswese. Departement Elektriese en Elektroniese Ingenieurswese se profs Dirk de Villiers en Robert Lehmensiek het die Instituut vir Elektriese en Elektroniese Ingenieurs se voortreflike Harold A Wheeler-toekenning vir hul toepassingsartikel ontvang.

Vyf nuutaangestelde professore het intreeredes gehou, naamlik profs Annie Bekker en Corné Coetzee (Meganiese en Megatroniese Ingenieurswese), Thinus Booysen and Rong-Jie Wong (Elektriese en Elektroniese Ingenieurswese) en Richard Walls (Siviele Ingenieurswese). Prof Nico de Koker (PrEng, PrSciNat) is die nuwe departementshoof vir Siviele Ingenieurswese.

Toekomsblik

Die Fakulteit se ses professionele, voorgraadse ingenieursprogramme word streng deur die professionele liggaam, die Ingenieursraad van Suid-Afrika (ECSA), beheer en geassesseer. Al ons programme is ten volle geakkrediteer tot ECSA se volgende besoek in 2023. Onder die bekwame leierskap van prof Celeste Viljoen, visedekaan vir onderrig en gehalteversekering, het die departementele voorsitters en programkoördineerders reeds goed met voorbereidings gevorder om 'n verfrisde, hoëkwaliteit- en koste-effektiewe programaanbod aan ECSA voor te lê vir akkreditasie.

Dean

Prof Wikus van Niekerk (PrEng)
engdean@sun.ac.za

Vice-Dean

RESEARCH AND INDUSTRY LIAISON
Prof Petrie Meyer (PrEng)
pmeyer@sun.ac.za

Vice-Dean

TEACHING AND QUALITY ASSURANCE
Prof Celeste Viljoen (PrEng)
celesteviljoen@sun.ac.za

DEPARTMENT OF CHEMICAL ENGINEERING
CHAIR: **Prof Christie Dorfling (PrEng)**
dorfling@sun.ac.za

DEPARTMENT OF CIVIL ENGINEERING
CHAIR: **Prof Nico de Koker (PrEng)**
ndekoker@sun.ac.za

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
CHAIR: **Prof Herman Engelbrecht (PrEng)**
hebrechtr@sun.ac.za

DEPARTMENT OF INDUSTRIAL ENGINEERING
CHAIR: **Prof Corne Schutte (PrEng)**
corne@sun.ac.za

DEPARTMENT OF MECHANICAL AND MECHATRONIC ENGINEERING
CHAIR: **Prof Johan van der Spuy (PrEng)**
sjvdspuy@sun.ac.za

CENTRE FOR RENEWABLE AND SUSTAINABLE ENERGY STUDIES
DIRECTOR:
Prof Cristina Trois (PrEng, Italy)
crses@sun.ac.za

INSTITUTE FOR BIOMEDICAL ENGINEERING
DIRECTOR:
Prof Kristiaan Schreve (PrEng)
kschreve@sun.ac.za

DEPARTMENT OF **CHEMICAL ENGINEERING**

Established as the Department of Chemical Engineering in 1969 and known as the Department of Process Engineering since the early 2000s, the Department has returned to its founding name. Chemical engineering is central to developing industrial processes that are safe, sustainable, and profitable. By using our planet's bioresources optimally, we help ensure a sustainable future. Above, master's student Elzé Grobler of the Department's dynamic Bioresource Engineering group is unravelling the mysteries of biological hydrogen production with the help of photobioreactors. Microbial cultivation in photobioreactors for high-value bio-based products, fuels and materials presents a viable option for tackling the world's increasing mass and energy demands.

Prof Robbie Pot (middle) accompanied by Stellenbosch University postgraduate students (from left to right) Mensah Brobbey, Veronica Lourens, Judi Kuyler, Darné Nunes, Roelof Maritz and Kudzai Chiodza.

Postgraduate students from across the Western Cape **create chemistry**

In a cooperative spirit, postgraduate candidates specialising in chemical engineering across the Western Cape came together to share their research at an Interinstitutional Chemical Engineering Postgraduate Symposium hosted by the Department of Chemical Engineering at Stellenbosch University (SU).

The event, held at the Stellenbosch Institute for Advanced Study (STIAS) on 30 September, welcomed researchers from the chemical engineering departments of the University of Cape Town (UCT), Cape Peninsula University of Technology (CPUT) and SU. Staff members of these departments were also present, including Profs Maggie Chetty (chair) and Mujahid Aziz from CPUT, Prof Christie Dorfling (chair) from SU, and UCT's Prof Jack Fletcher (director of the Catalysis Institute) and Steven Roberts.

The postgraduates presented stimulating work through oral and poster presentations. The hybrid event enabled those who could not attend to view these presentations virtually. Attendees enjoyed the opportunities for discussion in a collaborative atmosphere and could vote for their favourite posters and presentations. The Best Poster award went to Karen Ssekimpi of UCT. Candace Eslick and Carla Mathyse, also of UCT, were runners-up. SU's Kudzai Chiodza won Best Presentation with his fellow SU postgraduate, Veronica Lourens, the runner-up.

Two keynote speakers – Prof David Lokhat (University of KwaZulu Natal, President of the South African Institute of Chemical Engineers) and Prof Kevin Van Geem (Ghent University, Belgium) – gave fascinating and motivating presentations on collaborating in chemical engineering and how the profession can move towards net-zero through reduction and trapping of carbon.

"The day was a valuable showcase of the excellent, novel work being done in the Western Cape," said Prof Robbie Pott, postgraduate coordinator at SU's Department of Chemical Engineering. "I look forward to seeing their projects' progress at next year's symposium!"

Seasoned professors reap awards **abroad and at home**

Two Department of Chemical Engineering staff members were honoured for their outstanding academic achievements and leadership.

Professor Izak Nieuwoudt, an extraordinary professor and icon in his field, was honoured for his exceptional contribution to distillation and absorption by the American Institute of Chemical Engineers at their Spring Meeting 2022 in Texas. Over his 35-year career, Prof Nieuwoudt developed multiple patents, contributing to improved performance of industrial separation technology unit operations and processes. He supervised seven doctoral and 14 master's students and delivered papers at national and international conferences.

Prof Nieuwoudt received his award during a special session held in his honour at the Distillation Symposium 2022, where two of his former PhD students also delivered presentations. Another of his former PhD students, Prof Cara Schwarz, is now a full professor and the first woman in SU's Faculty of Engineering history to achieve this rank.

Prof Johann Görgens, a distinguished professor in chemical engineering at SU, received both the SU's Research Excellence Award and Distinguished Postdoctoral Mentor Award. He received the former award for the most significant contribution to accredited publications in the 2021-output year by appearing in 16 publications. The latter award recognised SU mentors with 20 or more postdoctoral research fellows from 2017 to 2021. Prof Görgens supported 42 postdoctoral research fellows in the five years. Prof Görgens encourages his students to find their passion in Chemical Engineering education's broad range of opportunities.

He holds the NRF Research Chair in Sugarcane Biorefineries, and his research focuses on bioenergy and biomass projects. His work provides the sugarcane industry with meaningful insights into new investment opportunities beyond conventional options and defines opportunities that will lead to diversification of the products derived from sugarcane.

PhD student's water quality app **wins global recognition**

Stanley Chindikani Msiska, one of our PhD chemical engineering students, returned with great pride and excitement from Camp 2030, a project of Unite 2030, a non-profitable global youth community striving to achieve the United Nations' Sustainable Development Goals (SDGs) by 2030. Unite 2030 believes young people can find solutions, especially for the global challenges of poverty, inequality, injustice, climate change, and water and sanitation.

Msiska's digital application, which provides information about water quality in water supply systems, took third place at the gathering in New York. The delegates were divided into 36 groups focused on different SDG challenges. More than 250 young leaders from 61 countries pitched solutions for sustainable development. Msiska and Stefani Terblanche, a BA student in international studies, represented Stellenbosch University at this global event.

> *"I worked very hard and hope this success will transform the lives of millions in despair and suffering.*

"I'm overwhelmed that the judges selected my innovation as a winning solution," Msiska said about his achievement. "I worked very hard and hope this success will transform the lives of millions in despair and suffering."

Msiska's group came up with a website application, Maji, as a solution for the SDG for water and sanitation. Maji means water in Tumbuka, a language spoken in Northern Malawi. The app formed part of Msiska's postgraduate engineering studies on water quality maintenance challenges in Malawi, his home country, where he lectures in chemical engineering at the Malawian University of Technology and Sciences.

Stanley Chindikani Msiska

Maji is a digital platform that provides maintenance services and information about water quality in water supply systems, especially in developing countries. Maji will operate on smartphones, computers and even through text messages if there is no internet.

Msiska's group and Unite 2030 will support him in implementing his innovation, starting at the Malawian capital Lilongwe, where it will also create jobs by employing community members to collect data on water and systems.

Top new research chair set to boost geometallurgy as a force for **sustainable mining**

Our Department's Dr Margreth Tadie was named the new African Rainbow Minerals (ARM) Research Chair in Geometallurgy at Stellenbosch University. She shares this interdisciplinary research grant with Dr Bjorn von der Heyden from SU's Department of Earth Sciences, whose geological background complements her metallurgical knowledge.

Research in geometallurgy has gained significant traction. First introduced as a concept in the late 1990s, it has since evolved into a critical component of the mining industry. Geometallurgy integrates geological, mineralogical and metallurgical data in three-dimensional space to create a spatially aware processing model that predicts the life cycle of a mining and extraction operation in detail. These predictive models enable mining companies to optimise their processes and reduce costs, as several high-profile case studies show in bulk commodities like iron ore.

New technologies, such as hyperspectral imaging and automated mineralogy techniques, increased the efficiency and accuracy of geo-metallurgical studies, leading to a better understanding of the deposits and creating opportunities for efficient mineral processing to maximise their value.

Recognising the importance of interdisciplinary collaboration in geometallurgical studies has led to a collaborative research initiative between industry and academia, the ARM Geometallurgy Chair. Ongoing collaboration and the continued development of new technologies and standards will ensure the sector realises significant economic and environmental benefits. André Joubert, chief executive of ARM Ferrous, said: "We believe this interdisciplinary collaboration will position the South African mining industry to be a globally competitive player."

Dr Tadie looks forward to the many research prospects that lie ahead to develop sustainable mining practices. Dr Von der Heyden is equally excited to work with Dr Tadie. "She is a dynamic, hard-working and incredibly personable scientist – a fantastic inspiration to myself and the students we have co-supervised," he said. "What I respect most about her is that she truly manifests, even epitomises, those qualities that I think are most important to a tertiary level academic. She couples excellent discipline and scientific rigour with an unwavering sense of fairness, care, and empathy for the students and the natural environment."

Dr Margreth Tadie

Research **Output**

69	7	2	4	19
Subsidised Journal Articles	International Proceedings	Chapters in Books	Doctorates	Master's Degrees

Research **Themes**

Extractive Metallurgy

The sustainable production of valuable minerals and metals from ore or metal-containing waste material is critical for a sustainable future. Extracting the metal values from natural ores bodies and complex engineered wastes requires various treatment processes. The group undertakes research into the fundamentals and application of such treatment processes. Key challenges include the changing characteristics of raw materials due to depletion of easy-to-process ore bodies, dealing with complex metal structures and associations in engineered wastes, and ensuring that new and existing extraction processes minimise energy and water use.

Separations Technology

The Separations Technology research group focuses on understanding the fundamentals and thermodynamics of separation processes involving hydrocarbons and other chemicals.

Typical processes include distillation, liquid-liquid extraction, adsorption, supercritical fluid fractionation and membrane separation. Much of the work focuses on separating compounds where the underlying systems may exhibit azeotropy and association due to hydrogen bonding and where the systems may involve molecules with varying polarity and asymmetrical structure.

Bioresource Engineering

We can transition toward a more sustainable future by optimally using our available bioresources. This group focuses on developing industrial bioprocesses that are safe, sustainable and profitable, either by employing biological resources (e.g. live organisms or active biological molecules) to transform raw materials into valuable products, or by using biological raw materials as inputs into processes. A robust interdisciplinary approach leads to frequent collaboration with other disciplines at Stellenbosch University and leading international institutions.

Water Technology

The group focuses on research and development to address local and international challenges in water provision by improving existing water treatment technologies and developing new technologies. The group's strengths include membrane technology (microfiltration, ultrafiltration, reverse osmosis, forward osmosis, membrane distillation and Donnan dialysis) and technologies suitable for developing economies. Current projects range from investigation and modelling of basic phenomena to technology development leading to implementation in the field.

Process Monitoring and Machine Learning

Advances in online monitoring and data collection present an opportunity to enhance chemical engineering processes' efficiency, sustainability, and profitability. This group's expertise rests in applying machine learning techniques to improve the operation and control of chemical plants, emphasising industry-ready solutions. Applications include fault detection and diagnosis, causality analysis, operational state identification and actionable advisories.

Chair

Prof Christie Dorfling (PrEng)
EXTRACTIVE METALLURGY:
Hydrometallurgy; metal recycling; process modelling; waste valorisation.
dorfling@sun.ac.za

Prof Guven Akdogan (PrEng)
EXTRACTIVE METALLURGY:
Mineral processing; extractive processing; waste processing and recycling.
gakdogan@sun.ac.za

Prof Steven Bradshaw (PrEng)
EXTRACTIVE METALLURGY; MACHINE LEARNING:
Hydrometallurgy; pyrometallurgy; machine learning; microwave processes.
smb@sun.ac.za

Prof André Burger (PrEng)
SEPARATIONS TECHNOLOGY:
Thermodynamics and phase equilibria; membrane separation; adsorption and ion exchange.
ajburger@sun.ac.za

Prof Annie Chimphango
BIORESOURCE ENGINEERING:
Bioresources and circularity; bioprocess engineering; biomaterials and biocomposites; integrated agro-waste-biorefineries; postharvest technologies. environment and sustainability.
achimpha@sun.ac.za

Dr Jamie Cripwell
SEPARATIONS TECHNOLOGY, MACHINE LEARNING:
Thermophysical property measurement; thermodynamic modelling; machine learning.
cripwell@sun.ac.za

Ms Danielle de Klerk
SEPARATIONS TECHNOLOGY:
Low pressure phase equilibria; thermodynamic modelling.
dldk@sun.ac.za

Prof Neill Goosen (PrEng)
DIRECTOR: ARUA Centre of Excellence in Energy
BIORESOURCE ENGINEERING:
Water-energy-food Nexus; bioresource utilisation and valorisation; biomass fractionation.
njgoosen@sun.ac.za

Prof Johann Görgens (PrEng)
SARChI RESEARCH CHAIR:
Sugarcane Biorefineries.
BIORESOURCE ENGINEERING:
Waste valorisation; development of biorefining; second generation biofuels; industrial enzyme production.
jgorgens@sun.ac.za

Prof Tobi Louw (PrEng)
BIORESOURCE ENGINEERING, EXTRACTIVE METALLURGY AND MACHINE LEARNING:
Multiscale mathematical modelling of chemical engineering processes; process monitoring, control, data analysis and machine learning.
tmlouw@sun.ac.za

Mr Zwonaka Mapholi
BIORESOURCE ENGINEERING:
Plant-based pharmaceuticals, ultrasound technology, biofuels and cosmetics. Photocatalysis and underground coal gasification technology.
zmapholi@sun.ac.za

Ms Neo Motang
SEPARATIONS TECHNOLOGY:
High-pressure phase equilibrium; Supercritical fluid fractionation.
nmotang@sun.ac.za

Prof Prathieka Naidoo
SARChI RESEARCH CHAIR: Green Hydrogen.
SEPARATIONS TECHNOLOGY: Phase equilibria measurement and modelling; thermophysical property measurement; chemical separation technologies: distillation, enhanced distillation techniques, crystallization and extraction studies; waste management process technology.
prathiekan@sun.ac.za

Prof Robbie Pott (PrEng)
BIORESOURCE ENGINEERING:
Bioprocess engineering; biofuels; waste valorisation; biorefineries.
rpott@sun.ac.za

Prof Lingam Pillay
WATER TECHNOLOGY:
Wastewater remediation and reuse; rural water treatment; membrane technology; novel water treatment processes.
pillayvl@sun.ac.za

Prof Cara Schwarz (PrEng)
SEPARATIONS TECHNOLOGY:
Supercritical fluid extraction; high pressure phase equilibria; low pressure phase equilibria; thermodynamics; separation processes; green solvents; waste valorisation.
cschwarz@sun.ac.za

Dr Margreth Tadie
RESEARCH CHAIR: Geometallurgy.
EXTRACTIVE METALLURGY:
Geometallurgy; electrochemical technologies; valorisation of mine tailings.
mtadie@sun.ac.za

Prof Siew L Tai
BIORESOURCE ENGINEERING:
Pharmaceutical engineering; reactor engineering; industrial biotechnology.
stai@sun.ac.za

Prof Eugene van Rensburg
BIORESOURCE ENGINEERING:
Biomass processing; waste valorisation; fermentation; anaerobic digestion.
eugenevrb@sun.ac.za

Mr Petrie van Wyk
EXTRACTIVE METALLURGY:
Mineral processing; hydrometallurgical extraction processes; metals recycling.
apvanwyk@sun.ac.za

2022–2023 Engineering **Student Council**

Matt Tate
Chair

Celia Britz
Vice-Chair

Camryn Abrahamson
Secretary

Ans Tshilumbu
First-Year Mentor and Social Impact

Zaid Najjaar
First-Year Mentor and Mental Health

Piya Igwer
Sustainability

Nonelwa Madumela
Womxn and Queer Empowerment and Transformation

Luca Anastasis-Lan
Treasurer

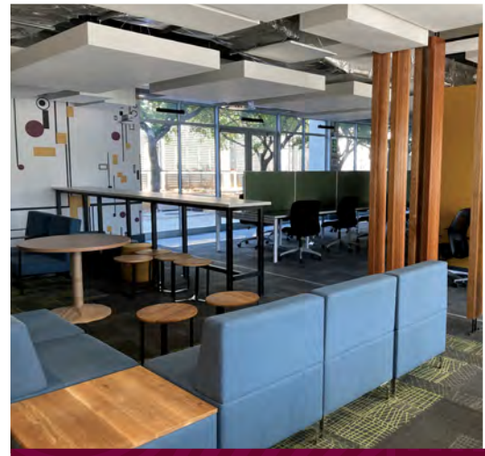
Elizabeth Montgomery
Marketing and Merchandise

Richard Visagie
Industrial Liaison

Marcel Lusheshe
Events Coordinator

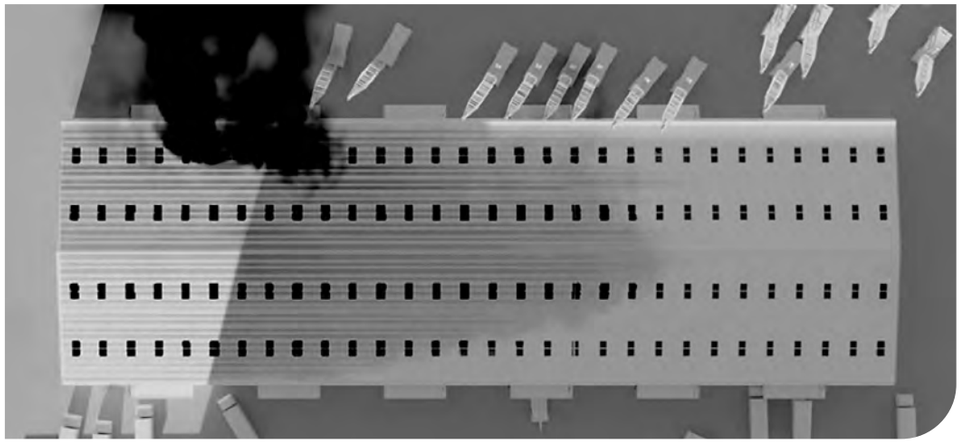
Tanyaradzwa Masaire
International Students

Christine Kyagunlanyi
Engineering Ball



DEPARTMENT OF **CIVIL ENGINEERING**

The completed two-year renovation of our Civil Engineering Building ideally positions the Department of Civil Engineering to train engineers with new technology and the requirements of an evolving industry. New class venues and specialised laboratories enable the Department to keep its academic offering relevant to present-day trends. In addition, the Department can now present its professional development courses in-house! As research forms an essential part of activities within the Department, our postgraduate courses cultivate creative solutions in specialised fields of civil engineering.



A three-dimensional explosion simulation demonstrates smoke leaving the warehouse where the ammonium nitrate was stored.

Civil engineers champion justice in Beirut blast through **forensic investigation**

In August 2020, a massive explosion rocked Beirut, the capital of Lebanon, devastating large parts of the city. Little did adjunct staff members from the Department of Civil Engineering, Dr Antonio Cicione and Danielle Antonellis, suspect their expertise in fire engineering would pull them into the aftermath of this event.

The explosion, the largest non-nuclear one in recorded history, resulted from the detonation of a large shipment of ammonium nitrate stored unsafely in a city port warehouse since 2014. Local authorities quickly blamed welders working on-site the day of the explosion.

London-based Forensic Architecture (FA) research team launched its investigation in an ongoing effort to establish accountability in political contexts with unequal power balances. FA relied on Dr Cicione and Antonellis's expertise in fire simulations. Working with engineers at Kindling Safety, a non-profit dedicated to fire safety, their study focused on identifying the most likely region of fire origin in the warehouse between two locations: an area previously identified as the smoke plume source and a new area of interest based on welding activities that occurred on the day of the incident.

Using computational fluid dynamics modelling, the team analysed publicly available video footage and blast information to create a 3D model and timeline of the explosion. Their analysis, based on external smoke plume patterns and melted vent locations, numerical simulations, and modelling results of both areas, led to the conclusion that the most likely origin of the explosion is at the northeast corner of the warehouse, where the ammonium nitrate was stored.

The scientific outcomes of the forensic investigation cleared the welders, placing the blame squarely on negligent Lebanese authorities, who ignored several warnings and failed to adhere to international codes for the safe storage of ammonium nitrate.

COVID-19 impacted South African **movement patterns**

The COVID-19 pandemic significantly affected day-to-day traffic movement patterns, with travel demand reducing worldwide due to governmental directives. The South African government implemented a stepwise lockdown approach according to five alert levels, which have guided movement, social gatherings, and economic activities throughout the pandemic.

Dr Megan Bruwer, a transport engineer in the Department of Civil Engineering, investigated the pandemic's impact on urban movement patterns and evaluated the longevity of these shifts in mobility trends as part of her PhD research. She used traffic volume and a relatively new source of traffic data in Africa, namely commercial floating car data. GPS devices, primarily smartphones, collected data about trip trajectories and speeds of vehicles.

Traffic congestion varied significantly between the alert levels in 2020 and 2021. For months in 2020, traffic volumes dropped to 20% of typical levels along some major arterials. The morning peak period vanished, and weekday traffic followed patterns similar to weekend trends. While 2021 traffic volume and congestion remained somewhat lower than in 2019, trip distribution patterns – trip length and time of day – had returned to a pre-lockdown profile by the end of 2021.

Analysis of public transport operations through the pandemic, considering rail, bus and minibus taxi services, identified the significant impact of curfews and operational restrictions on public transport operators, with some services decreasing by 90% during the strictest lockdown periods.

Dr Megan Bruwer

By September 2022, public transport operations reported similar passenger ridership to pre-COVID-19 periods. The only lasting impact of the pandemic has been a slight shift towards higher movement in the midday period, a shorter morning and afternoon peak period, and somewhat less travel at night, indicating a more flexible approach to business-related movement patterns.

Dr Bruwer has found her niche in sustainable transport and urban psychology, which will direct much of her future research.

New ERA-MIN project launched to support circular construction

The ERA-NET Cofund project on Raw Materials (ERA-MIN3), a global, innovative and flexible pan-European network of research funding organisations supported by the European Union's Horizon 2020, builds on a decade of experience with successful research and innovation projects. SU joined the ERA-MIN RecycleBIM consortium in 2022. This multinational, multi-stakeholder collaboration aims to create an integrated framework for the circularity of construction raw materials.

SU's civil engineering experts in circularity, sustainability and 3D concrete printing, Prof John Babafemi, Dr Wikbe de Villiers and Prof Gideon van Zijl, collaborate with the University of the Western Cape and ten more international partners in Portugal, France, Germany, Spain, and Italy in this ERA-MIN3 research project entitled Integrated Planning and Recording Circularity of Construction Materials through Digital Modelling.

Project partners will develop strategies and devices for cost-effective building information models (BIM) of infrastructure before demolition. They will also develop open-source software for life cycle analysis and life cycle cost to optimise the energy requirements and environmental impact of construction and demolition waste (CDW) in 3D printed concrete (3DPC) construction.

The work package 3D Printing and New Opportunities for Circularity aims to create an inventory of construction and industrial waste with demonstrated compatibility for quality and viable 3D printed concrete structural elements. This high-technological construction circularity aims to maximise CDW and other industrial solid waste in 3DPC.

The Stellenbosch group will use case studies to demonstrate using 3D-printed real-scale building elements and disseminate the findings (see **https://recyclebim.eu**), hoping to entice engineering, architecture and municipality stakeholders to use its open-access products. These products exploit to-be-demolished buildings and solid agricultural and industrial waste as commodities in circular construction.

Engineers can mitigate **environmental disasters**

South Africa witnessed two environmental tragedies in 2022, where the civil engineering know-how and research capabilities at Stellenbosch University were used well. Media engagements demonstrated the role of engineers in preventing similar disasters.

The first disaster was the devastating landslides that followed the KwaZulu Natal flooding in April, which left many fearing for the vulnerability of their dwellings to similar destruction. Dr Charles MacRobert, a geotechnical engineer in the Department of Civil Engineering, addressed these fears by publishing "How Geology Put a South African City at Risk of Landslides" in *The Conversation* (an online academic news platform), describing the geological risks associated with the Berea formation, Ecca shales and Natal group sandstones. The article explained why the soils and rocks associated with these geological formations are at risk of failure and pointed to research predicting and mitigating these risks.

The University of KwaZulu Natal organised a webinar to look at future-proofing the region, where Dr MacRobert was the keynote speaker. He also delivered the keynote lecture at the IAIA International Climate Change Symposium in Cape Town. Besides this, he was a technical guide on the Board of the Council for Geosciences (CGS) tour of affected areas following the CGS Geoscience Summit in Durban.

Likewise, when Jagersfontein, a small town in South Africa, awoke to torrents of muddy water cascading from a breached tailings storage facility in September, Dr MacRobert wrote the article "Burst Mining Dam in South Africa: What Must be Done to Prevent another Disaster" for *The Conversation*, addressing the question of responsibility. The article described the management structures that should be in place to ensure such tragedies do not occur based on research on the personnel necessitated by the newly adopted Global Industry Standard on Tailings Management.

As part of the efforts to adopt this standard, Dr MacRobert's research group surveyed local and international tailings practitioners to identify the skills and competencies of the individuals responsible for the safe management of tailings. The results were published in *The Journal of the Southern African Institute of Mining and Metallurgy* titled "GISTM: Who Are the Responsible Individuals?"

The aftermath of Jagersfontein Tailings Dam failure. Dr Charles MacRobert *(insert)*.

Research **Output**

77	35	4	10	57
Subsidised Journal Articles	International Proceedings	Chapters in Books	Doctorates	Master's Degrees

Research **Themes**

Structural Engineering

We investigate smart and green construction materials, steel and concrete structures, structural reliability, fire engineering, built environment sustainability, and digital construction. Structural reliability covers the probabilistic load and resistance provisions for structural design. Fire engineering investigates structural performance during a fire. Built environment sustainability considers the durability of materials and structures, objective modelling and minimisation of environmental impact. Digital construction develops 3D printing equipment and materials while designing and testing printed structures.

Civil Engineering Informatics

This theme covers the needs of civil engineering practices in an information-driven environment. Applying information technology is concerned with intelligent modelling of the design process, the support systems for engineering management, and the technical aspects of urban engineering. We develop real-time data processing methods for decision-making and modelling complex engineering problems with inherent uncertainties.

Construction Engineering and Management

Research into construction management investigates the management and development of multidisciplinary capital projects. It focuses on modular construction, construction risk, design management, constructability, sustainability and advanced technologies in construction.

Water and Environmental Engineering

Enabling stewardship of our natural resources while developing infrastructure for the functioning of our society is central to modern-day civil engineering. For instance, ensuring reliable and sustainable water supply to human settlements. Water resource development regards environmental requirements when designing large hydraulic structures such as dams, river abstraction works and bridges. A key concern is the medium-term effects of climate change on the continued design suitability of hydraulic and coastal structures.

Geotechnical Engineering

Large and impressive structures invariably require advanced support structures to ensure stability. We work on the challenges of problematic soils and mine tailings. Current research includes robust geotechnical analysis methods, designing high-specification structures on problem soils, and disposal method safety in mine tailings dams.

Pavement Engineering

This group is concerned with designing resilient, sustainable, and long-lasting roads for heavy traffic carried by our world-class network of national highways. Regarding materials science, the group evaluates the performance of secondary materials (crushed concrete, masonry, glass) for roads, accelerated testing of asphalt and environment-friendly bitumen stabilised materials, a performance-related seal design method for bitumen and modified binders, and a mix design and analysis system for asphalt bases.

Transportation Engineering

Road safety and intelligent transport systems (ITS) are top considerations in designing safe and efficient transportation systems. Our road safety research includes road crash causation, human factor influences, the role of geometric design, and public transport and pedestrian safety. Our ITS research covers public transport user information, multimodal database development, appropriate technology applications in developing countries and freeway management information applications for travel-time estimation and incident management systems.

Chair

Prof Nico de Koker (PrEng)
UNCERTAINTY QUANTIFICATION:
Numerical modelling; probabilistic assessment.
ndekoker@sun.ac.za

Prof Johann Andersen (PrEng)
INTELLIGENT TRANSPORT SYSTEMS.
jandersen@sun.ac.za

Prof Adewumi John Babafemi
CONSTRUCTION MATERIALS:
Cement-based material; waste materials.
ajbabafemi@sun.ac.za

Dr Adèle Bosman (PrEng)
HYDRAULICS.
abosman2@sun.ac.za

Dr Isobel Brink
WATER AND WASTEWATER TREATMENT; ENVIRONMENTAL ENGINEERING:
Wastewater and potable water treatment; stormwater quality; bio-filtration.
icbrink@sun.ac.za

Dr Megan Bruwer
TRANSPORTATION ENGINEERING:
Intelligent transport systems.
mbruwer@sun.ac.za

Dr Antonio Cicione
FIRE ENGINEERING.
acicione@sun.ac.za

Prof Riaan Combrinck (PrEng)
CONCRETE TECHNOLOGY:
Materials and mechanics.
rcom@sun.ac.za

Dr Wibke de Villiers
SUSTAINABILITY OF THE BUILT ENVIRONMENT:
Masonry structures.
wdv@sun.ac.za

Mrs Courtney Devine
FIRE ENGINEERING.
cdevine@sun.ac.za

Prof Kobus du Plessis (PrEng)
HYDROLOGY; WATER RESOURCES AND ENVIRONMENTAL ENGINEERING.
jadup@sun.ac.za

Dr Humaira Fataar
CONCRETE TECHNOLOGY:
Cement-based materials.
humairaf@sun.ac.za

Dr Nanine Fouché
GEOTECHNICAL ENGINEERING.
naninef@sun.ac.za

Dr Elaine Goosen
PAVEMENT ENGINEERING:
Bitumen rheology, numerical modelling and machine learning.
esoosen@sun.ac.za

Prof Trevor Haas (PrEng)
EARTHQUAKE ENGINEERING.
trevor@sun.ac.za

Prof Kim Jenkins (PrEng)
SANRAL CHAIR:
Pavement Engineering.
kjenkins@sun.ac.za

Mr Chris Jurgens
CONSTRUCTION ENGINEERING AND MANAGEMENT:
Project management.
cj@sun.ac.za

Dr Jacques Kruger
STRUCTURAL ENGINEERING:
3D concrete printing, rheo-, structural and interface mechanics,
pjkruger@sun.ac.za

Dr Charles MacRobert (PrEng)
FUNDAMENTAL GEOTECHNICS.
macrobert@sun.ac.za

Mr Tanduxolo Nguza
SEWER INFORMATION SYSTEMS.
tnguza@sun.ac.za

Prof Marion Sinclair
TRANSPORT ENGINEERING AND ROAD SAFETY.
msinclair@sun.ac.za

Dr André Theron
PORT AND COASTAL ENGINEERING:
Coast and estuarine hydro- and sediment-dynamic; coastal environmental studies.
aktheron@sun.ac.za

Prof Pierre van der Spuy (PrEng)
BRIDGE ENGINEERING.
pierrevds@sun.ac.za

Prof Gideon van Zijl (PrEng)
STRUCTURAL ENGINEERING:
Cement-based materials; 3D construction printing.
gvanzijl@sun.ac.za

Prof Richard Walls (PrEng)
STRUCTURAL & FIRE ENGINEERING:
Fire safety; structural fire design, informal settlements; steel structures.
rwalls@sun.ac.za

Mr Dirk Streicher (PrEng)
FIRE ENGINEERING.
dirkjs@sun.ac.za

Prof Andre van Tonder (PrEng)
PORT AND COASTAL ENGINEERING.
andrevt@sun.ac.za

Dr Algurnon van Rooyen
CONCRETE TECHNOLOGY:
Engineering mechanics.
asvr@sun.ac.za

Prof Celeste Viljoen (PrEng)
RELIABILITY OF STRUCTURES:
Concrete structures; standardisation.
celesteviljoen@sun.ac.za

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

A key benefit of studying electrical and electronic engineering at Stellenbosch University is our hands-on approach to learning. This approach, epitomised in our design modules, provides a tangible advantage to our students.

Above, electronic engineering students pitch their remote-control cars with specialised features, a third-year design project, against one another in a robot war battle. Besides providing some light relief before the final examinations, this informal fun competition demonstrated the innovative and practical skills students acquire in the design module at the Department of Electrical and Electronic Engineering.

Alex Muthua, an innovative master's graduate, improved the performance of facial recognition technology to accurately recognise the faces of people with highly pigmented skin tones.

Master's student redresses bias in **facial recognition technology**

With sophisticated algorithms that can quickly analyse and compare people's facial features with images stored in a computer database, facial recognition technology has become essential to a range of sectors – from airports, retail stores and banks to healthcare, law enforcement and marketing. However, a shortcoming of this technology is that it does not accurately recognise the faces of people with highly pigmented skin tones.

"One way to enhance the facial recognition of people with darker skin is to incorporate the portion of the infrared spectrum (the near-infrared part) that electronic sensors can perceive," says Alex Muthua, who, supervised by Prof Thinus Booysen and Dr Rensu Theart, received his MEng in Electrical and Electronic Engineering at Stellenbosch University's December graduation. "Individuals with highly pigmented skin appear darker in visible light images, providing less information on which to perform facial recognition. The addition of infrared increases the dynamic range of the intensity values, which in turn aids the face recognition system."

Most digital cameras have a filter that blocks out the infrared light needed for this type of facial recognition. Using a camera without the filter, Muthua took 9 000 images of 500 individuals with highly pigmented skin in different light spectra – visible, near-infrared and a combination of the two (full-spectrum). He found that by incorporating infrared light, the faces of people with a highly pigmented skin tone could be more accurately recognised.

Besides assessing the impact of narrow and wide cropping, different facial orientations, and sunlight and shaded conditions, Muthua fine-tuned an existing face recognition algorithm and investigated the activation maps of an available convolutional neural network, a machine learning architecture for image processing. He found that the nose area was the most important facial recognition feature for people with highly pigmented skin.

In this way, datasets could be augmented with revolutionary images of highly pigmented individuals, correcting a typical bias in these datasets more representative of light-skinned people.

Meet Engineering's **Scholarly Teacher Award winner**

The Stellenbosch University Teaching Awards annually acknowledge and reward outstanding teaching at the University. Prof Herman Kamper (associate professor and postgraduate coordinator of Machine Learning and Pattern Recognition in the Department of Electrical and Electronic Engineering) won a Teaching Award in the category Scholarly Teacher, one of three categories. This category is open to teaching academics who are reflective practitioners. They draw on educational literature to reflect on their teaching practice and professional growth and move beyond personal reflection to observation and peer review of their teaching.

On the recognition, Prof Kamper says: "As part of the award, I had to prepare a teaching portfolio. Firstly, reading other lecturers' portfolios showed me the quality and passion of the lecturers here at Stellenbosch, making this award humbling. Secondly, I realised again what a privilege it is to teach some of the best students in the world."

An NRF Y1-rated researcher, Prof Kamper was named the Faculty of Engineering's Upcoming Researcher of the Year in 2019 and received the IEEE ICASSP Outstanding Reviewer Award in 2022. He has been the co-founder and organiser of the seminar series and discussion forum Maties Machine Learning (MML) from 2017 to the present.

Prof Kamper's teaching philosophy aims to enable students to grasp the threshold concepts in his course and learn the skills to apply these concepts to solve real problems. He accomplishes this by getting students excited so that they are motivated to engage with the subject matter, making them aware of the bigger picture, and equipping them to build their knowledge by showing them where to find and how to process the relevant resources.

Prof Kamper is a Professional Engineer registered with the Engineering Council of South Africa (ECSA).

Prof Herman Kamper

Collaboration powers up Northern Cape municipalities to pay Eskom

Namakwa district municipality and eight Northern Cape local municipalities – Richtersveld, Nama Khoi, Khai-Ma, Kamiesberg, Hantam, Tsantsabane, Ubuntu and Renosterberg – were in dire straits. Unable to pay Eskom's bulk bill in full, their debt escalated. To make matters worse, they were reeling under the negative impact of the current national Eskom Under Frequency Load Shedding Scheme.

Taking on this double challenge, the Smart Municipal Areas Programme driven by Christo Nicholls, head researcher of Stellenbosch University Utility Solutions Research Chair (SUN-USRC) and alumnus of the Department of Electrical and Electronic Engineering, joined forces with these municipalities to help them meet their electricity service delivery obligation.

With brilliant support from the Northern Cape Eskom team, the collaboration has already yielded tangible results. The current direct cost of electricity supply was reduced by more than 17%, enabling the municipalities to settle their monthly bulk bill and start paying their validated historic debt. These results were made possible by identifying the root causes contributing towards mismatches between the cost of electricity and collection of revenue linked to distribution services and using machine learning and analytics to identify, normalise and maintain a feasible electricity distribution network. Frequent engagements will ensure the municipalities achieve and maintain their targets.

This collaboration will gear up early in 2023 with a municipality-bespoke five-day NRS048-9 compliant alternative load reduction programme. This initiative will enable the municipalities to implement smart load reduction, curtailing the annual loss of income averaging more than R20 million per municipality. The objective is to stop whole-town load shedding and enhance customers' supply security.

Staff members received **a prestigious award**

The Institute of Electrical and Electronics Engineers (IEEE) handed their sought-after Harold A Wheeler Applications Prize Paper Award to Profs Dirk De Villiers and Robert Lehmensiek for the best applications paper in their top engineering journal, *IEEE Transactions on Antennas and Propagation*.

The National Radio Astronomy Observatory (NRAO) tasked the researchers to design the reflector antenna shapes of the USA's upcoming next-generation Very Large Array (ngVLA) radio telescope. Through detailed electromagnetic analyses, the researchers thoroughly explore the performance parameters of the proposed antenna system for different reflector shapes in their paper "An Optimal 18 m Shaped Offset Gregorian Reflector for the ngVLA Radio Telescope".

They suggest a best-performing antenna reflector system for the ngVLA radio telescope, guaranteeing better focusing, more sensitivity, and better and faster science.

"The journal receives thousands of submissions annually from leading researchers worldwide," said Prof Lehmensiek, who led the research while an antenna engineer at EMSS Antennas in Stellenbosch, a contractor to NRAO for the ngVLA. "This award recognises our work as at the forefront of global antenna design."

Prof Lehmensiek joined the NRAO's Central Development Laboratory (CDL) in Charlottesville, VA, USA, as a research engineer in August. The NRAO, a facility of the National Science Foundation, operated under a cooperative agreement by Associated Universities, Inc.

In a separate project, Prof de Villiers was part of a team of researchers that developed a method to 'see' through the hydrogen fog of the early universe and detect light from the first stars and galaxies. Prof de Villiers was co-lead on the project with Dr Eloy de Lera Acedo from Cambridge University in the UK.

The team's methodology, part of the REACH (Radio Experiment for the Analysis of Cosmic Hydrogen) experiment, will improve the quality and reliability of observations from radio telescopes looking at this unexplored pivotal time in the universe's development.

This breakthrough will help explain how the universe evolved from the emptiness after the Big Bang to the complex realm of celestial objects we observe today – 13,8 billion years later.

Profs Dirk de Villiers (left) and Robert Lehmensiek received the Harold A Wheeler Applications Prize for the best applications paper in the IEEE's top engineering journal on electromagnetics and antenna design.

Research **Output**

69	89	13	34
Subsidised Journal Articles	International Proceedings	Doctorates	Master's Degrees

Research **Themes**

Robotics

In the Electronic Systems Laboratory (ESL), research, development and projects concentrate mainly on the control of remote sensing platforms. These platforms include satellites (e.g. CubeSats), manned and unmanned aerial vehicles (UAVs), as well as autonomous underwater vehicles (AUVs) and unmanned ground vehicles. As most of the research is part of a larger system, students gain first-hand experience of the full breadth of the management and technical activities required in complex system development.

Electromagnetics

Current activities focus on the following projects: RF and microwave antennas for communications and radar systems, FEM, FDTD and MoM modelling of antennas and wave propagation in complex electromagnetic environments, development of numerical methods and software for simulation of electromagnetic fields, free-space and near-field measurement techniques, optimising complex antennas and microwave components, the Karoo Array Telescope (KAT) and the Square Kilometre Array (SKA). Other activities involve superconducting elements, nanosensors, electromagnetic compatibility, microwave filters and non-linear circuits. An antenna and microwave laboratory, supported by sophisticated instrumentation and powerful computing facilities, provides the infrastructure for research work.

Electrical Energy

This division covers research on electrical energy in terms of conversion, distribution, control and management, and renewable energy. Specifically, attention is given to multilevel power electronic converters, electrical machine design and drive systems, energy efficiency, and the measurement and management of electrical energy. Renewable energy focuses on photovoltaic solar energy, wind generator systems, system identification and grid integration. Our facilities include world-class laboratories and instrumentation for prototype testing and measurement. The Department has the only high-voltage laboratory in the Western Cape for advanced insulator tests and research.

Telecommunications and Informatics

This division works in a variety of areas that involve the manipulation of information-bearing signals. The work comprises the extraction and embedment of information in the signal (digital signal processing), the transmission of such signals over large distances (telecommunication) and through complex networks (communication networks), and automatic learning and the recognition of the signal content (machine learning and deep learning) with particular focus on speech and image signals, and specialised sensor signals.

Chair

Prof Herman Engelbrecht (PrEng)
NETWORKS AND DISTRIBUTED SYSTEMS: Networking and networked applications; distributed virtual environments; reinforcement learning.
hebrecht@sun.ac.za

Prof Bernard Bekker
POWER SYSTEMS: Grid integration of distributed energy resources, probabilistic modelling, variable renewable energy forecasting.
bbekker@sun.ac.za

Dr Johan Beukes
POWER ELECTRONICS AND APPLICATIONS: Utility applications of power electronics converters.
jbeukes@sun.ac.za

Prof Matthys Botha (PrEng)
COMPUTATIONAL ELECTROMAGNETICS: Numerical techniques for EM analysis.
mmbotha@sun.ac.za

Dr Armand du Plessis
PHOTOVOLTAIC SYSTEMS: Solar PV technology; machine learning; embedded systems.
armandd@sun.ac.za

Dr William Duckitt
INDUSTRIAL CONTROL AND HIGH-SPEED DIGITAL DESIGN: Industrial Control, IoT, high-speed digital design, FPGA and embedded systems, DSP, SCADA and distributed control systems.
wdduckitt@sun.ac.za

Dr Benjamin Evans
AUTONOMOUS SYSTEMS: Autonomous navigation and racing, planning, reinforcement learning.
bdevans@sun.ac.za

Dr Arno Barnard
COMPUTER SYSTEMS: Space vehicle electronics; FPGA and DSP design; microcontrollers; radiation influence and mitigation techniques.
abarnard@sun.ac.za

Mr Nelius Bekker
HIGH VOLTAGE AND POWER SYSTEM MODELLING: Demand-side management; measurement and verification; renewable energy systems; parameter estimation.
neliusb@sun.ac.za

Prof Thinus Booysen (PrEng)
COMPUTER SYSTEMS: The Internet of Things (IoT) and 4IR applied to energy, water and paratransit.
mjbooysen@sun.ac.za

Prof Dirk de Villiers (PrEng)
SARChI RESEARCH CHAIR: Antenna Systems for SKA.
ANTENNAS AND MICROWAVES: Design and modelling of antennas and microwave passive devices.
ddv@sun.ac.za

Prof Johan du Preez
SPEECH PROCESSING AND PATTERN RECOGNITION: Speaker, speech and language recognition.
dupreez@sun.ac.za

Dr Japie Engelbrecht (PrEng)
AEROSPACE CONTROL SYSTEMS: Manned/unmanned aircraft flight control and navigation; Airbus collaboration contact point.
jengelbr@sun.ac.za

Dr Callen Fisher
LEGGED ROBOTS: Bio-inspired, high speed transient motion, optimal control.
cfisher@sun.ac.za

Prof Coenrad Fourie (PrEng)
ELECTRONICS: Electronics design automation (EDA) software; superconductor circuits; geomagnetism and space weather monitoring; VLSI inductance.
extraction coenrad@sun.ac.za

Dr Jacki Gilmore
ANTENNAS: South African Square Kilometre Array; antenna element and feed design; electromagnetic modelling.
jackivdm@sun.ac.za

Dr Nkosinathi Gule
ELECTRICAL MACHINES AND DRIVES: Multiphase induction machine drives and control; renewable energy and power systems.
nathie@sun.ac.za

Dr Willem Jordaan
SATELLITE CONTROL SYSTEMS: Satellite systems; satellite orbit and attitude control; process control; adaptive control; embedded systems.
wjordaan@sun.ac.za

Prof Maarten Kamper (PrEng)
ELECTRICAL MACHINE SYSTEMS: Electrical machine design; Electrical drives and control; Renewable energy generator systems.
kamper@sun.ac.za

Prof Toit Mouton (PrEng)
POWER ELECTRONICS: Converter technology; multilevel converters; AC to DC converters; control of power electronic converters.
dtmouton@sun.ac.za

Mr Christo Nicholls
MACROCOMM SMART UTILITIES CHAIR: IoT; machine learning; DSM: power systems; utility solutions.
cnicholls@sun.ac.za

Dr Karen Garner (PrEng)
ELECTRICAL MACHINE SYSTEMS: Electrical machine design; renewable energy generator systems; high voltage systems; transmission design.
garnerks@sun.ac.za

Mr Lanche Grootboom
ANTENNAS AND ELECTROMAGNETICS: Integrated antenna design.
llgrootboom@sun.ac.za

Dr Leanne Johnson
MACHINE LEARNING AND MICROWAVE ENGINEERING: Design and optimisation of microwave filters, antennas, and other microwave components with machine learning techniques.
ljohnson@sun.ac.za

Prof Herman Kamper (Eng)
MACHINE LEARNING AND PATTERN RECOGNITION: Speech, vision and language processing.
kamperh@sun.ac.za

Prof Petrie Meyer (PrEng)
MICROWAVE CIRCUITS: Network synthesis; microwave filters; low-noise amplifiers; numerical modelling.
pmeyer@sun.ac.za

Dr Fredrick Mwaniki (PrEng)
POWER ELECTRONICS; ELECTRICAL DRIVES: Renewable energy; power systems.
fmmwaniki@sun.ac.za

Prof Thomas Niesler (PrEng)
SPEECH PROCESSING AND PATTERN RECOGNITION: Speaker, speech and language recognition.
trn@sun.ac.za

Prof Willie Perold (PrEng)
ELECTRONICS: Superconducting Josephson circuits; SQUID sensors; nanotechnology sensing devices.
wjperold@sun.ac.za

Dr Arnold Rix
PHOTOVOLTAIC SYSTEMS: Solar PV technology; rooftop and utility scale solar PV; performance monitoring; network integration.
rix@sun.ac.za

Dr JC Schoeman
AUTONOMOUS SYSTEMS: Autonomous navigation, planning, reinforcement learning.
jcshoeman@sun.ac.za

Dr Willem Smit
DIGITAL HARDWARE: FPGA and DSP design; camera systems and security.
applications. wsmit@sun.ac.za

Prof Herman Steyn (Emeritus) (PrEng)
AEROSPACE & INDUSTRIAL CONTROL SYSTEMS: Satellite systems; satellite orbit and attitude control; process control; adaptive control.
whsteyn@sun.ac.za

Dr Werner Steyn
ANTENNAS AND MICROWAVE CIRCUITS: Design and modelling of antennas and microwave devices.
wernersteyn@sun.ac.za

Dr Johann Strauss (PrEng)
ELECTRICAL ENERGY SYSTEMS: Efficient energy conversion; linear generators.
jstrauss@sun.ac.za

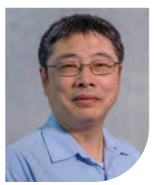
Dr Rensu Theart
IMAGE ANALYSIS AND MACHINE LEARNING:3D microscopy data visualisation and analysis; virtual reality applications; machine learning.
rptheart@sun.ac.za

Dr Corné van Daalen
AUTONOMOUS SYSTEMS: Autonomous navigation, planning, conflict detection and resolution.
cvdaalen@sun.ac.za

Ms Chantelle van Staden
RENEWABLE ENERGY: Grid integration; planning of renewable energy resources.
cvanstaden@sun.ac.za

Prof Johan Vermeulen
LOAD MODELLING AND RENEWABLE ENERGY: Load modelling; energy management; grid integration of renewable energy.
vermeuln@sun.ac.za

Prof Jaco Versfeld
TELECOMMUNICATIONS AND SIGNAL PROCESSING: Forward error correction; digital communication systems; array processing.
djjversfeld@sun.ac.za



Prof Rong-Jie Wang (PrEng)
ELECTRICAL MACHINE SYSTEMS: Special electrical machines; finite element modelling; renewable energy systems; thermal analysis in power devices.
rwang@sun.ac.za

DEPARTMENT OF **INDUSTRIAL ENGINEERING**

The Department of Industrial Engineering continuously pursues excellence in teaching and learning, research and partnerships. In today's world, there is a greater demand for productivity, competitiveness and effectiveness than ever. Modern businesses cannot compete without constantly improving their processes and systems. We train industrial engineers who can provide solutions for these modern challenges outstandingly. Above, ORSSA's president, David Clark, presents their premier award, the Tom Rozwadowski Medal, to Prof Van Vuuren for the best-written contribution to operations research by a member of the Society.

Prof Jacomine Grobler and Ntebaleng Matshabaphala with Prof Susan Adendorff (left), the daughter of Prof Kris Adendorff, and Jacques Fauré (right), SAIIE's 2022 president.

Profs Jan van Vuuren and Corne Schutte.

Dr Louzanne Bam with Prof Susan Adendorff (left) and Jacques Fauré (right).

SAIIE celebrates excellence with awards

The South African Institute of Industrial Engineering (SAIIE) awards honour and celebrate outstanding contributions to industrial engineering in Southern Africa every year. Our Department's staff did us proud at the 2022 SAIIE Awards and Gala Dinner, where the awards were announced.

Congratulations to the following recipients of these prestigious awards:

- Prof Jacomine Grobler and Ntebaleng Matshabaphala for the Award for Best Industrial Engineering Paper Published in SAIIE;
- Prof Corne Schutte for the Kris Adendorff Award for Most Prominent Industrial Engineering Professional;
- Prof Jan van Vuuren for the SAIIE Editor's Award; and
- Dr Louzanne Bam for the Runner-up Award for Best Industrial Engineering in Teaching and Learning.

The Conference on Competitive Manufacturing **outwitted Covid**

The Department of Industrial Engineering successfully hosted the eighth International Conference on Competitive Manufacturing (COMA '22) in Stellenbosch. COMA is a CIRP (International Academy for Production Engineering) sponsored conference presented by the Department every three years. The theme "Smart, Sustainable Manufacturing in an Ever-changing World" encapsulated the Conference objectives: to present recent developments, research results and industrial experience related to intelligent and sustainable manufacturing; and to generate innovative ideas and fruitful collaboration locally and abroad.

Despite the challenges posed by the Covid-19 pandemic, the Conference was successfully held in March, with the participation of delegates from 11 countries. While 37% of the speakers were from South African Universities, 63% were from abroad. Among the attendees were 18 delegates from the industry.

The CIRP evaluators pointed out that the Conference's success was evident in the in-person attendance of all the delegates, which led to interesting discussions and many new research initiatives, satisfying the Department that the conference realised its objectives.

Department of Industrial Engineering **excels at ORSSA Conference**

The Operations Research Society of South Africa (ORSSA) presents recognition awards to individuals who have served the profession of operations research (OR) in a commendable way. These awards, reserved only for outstanding achievements and contributions, are considered a respected distinction.

At the 51st Annual Conference of ORSSA in 2022, academic staff and students of the Department received various awards.

The Tom Rozwadowski Medal

Prof Christa Searle and Prof Jan van Vuuren won ORSSA's most distinguished award, the Tom Rozwadowski Medal. The Medal is awarded for the best-written contribution to operations research made by a member of the Society during the previous year. Prof Searle, an assistant professor at Edinburgh Business School at Heriot-Watt University, was formerly a data science and operations research lecturer in the Department of Industrial Engineering.

Their winning paper, "Modelling Forced Migration: A Framework for Conflict-induced Forced Migration Modelling According to an Agent-based Approach", is about designing agent-based simulation models to capture the emergent migration patterns of those forced to flee conflict areas.

She is well known in the local operations research community, having attended the annual ORSSA conferences since 2015, when she became a student member. She also received a Category IV Award from ORSSA in 2020 in recognition of her excellent service rendered to the local profession of operations research as a lecturer and mentor of a new generation of operations researchers.

Prof Van Vuuren, professor of Operations Research in the Department of Industrial Engineering, has received the Tom Rozwadowski Medal for a record eighth time since 2000. He founded the Stellenbosch Unit for Operations Research in Engineering (SUnORE). This group researches combinatorial and nonlinear optimisation and machine learning aimed at objective decision support for the industry.

He is also a registered Professional Natural Scientist, an NRF-rated researcher and a Fellow of ORSSA. Since 2008, Stellenbosch University has awarded him eight Research Excellence awards. In addition, he received the Rector's Award for Exemplary Teaching in 1999 and 2013 based on student feedback and the Medal for Lecturer of the Year in the Faculty of Engineering in 2019.

ORSSA's national student competitions

Alexander Flemming received the esteemed 2022 Theodor Stewart Medal for the best master's thesis in OR titled *A Framework for Modelling Spatio-temporal Competition and Spread of Invasive Acacia Species in South Africa*.

> *"Seeing all my hard work and sacrifices pay off is gratifying.*

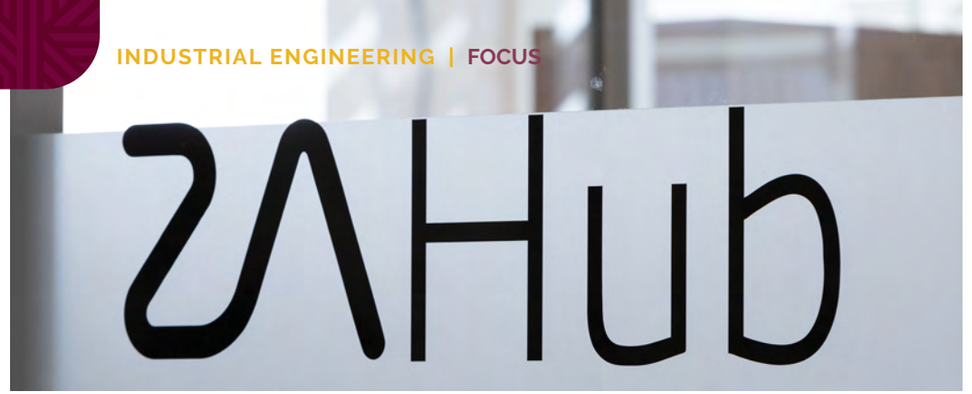
Flemming said, "It is sometimes difficult to explain the scope and difficulty of one's work to people not working on it, but this award for the best master's project in operations research nationwide establishes that very elegantly."

Fuzail Dawood received the prestigious 2022 Gerhard Geldenhuys Medal for the best fourth-year project in OR, titled *Modelling Control Strategies for the Invasive Tree Species Prosopis in the Northern Cape*.

"Seeing all my hard work and sacrifices pay off is gratifying. The project required a lot of commitment and perseverance, which would not have been possible without continuous support from my supervisors, family and friends," said Dawood.

His project was conducted under Flemming's supervision, while Flemming's supervisor took on the role of co-supervisor. Flemming appreciated the opportunity to explore collaboration in research and assist someone in pursuing a research topic, making it their own.

Medal-winning duo: Alexander Flemming (left) and Fuzail Dawood.



The launch of the BMW IT Hub is toasted by (above from the left) Prof Deresh Ramjugernath (deputy vice-chancellor of Learning and Teaching), Prof Wikus van Niekerk (dean of Faculty of Engineering), Prof Corne Schutte (chair of Department of Industrial Engineering) and Klaus von der Osten-Sacken (director of Digital and Global Solutions at BMW Group South Africa). Above on the right, staff and student beneficiaries celebrate the new hub with BMW partners.

New BMW IT Hub research space fosters **innovation and knowledge transfer**

The newly founded partnership between Stellenbosch University (SU) and the BMW Group South Africa has progressed to the next phase. In July 2022, the partners officially launched the BMW IT Hub, also known as the ZA Hub research space at the Faculty of Engineering (in the Mechanical and Mechatronic Building).

Various stakeholders from BMW, SU researchers, staff members, and current BMW-sponsored postgraduate students attended the launch. The new state-of-the-art research space creates an environment that fosters innovation and the transfer of technical knowledge.

The launch of the BMW IT Hub research space follows the recent partnership between SU and the BMW IT Hub that involves an agreement of five years that started in 2022 with ten master's bursary students. The initiative aims to develop a homegrown IT talent pipeline for the company by promoting skills in artificial intelligence and data analysis and ultimately establishing a group of talented students that will support BMW in growing and maintaining software in the scope of their IT business.

Prof Wikus van Niekerk, dean of the Faculty of Engineering, warmly welcomed the guests and reminisced about the newly renovated floor space where, in the past, BEng students conducted studies on ramjets. From now on, BMW-sponsored postgraduate students will have a designated area to conduct research, hold discussions and collaborate to create valuable expertise.

Klaus von der Osten-Sacken, director of Digital and Global Solutions at BMW Group South Africa, emphasised the value of long-term collaborative business relationships, which enhances productivity and results by contributing diverse skillsets to a common cause. He concluded that he looks forward to this longstanding partnership with the University.

Prof Corne Schutte, chair of the Department of Industrial Engineering and project leader, thanks Dr Andreas Hees, head of Business Management at BMW Group South Africa. Dr Hees initiated the partnership due to his commitment and love for South Africa. Prof Schutte also thanked BMW for creating a space that envisioned the future for new thought leaders and impactful research to emerge.

Research **Output**

72	48	14	1	11	49
Subsidised Journal Articles	International Proceedings	National Proceedings	Books	Doctorates	Master's Degrees

Research **Themes**

Engineering Management

Our research aims to improve value creation in technology-based enterprises by focussing on the following:

- Enterprise Engineering: Analysing enterprise design, implementation and operation to improve knowledge, innovation, financial and technology management.
- Sustainable Systems: Enabling the transition to sustainability by enhancing systems and technology evaluation, development, planning, design and management.
- Health Systems Engineering: Finding engineering solutions for challenges facing the healthcare sector.
- Innovation for Inclusive Development: Analysing, developing and evaluating inclusive innovations and systems.
- Industrial Policy and Beneficiation: Enabling mineral-rich countries to achieve sustainable development.
- Innovation: Management of technological innovation, innovation strategy, dynamics of technological change and the impact of emerging technologies.

Manufacturing

Our research covers the development of resource-efficient process chains for the sustainable and smart manufacturing of products through digital, economically-sound process chains that minimise negative environmental impacts while conserving energy and natural resources.

Additive and subtractive manufacturing; reverse engineering, materials design and development; prototyping, ergonomics (human factors); commercial readiness; micro-manufacturing; novel biocompatible alloy development.

Operations Management

Operations and supply chain management focus on process excellence from both intra-organisational and inter-organisational points of view in the following areas:

- Asset Management: Improving the coordinated activities of an organisation to realise value from assets.
- Supply Chain Management: Leveraging the impact of 4IR technologies to improve operations and supply chains through digitalisation.
- Sustainable Freight Transport: Facilitating decarbonisation of freight transport activities by focussing on modal shift and vehicle technology.

Systems Modelling, Operations Research and Decision Support

This theme covers the development of mathematical models and their incorporation into computerised systems to support effective decisions in the industry. These models draw from applied mathematics, statistics, industrial engineering and computer science and apply to complex problems with many trade-off solutions.

Examples include routing and scheduling decisions for delivery vehicle fleets, employee duty roster/timetabling construction, optimal production facility layout; simulation; spatio-temporal modelling using machine learning; and sentiment analysis.

Data Science

Research produces novel, efficient and robust data science technologies by developing machine learning and optimisation techniques.

Data science techniques are applied to data sets to reveal patterns, trends and associations. Examples include:

- Forecasting customer demand from millions of retail transactions to understand demand patterns.
- Determining optimal segmentation of customers to customise service delivery and develop targeted marketing strategies.
- Using machine learning to predict order delivery times in a distribution scenario.
- Analysing imaging data for real-time inventory decision making.

Fourth Industrial Revolution and the Internet of Things

This theme focuses on automating industry and society using large-scale machine-to-machine communications, sensors, actuators, and other connected devices (the "Internet of Things"). Automatisation enables autonomous interaction between machines and humans.

Examples include smart systems in transport and agriculture; Intelligent management of energy and water in education and health sectors; Real-time digital modelling of devices and industrial processes, using this "digital twin" for monitoring, diagnostics and prediction.

Chair

Prof Corne Schutte (PrEng)
ENTERPRISE ENGINEERING AND PROJECT MANAGEMENT: Knowledge management; innovation; enterprise life-cycles; project, programme, risk and communication management; PMBOK; engineering management.
corne@sun.ac.za

Prof Wouter Bam (PrEng)
INDUSTRIAL POLICY ANALYSIS: Mineral economics; industrial policy; value chains analysis; sustainability assessment; global production networks.
wouterb@sun.ac.za

Prof Taryn Bond-Barnard (PrEng, PMP)
ENGINEERING MANAGEMENT AND PROJECT MANAGEMENT: Human factors of PM; agile, knowledge management PMO; PM education.
tarynbarnard@sun.ac.za

Mr Eldon Burger
DATA SCIENCE: Artificial Intelligence; data analytics; digital transformation; explainable artificial intelligence; machine learning.
eldonburger@sun.ac.za

Dr Theuns Dirkse-van Schalkwyk
SYSTEMS MODELLING, SIMULATION AND DATA PROCESSING: Blockchain, business and other processes; RPA and data analysis.
theuns@sun.ac.za

Prof Sara Grobbelaar (PrEng)
INNOVATION AND TECHNOLOGY MANAGEMENT: Health systems engineering and innovation; innovation systems and ecosystems; innovation for inclusive development; ICTs for development.
ssgrobbelaar@sun.ac.za

Dr Wyhan Jooste (PrEng)
PHYSICAL ASSET MANAGEMENT: Maintenance management; reliability engineering; asset management methodologies.
wyhan@sun.ac.za

Dr Louzanne Bam (PrEng)
HEALTH SYSTEMS MANAGEMENT: Operations research; business process re-engineering; simulation; facility design; project management; operations management; workforce planning.
louzanne@sun.ac.za

Prof James Bekker
OPERATIONAL SYSTEMS DESIGN: Information systems; computer simulation; multi-objective optimisation.
jb2@sun.ac.za

Prof Thinus Booysen (PrEng, CEng)
RESEARCH CHAIR IN THE INTERNET OF THINGS: Information and communications technology; sensors, software, networking and distributed computing.
mjbooysen@sun.ac.za

Prof Imke de Kock (PrEng)
ENGINEERING MANAGEMENT AND SUSTAINABLE SYSTEMS: Technology management; decision support; system dynamics and analysis; sustainability science; health systems engineering and innovation.
imkedk@sun.ac.za

Prof Andries Engelbrecht
VOIGT CHAIR IN DATA SCIENCE: Swarm intelligence; evolutionary computation; machine learning; optimisation; data analytics; artificial intelligence.
engel@sun.ac.za

Prof Jacomine Grobler (PrEng)
SUPPLY CHAIN DATA SCIENCE AND OPTIMISATION: Data science; optimisation algorithm development; supply chain management.
jacominegrobler@sun.ac.za

Mr Jacobus King
OPERATIONS RESEARCH: Combinatorial optimisation; multi-objective optimisation; vehicle routing; metaheuristic optimisation.
jacobusk@sun.ac.za

Prof Louis Louw
ENTERPRISE ENGINEERING AND OPERATIONS and SUPPLY CHAIN MANAGEMENT: Enterprise (re) design; innovation management; production management; digitalisation in operations and supply chains.
louisl@sun.ac.za

Ms Thuli Mkhaliphi
ADVANCED MANUFACTURING: Novel biocompatible alloy development; additive manufacturing technologies.
thuli@sun.ac.za

Prof Calie Pistorius (CEng)
TECHNOLOGY INNOVATION MANAGEMENT: Management of technological innovation; dynamics of technological change and the impact of emerging technologies; innovation strategy.
caliepistorius@sun.ac.za

Mr Clint Steed
MANUFACTURING SYSTEMS: Digital twin; virtual reality; artificial intelligence; human centric manufacturing.
steed@sun.ac.za

Prof Joubert van Eeden (PrEng)
SUPPLY CHAIN AND LOGISTICS MANAGEMENT: Supply chain planning and analysis; transport modelling; sustainable freight transport planning; logistics management.
jveeden@sun.ac.za

Prof Jan van Vuuren (PrSciNat)
OPERATIONS RESEARCH: Combinatorial optimisation; vehicle routing; scheduling and timetabling; facility location; decision support systems; graph and network theory.
vuuren@sun.ac.za

Dr Philani Zincume
ENGINEERING MANAGEMENT PRACTICE: Leadership, teams and organisations human capital and technical competency; production management; management systems.
philaniz@sun.ac.za

Prof Stephen Matope (PrEng)
MANUFACTURING AND INDUSTRIAL MANAGEMENT: Micromanufacturing; advanced manufacturing; robotics; production management.
smatope@sun.ac.za

Dr Stephan Nel
OPERATIONS RESEARCH: Evolutionary optimisation; multi-objective optimisation; machine learning; data analytics.
gsnel@sun.ac.za

Prof Natasha Sacks
ADVANCED MANUFACTURING: Additive and subtractive manufacturing; sustainable and smart manufacturing; materials design and development; prototyping.
natashasacks@sun.ac.za

Prof André van der Merwe
SMART DIGITAL SYSTEMS: Additive manufacturing; ergonomics (human factors); commercial readiness.
andrevdm@sun.ac.za

Dr Jean van Laar
MINING AND ENERGY MANAGEMENT: Deep-level mining; energy management. Energy efficiency; digital twinning; mine simulations; industry 4.0.
jeanvanlaar@sun.ac.za

Mr Konrad von Leipzig (PrEng)
ENGINEERING MANAGEMENT: Engineering management; strategic operations management; supply chains; engineering economics and finance.
kvl@sun.ac.za

In **Memoriam**

Although deeply saddened by the passing of Prof Albert Groenwold in the Mechanics Division of the Department of Mechanical and Mechatronic Engineering (M&M), the Faculty of Engineering is grateful for the research frontiers he explored in mathematical and computational modelling and the students he accompanied on their own journeys of discovery. Born on 10 October 1962 in Arnhem, the Netherlands, he was fluent in three languages – English, Afrikaans and Dutch. He passed away on 3 August 2022 in Cape Town.

Starting his career in 1988 as an engineer-in-training at ESKOM Tutuka Power Station, Prof Groenwold quickly rose to engineer at ESKOM Technology, Research and Investigations. Returning to the University of Pretoria as a graduate research assistant, he found his stride and obtained a master's degree *cum laude*. While there, he paid an extended visit to the Department of Aerospace Engineering, Mechanics and Engineering Science at the University of Florida in Gainesville, USA.

After an eight-month stint as a consultant for Denel Aviation in the Rooivalk Stress Office, Prof Groenwold returned to academics in 1997, first as a researcher in the Department of Mechanical Engineering of the Technikon Northern Gauteng, then as a senior lecturer in the Division of Structural Mechanics at the University of Pretoria. He obtained his PhD in 1998, laying the foundation for a lifelong passion for optimisation research, matched only by his passion for cricket.

Prof Groenwold joined Stellenbosch University's Faculty of Engineering as an associate professor in M&M's Structural Mechanics Division in January 2006 and was promoted to full professor a year later.

An inspirational enthusiast in developing algorithms and mathematical models for structural and multidisciplinary optimisations, his long-term research interests covered high-performance computing, energy-efficient computing, sequential approximate and structural optimisation, metaheuristics, finite element technology, composite materials, and environmental and sustainability modelling. Later, he ventured into multidisciplinary optimisation, particularly simultaneous analysis and design.

Much of his prolific research was published in international journals and conference proceedings. He contributed to three book chapters and supervised eight doctoral and 17 master's students.

He will be remembered as an internationally recognised researcher, a dedicated lecturer and supervisor, and a respected and well-loved colleague.

Prof Albert Groenwold

DEPARTMENT OF **MECHANICAL AND MECHATRONIC ENGINEERING**

Since 1944, the Department of Mechanical Engineering has laid a solid foundation for engineering training in South Africa. The first institution to offer a degree programme in Mechatronics, our name was changed to the Department of Mechanical and Mechatronic Engineering in 2006. We offer a world-class research and teaching environment to equip our graduates for modern engineering challenges. Our industry partnerships immerse us in complex, real-world problems requiring innovative solutions.

Waldo Wessels proudly exhibits his hybrid quadcopter.

Postgraduate student designs and builds a **hybrid quadcopter**

After building a clap-clap switch in his student residence room and a voice-controlled home automation system, Waldo Wessels was ready to design and build a novel quadcopter as part of his research for a master's degree in mechatronics, robotics and automation engineering.

Dr Willie Smit, a senior lecturer in the Division for Design and Mechatronics at the Department of Mechanical and Mechatronic Engineering, proposed the research topic "Design, Build and Test a Quadcopter with a Novel Configuration for Endurance Flights".

First, Wessels conducted theoretical calculations to convince sceptics of the drone's ability to fly. He also focused on advancing his central propeller innovation beyond traditional quadcopter designs. While initially intended for electric motors, Wessels discovered that a petrol engine would optimize flight duration. This led to the development of a hybrid quadcopter.

Wessels' interest in engineering was piqued when his grandfather gave him a soldering iron in Grade 1, leading to a BEng in Mechatronic Engineering and a passion for design. Master's research was a way to improve and put his skills in electronic and mechanical engineering to the test.

Concerning the design, he explained: "Since the large central propeller is responsible for producing most of the lift in this novel configuration, it is powered by a petrol engine. The small electric motors responsible for roll, pitch, yaw control and stability are canted horizontally at a fixed angle to counteract the counter torque like a conventional helicopter's tail rotor."

Built from lightweight materials resistant to petrol, the quadcopter's parts can easily be removed, fixed and replaced. The drone weighs 5,5 kg with the battery and a full petrol tank but becomes lighter in flight and more fuel-efficient.

Bonnievale sets its sights on **space technology**

Learners from Bonnievale High School helped build the first meteor detection camera system in South Africa linked to the Global Meteor Network. Mentored by Prof Nawaz Mahomed and Llewellyn Cupido from the Department of Mechanical and Mechatronic Engineering, they gained skills in tracking satellites and space debris.

The learners participated in a development programme nurturing an interest in space-related technology to attract students to engineering studies. The Chinese Academy of Sciences funded the programme under the ASTRONOC (Astronomical Observation Centre) initiative for optical tracking of space objects due to global concerns over space debris.

The cameras are based at the ASTRONOC Space Object Optical Tracking station on the black-owned wine farm Elethu. The first locally operated optical tracking and cataloguing facility for satellite and space debris in Southern Africa, the station is privately owned and registered with the South African Council for Space Affairs. Completed in October 2020, it was a partnership with Purple Mountain Observatory and Keldysh Institute of Applied Mathematics to provide observation data in the Southern Hemisphere, complementing Northern Hemisphere tracking stations.

Following the United Nations Space Debris Mitigation Guidelines, this initiative establishes a local space situational awareness capability to promote responsible space utilization and advance global collision warning measures.

The facility provides access to an integrated hardware and software system for optical tracking including an all-sky camera and a weather station to measure cloud cover and sky quality. The public may access the all-sky and in-dome cameras live on www.astronoc.co.za (scroll to the bottom) and view daily meteor stacks on istrastream.com/rms-gmn/.

The research efforts are still at an early stage; nevertheless, tracking data on the close approach of Asteroid 2019 XS contributed to the article "International Asteroid Warning Network Timing Campaign: 2019 XS", published in the *Planetary Science Journal*, July 2022.

This capability will be enhanced in 2023 by adding a dual-tube telescope for asteroid research to complement the current two wide-field-of-view telescopes.

Engineering students **ace MATHack**

Two teams, including five undergraduate students from the Faculty of Engineering, participated in the MATHack Western Cape 2022 and won the first and second prizes in the challenge.

MATHack 2022, hosted by Opti-Num Solutions and MathWorks, was a 24-hour coding challenge for Western Cape higher education institutions. Teams of two to four people aimed to solve challenges faced by small businesses during the global Covid-19 pandemic using MATLAB. Participants analysed data, developed algorithms, and created models. The submission requirements included the code, a three-slide presentation, and a 120-second project video, all to be completed within the 24-hour timeframe.

Team !Prepared took first prize and consisted of Gabrielle Liebenberg (Electrical and Electronic), Rosanne Maritz (Mechanical and Mechatronic) and Bianca Harber (Mechanical and Mechatronic). Maritz, with prior hackathon-winning experience, brought the winning team !Prepared together. They designed an application using sales data and machine learning tools to predict how much stock a business should order to prevent inventory excess or shortage.

Entering at the intermediate level, they believed their engineering studies had given them a head start having come to grips with MATLAB in several modules. They gained valuable experience in turning an idea into a minimum-viable product in a short amount of time.

Team 404 Not Found claimed the second prize with members Nickilese van der Walt (Mechanical and Mechatronic), Nicane September (Mechanical and Mechatronic) and Ryan Hansen (Chemistry, Faculty of Science). They assessed the viability of starting a small coffee shop, focusing on the Stellenbosch Central area. Learning object-orientated programming and coding an app in MATLAB, the competition opened their eyes to the opportunities available in the industry.

Team 404 Not Found enjoying a break outside (top).
Team !Prepared and Team 404 claiming their prizes (bottom).

(Left) Prof Annie Bekker with postgraduate engineering students Ben Steyn (left) and James-John Matthee on the SA Agulhas II. (Right) The Endurance resting intact on the Weddell Sea bottom.

SU researchers ventured on a historical **Antarctic expedition**

Members of the Sound and Vibration Research Group (SVRG) at the Department of Mechanical and Mechatronic Engineering earned celebrity status by being part of the expedition team who made history when they discovered the wreck of Endurance, the lost ship of renowned polar explorer Sir Ernest Shackleton, which sank in the Weddell Sea more than a century ago.

In 1915, Shackleton and his team set out to become the first to cross Antarctica from the Weddell Sea via the South Pole. However, Endurance became trapped and crushed by pack ice.

The team found the Endurance four miles south of its recorded position in the Weddell Sea, at a depth of 3,008 meters. The search required expertise in ice conditions and navigation, making tactical knowledge crucial.

Mensun Bound, director of exploration on the expedition funded by the Falklands Maritime Heritage Trust, described the find as the "finest wooden shipwreck I have ever seen, upright, well proud of the seabed, intact, and in a brilliant state of preservation".

Prof Annie Bekker, head of the SVRG and two postgraduate engineering students James-John Matthee and Ben Steyn, left Cape Town harbour with more than 65 scientists and explorers on board the SA Agulhas II in search of the Endurance in February 2022. Together with representatives from the South African Weather Service, German firm Drift & Noise, Germany's Alfred-Wegener-Institute, German Aerospace Centre and Aalto University in Finland, they provided crucial logistical support in locating and surveying the wreck in the harsh Weddell Sea environment.

An ecstatic Bekker said, "The SA Agulhas II has been the focus of my research since 2012, taking more than 30 researchers and collaborators on research voyages. To be onboard during this pinnacle moment in her service life with the discovery of the Endurance takes my breath away."

Endurance is protected as a historic site and monument under the Antarctic Treaty, which means that while the wreck is being surveyed and filmed, it may not be touched or disturbed in any way.

Research **Output**

41	27	1	2	35
Subsidised Journal Articles	International Proceedings	Patents	Doctorates	Master's Degrees

Research **Themes**

Energy and the Environment

In close collaboration with the Centre for Renewable and Sustainable Energy Studies, the Department contributes to fundamental research into a wide range of energy generation technologies. Addressing transport needs, the group investigates the performance and impact of biofuels and blends in compression-ignition and spark-ignition engines. Finding uniquely South African solutions for concentrating solar thermal power and energy storage systems, the group's world-leading research in air-cooled heat exchangers and cooling towers is well known.

Excellent experimental capabilities and strong computational expertise enable the group to develop custom-made fans, compressors and turbines for ocean current, wind, and solar energy exploitation, and air-cooled and hybrid (dry/wet) cooling systems. Research covering the energy-efficient design of ship propulsion, ship hulls and various turbomachinery is supported by the only 90 m long towing tank in southern Africa. The Department boasts the largest fan test facility (7 m diameter) in South Africa.

Mechanics and Dynamics

The group's activities consist of fundamental research on materials, the behaviour of structures and failure mechanisms and criteria. The materials research focuses on powder metal processing and products, material property extraction using digital image and volume correlation, characterisation of granular materials, and qualification of additive manufactured parts. The structures research looks for a fundamental understanding of the behaviour of structures under static and dynamic conditions and, in the case of vehicles, aircraft or ships, their impact on humans. Failure mechanisms and criteria cover composite materials and fracture and creep deformation of steels.

Mechatronics, Automation and Design

Diverse mechatronic systems such as reconfigurable manufacturing systems, machine vision applications, cyber-physical systems and digital twins, augmented/virtual reality and human-system integration. These systems are applied in diverse contexts, including manufacturing, mining, health care, renewable energy systems, motor vehicles production, facilities management and maintenance management.

Computational Modelling

The group's expertise in optimisation theory and algorithm development, finite element methods (FEM), computational fluid dynamics (CFD), discrete element methods (DEM) and continuum methods is world-renowned. The DEM work is applied to, among other things, mining and earthmoving equipment, particle dampers and conveyors. We often link optimisation methods with the FEM and CFD work in applications related to fluid-structure interaction, turbomachinery, combustion and various renewable energy technology applications. The group also has expertise in the modelling and simulation of metal casting processes, emphasising solidification analysis and segregation.

Biomedical Engineering

Technologies such as 3D printing, microcomputers and artificial intelligence are opening up new opportunities for engineering in the biomedical field. This group develops innovative minimally invasive devices to collect healthcare information, mechatronic devices for telemedicine, customised solutions for treating specific diseases, and develops and tests medical sensors for in vivo testing of the human knee's biomechanical properties.

Chair

Prof Johan van der Spuy (PrEng)
FLUID MECHANICS AND TURBOMACHINERY: Axial flow fans; micro gas turbine development; centrifugal compressor development.
sjvdspuy@sun.ac.za

Prof Anton Basson (PrEng)
MECHANICAL AND MECHATRONIC DESIGN: Distributed controlsystems: automation of manufacturing; digital twins for complex systems.
ahb@sun.ac.za

Prof Annie Bekker (PrEng)
VIBRATION AND ACOUSTICS: Measurement; human response; rotating machines, signal processing, data-driven modelling, modal analysis, digital twins.
annieb@sun.ac.za

Prof Deborah Blaine
MATERIALS ENGINEERING: Powder and particulate materials; characterisation of material properties; material development.
dcblaine@sun.ac.za

Mr Raymond Botete
MATERIALS ENGINEERING: Characterisation of material properties; selective laser melting; material development.
mrbotete@sun.ac.za

Mr Johann Bredell (PrEng)
MECHANICS: Structural analysis and design.
jrbredell@sun.ac.za

Prof Corné Coetzee
MODELLING OF GRANULAR FLOWS: Meshless finite element and discrete element method.
ccoetzee@sun.ac.za

Mr Llewellyn Cupido
MATERIALS ENGINEERING: Metal casting; heat treatment; mechanical metallurgy.
llcupido@sun.ac.za

Dr Nur Mohamed Dhansay
STRENGTH OF MATERIALS: Fracture mechanics; failure analysis; metal fatigue.
nurmdhansay@sun.ac.za

Dr Danie Els
MECHANICAL DESIGN: Modelling of granular flows and particle dampers; infantry weapon systems and fuse design.
dnjels@sun.ac.za

Dr Andrew Gill
THERMOFLUIDS: Fluid dynamics; thermodynamics; turbomachinery; multi-phase flows; computational fluid dynamics.
agill@sun.ac.za

Ms Liora Ginsberg
MECHANICAL DESIGN: Biomechanics; biofluids.
ginsberg@sun.ac.za

Mr Preyin Govender
MATERIALS CHARACTERIZATION, ADDITIVE MANUFACTURING, POWDER METALLURGY.
govenderp@sun.ac.za

Mrs Taneha Hans
THERMODYNAMICS AND HEAT TRANSFER: Supercritical carbon dioxide Brayton cycles.
taneha@sun.ac.za

Prof Jaap Hoffmann (PrEng)
THERMODYNAMICS, HEAT TRANSFER AND FLUID DYNAMICS: Computational fluid dynamics; dispersed two-phase flow.
hoffmaj@sun.ac.za

Mr Shival Indermun
MECHANICAL AND MECHATRONIC DESIGN: Robotic navigation and perception; machine vision; semantic inference.
shivalindermun@sun.ac.za

Dr Karel Kruger
MECHANICAL AND MECHATRONIC DESIGN: Design, control, manufacturing and assembly systems; industrial robot programming; machine vision.
kkruger@sun.ac.za

Dr Ryno Laubscher
THERMODYNAMICS, HEAT TRANSFER AND FLUID DYNAMICS: Computational fluid dynamics and scientific machine learning.
rlaubscher@sun.ac.za

Prof Nawaz Mahomed
COMPUTATIONAL MECHANICS: Solidification in metal casting; steel metallurgy; heat treatment.
nawaz@sun.ac.za

Prof Craig McGregor (PrEng)
ENERGY SYSTEMS: Renewable energy; concentrating solar thermal.
craigm@sun.ac.za

Mr Matthew Meas
HEAT TRANSFER AND FLUID DYNAMICS: Concentrating solar power systems; solarised gas turbines.
mmeas@sun.ac.za

Prof Christiaan Meyer
MULTIPHASE FLOWS: Mineral processing; particulate dispersion and suspension; non-Newtonian behaviour of multiphase fluids; combustion.
cjmeyer@sun.ac.za

Prof Josua Meyer (PrEng)
HEAT TRANSFER AND INTERNAL FORCED CONVECTION.
jpm2@sun.ac.za

Dr Melody Neaves
MATERIALS ENGINEERING: Digital image correlation; materials testing; microstructural analysis.
melzvanrooyen@sun.ac.za

Dr Brendon Nickerson
VIBRATIONS: Vibration measurement and analysis; structural simulation; computational and numerical methods; data analysis; experimental measurement and testing.
nickersonbm@sun.ac.za

Dr Michael Owen
THERMODYNAMICS, HEAT TRANSFER AND FLUID DYNAMICS: Industrial heat exchangers; thermal energy systems; aerodynamics.
mikeowen@sun.ac.za

Mr Michael Perumal
SENIOR ENGINEER IN GIBELA RESEARCH CHAIR: Dynamic measurements and maintenance.
mperumal@sun.ac.za

Dr Hannes Pretorius (PrEng)
THERMODYNAMICS, HEAT TRANSFER AND FLUID DYNAMICS: Cooling systems; gas turbine engineering and heat transfer.
jpp@sun.ac.za

Mr Otto Scheffler
MODELLING OF PARTICLE FLOWS: Application of the discrete element method to agricultural systems.
ocscheffler@sun.ac.za

Prof Kristiaan Schreve (PrEng)
MECHANICAL AND MECHATRONIC DESIGN: Micrometrology; machine vision; reverse engineering.
kschreve@sun.ac.za

Dr Willie Smit
MECHATRONICS: Unmanned aerial vehicles; heliostat control and calibration.
wjsmit@sun.ac.za

Dr Gerrit ter Haar
MATERIALS ENGINEERING: Additive manufacturing; titanium alloy metallurgy; material characterization; mechanical properties.
gterhaar@sun.ac.za

Mr Piero Trinchero
MECHANICAL DESIGN: Engineering drawing; CAD and machine design.
ptrinchero@sun.ac.za

Mr Carl Tshamala (PrEng)
THERMODYNAMICS AND HEAT TRANSFER: Power generation; cooling systems performance evaluation and optimisation for industrial applications.
mctshamala@sun.ac.za

Dr Johan van der Merwe
BIOMEDICAL ENGINEERING: Design; endoprosthetics; computational geometry.
jovdmerwe@sun.ac.za

Prof Wikus van Niekerk (PrEng)
RENEWABLE AND SUSTAINABLE ENERGY: Solar, ocean and wind energy, for both utility and small-scale electricity generation.
wikus@sun.ac.za

Prof Gerhard Venter (PrEng)
COMPUTATIONAL MECHANICS: Structural analysis and optimisation; multidisciplinary optimisation.
gventer@sun.ac.za

Prof Martin Venter (PrEng)
COMPUTATIONAL MECHANICS: Structural analysis; Inflatable structures; materials characterisation; textile composites.
mpventer@sun.ac.za

Outreach Programmes

Open Day

The annual Open Day unlocks the fascinating world of engineers and its vast career opportunities for learners, parents and the general public.
Enquiries: Ms Tanya Ficker, tel: +27 21 808 9403, e-mail: tanya@sun.ac.za

Women in Engineering

At the annual Women in Engineering afternoon, Grade 10 to 12 girls, who excel in Mathematics and Physical Sciences, find out more about engineering as a career for women when women engineers currently in industry, lecturers and students address them. We plan to host it again during Women's Month in August 2023.
Enquiries: Mr August Engelbrecht, tel: +27 21 808 3947, e-mail: august@sun.ac.za

Engineering Winter Week

During the annual Winter Week, Grade 11 and 12 learners get a clear picture of the work of an engineer through presentations by lecturers and engineers, as well as visits to industries and laboratories. **Enquiries:** Ms Portia Adonis, tel: +27 21 808 4203, e-mail: winterweek@sun.ac.za

Top Achiever Sessions

During sessions presented in Stellenbosch and various major cities countrywide and Namibia, top achievers (Grade 11 and 12) and their parents are informed about engineering as a career and the Faculty's degree programmes.. Some departments followed up with programme-specific webinars to market engineering and increase registrations.
Enquiries: Mr August Engelbrecht, tel: +27 21 808 3947, e-mail: august@sun.ac.za

First Generation Experience

Universities can be pretty daunting if you have no experience in academic or tertiary institutions. In 2018 the Faculty launched this outreach for Grade 11 and 12 top achievers whose parents have not had the opportunity to study at a university. During a day visit, they experience the exciting vibe of campus, hear about the Faculty's degree programmes and other SET fields of study and meet the Dean. We plan to continue with this event in the second semester of 2023.
Enquiries: Mr August Engelbrecht, tel: +27 21 808 3947, e-mail: august@sun.ac.za

August Engelbrecht, student recruiter and Faculty representative for the Division of Social Impact at Stellenbosch University, addresses learners during a Railway Safety Awareness programme introducing them to Science, Engineering and Technology (SET). Sponsored by Stellenbosch University and the Gibela Rail Transport Consortium, the programme offered interactive sessions on railway safety, train rides, and hands-on experience with electronic components. Prof Annie Bekker, Gibela Research Chair incumbent, hopes the initiative will inspire future studies in SET.

Talent Development Programme

The national Department of Science and Innovation initiated this school holiday enrichment programme in collaboration with the national Department of Education and SUNCEP at Stellenbosch University. Offered to all nine provinces, Grade 11 and 12 (mostly black) learners are brought together per province and instructed by the relevant province's best Mathematics and Physical Sciences teachers. Our Faculty visits these centres for recruitment.

Enquiries: Mr August Engelbrecht.
tel: +27 21 808 3947, e-mail: august@sun.ac.za

An outreach to increase the registration rate of black, African speaking students in South Africa

We launched this project in October 2019. The project involved contacting prospective students from nine vernacular language backgrounds (except English and Afrikaans) who received a provisional offer to study engineering at Stellenbosch University. Senior Matie students from similar language backgrounds participated in the project. Addressing the prospective students in their mother tongue, they shared their own experiences as engineering students at Stellenbosch University. They also managed to deal with fears and concerns that these students had. We plan to continue with this project in the second semester.

Enquiries: Mr August Engelbrecht.
tel: +27 21 808 3947, e-mail: august@sun.ac.za

TRAC South Africa

TRAC, a community intervention program of Stellenbosch University, offers support in Mathematics and Physical Sciences to Grade 11 and 12 learners from disadvantaged and poor communities across South Africa. TRAC also provides vocational guidance to its beneficiaries, assisting them in applying to tertiary institutions and facilitating the process of funding applications for tertiary studies.

Enquiries: Ms Debbey Olivier,
e-mail: debbey@sun.ac.za

Postal address
Faculty of Engineering
Stellenbosch University
Private Bag X1, Matieland 7602, South Africa

Street address
Cor. Banghoek Road and Joubert Street
Stellenbosch

Telephone
+27 21 808 4203

Coordinates
33° 55' 45" S
18° 51' 54"

Posadres
Fakulteit Ingenieurswese
Universiteit Stellenbosch
Privaat Sak X1, Matieland 7602, Suid-Afrika

Straatadres
H/v Banghoekweg en Joubertstraat
Stellenbosch

Telefoon
+27 21 808 4203

Koördinate
33° 55' 45" S
18° 51' 54" O

www.eng.sun.ac.za

Editorial Team
Carla Nel (editor), Mattie van der Merwe (language services)

Images
Stefan Els
Ignus Dreyer
©Falklands Maritime Heritage Trust / National Geographic

Contributors
Staff members of the departments of Chemical Engineering,
Civil Engineering, Industrial Engineering,
Electrical and Electronic Engineering and
Mechanical and Mechatronic Engineering

Layout and Design
Kijk Design Studio