



ANNUAL REPORT  
Faculty of Engineering

2020

Fakulteit Ingenieurswese  
JAARVERSLAG



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ENGINEERING  
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INGENIEURSWESE

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Six members of the class of 1964 celebrate six decades of camaraderie as Engineering alumni. Back, from the left: Danie Theron, Prof Kristiaan Scheve and Gerard Marais. Front: Neil Möller, Sampie Viljoen, Rooies Loedolff and Martin Petrick.

**I**n 2020 het die COVID-19-pandemie onderrig by die Universiteit Stellenbosch (US) in vele wesenlike opsigte verander, ook in die Fakulteit Ingenieurswese. Ons personeellede het besonder goed gevaar met die oorskakeling na ten volle aanlyn leer en die uitdagings wat daarmee gepaard gaan. Ons het die akademiese jaar 2020 ondanks al die ontwrigtings en regulasieveranderinge voltooi. Die baie lesse wat ons geleer het, sal ons beslis goed te staan kom om voortaan ons hibriede onderrig-en-leeraktiwiteite te verbeter en uit te brei. Daarbenewens het die Fakulteit die afgelope jaar die diversiteit van ons studente en personeel verder verhoog. Ons het ook voortgegaan om die Universiteit se kern strategiese temas te bevorder, veral deur navorsing vir impak te onderneem.

Wanneer ons op 2020 terugkyk, het ons heelwat hoogtepunte en suksesse om te vier, ten spyte van die uitdagende en komplekse omstandighede wat ons moes trotseer. Hieronder volg 'n samevatting van sommige van ons hoogtepunte, ingedeel volgens die Universiteit se kern strategiese temas.

## 'n Transformerende, inklusiewe studente-ervaring

Die gebeure van 2020 het die akademiese personeel oor die hele Fakulteit 'n stewige grondslag in aanlyn leer gebied. Alle departemente het die US se strategie van noodafstandsonderrig, -leer en -assessering (ERTLA) suksesvol in werking gestel en 'n leidende rol gespeel om innoverende aanlyn aanbiedinge van stapel te stuur. Dosente in die Fakulteit is dit eens dat die oorskakeling na aanlyn en aangevulde leer die Universiteit se strategiese tema om 'n transformerende studente-ervaring te bied ondersteun.

Ook inklusiwiteit en diversiteit is in die verslagjaar verder verbeter. In die Departement Prosesingenieurswese maak bruin, swart Afrikaan-, Indiër- en Asiër-studente van Suid-Afrika nou meer as 40% van die voorgraadse komponent uit, wat meer is as in enige ander departement in die Fakulteit. Dit is ewe bemoedigend dat meer as die helfte van die voorgraadse studente in die Departement vroue is.

## Genetwerkte en samewerkende onderrig en leer

Om die US se strategiese tema van genetwerkte en samewerkende onderrig en leer te onder-

steun, het die Departement Elektriese en Elektroniese Ingenieurswese in die verslagjaar sy eerste inname van 37 studente vir die nuwe voorgraadse program in Data-ingenieurswese verwelkom, en daarmee die aanvanklike teiken van 30 studente oorskry. Bedryfsingenieurswese is 'n al hoe gewilder keuse onder voornemende studente. Die gehalte van akademiese programme in die Departement Bedryfsingenieurswese is 'n belangrike fokus, en die volle programaanbod is steeds by die Ingenieursraad van Suid-Afrika (ECSA) geakkrediteer.

Prof Tobi Louw, 'n medeprofessor in die Departement Prosesingenieurswese, het die Fakulteit se toekenning vir uitgelese opvoeder van die jaar ontvang, sowel as die Universiteit se toekenning vir ontwikkelende opvoeder. Dit is die derde agtereenvolgende jaar wat 'n personeelid uit Prosesingenieurswese laasgenoemde toekenning ontvang, wat van die Departement se toewyding aan uitnemende onderrig getuig.

## Navorsing vir impak

Die COVID-19-pandemie was in 2020 'n belangrike dryfveer vir die aktiwiteite van die Departement Meganiese en Megatroniese Ingenieurswese. Personeel het gereageer op die nasionale oproep om hulp om in die dringende behoefte aan ventilators te voorsien deur aan ventilatorontwikkelingsprojekte deel te neem.

Die Departement Prosesingenieurswese gaan voort om sy navorsingsaktiwiteite op al hoe meer relevante terreine uit te brei, waaronder bioprosesingenieurswese, masjienleer en afvalherbenutting.

Internasionale samewerking is noodsaaklik vir navorsingsgroepe se werk én vir personeelontwikkeling in die Departement Siviele Ingenieurswese. Nietemin bly impak op plaaslike gemeenskappe en die Suid-Afrikaanse samelewing die oorhoofse doel van die Departement.

## Doelgerigte vennootskappe en inklusiewe netwerke

Die Departement Bedryfsingenieurswese het voortgegaan om bestaande navorsingsvennootskappe uit te bou. Nuwe bande is ook met vennote soos Imperial, Eerste Nasionale Bank (FNB), die Passasierspooragentskap van Suid-Afrika (PRASA), DeltaV Aerospace en 'n aantal klein en middelslagondernemings gesmee. Daarbenewens is Bedryfsingenieurswese 'n sterk voorstander van samewerking tussen verskillende dissiplines. In dié verband het die Departement die afgelope jaar sy vennootskap met die Departement Elektriese en Elektroniese Ingenieurswese versterk, wat tot die vestiging van 'n nuwe gesamentlike navorsingsleerstool in die Internet van Dinge gelei het. Voorts het die Departement Bedryfsingenieurswese sy navorsing op die gebied van datawetenskap en logistiek in vennootskap met die Departement Logistiek uitgebrei.

Die visie van die Departement Siviele Ingenieurswese is om 'n sentrum van uitnemendheid te wees wat 'n diverse groep studente en personeellede verwelkom, stimulerende leergeleenthede bied, en deur middel van slim-ingenieurswese leiers op die gebied van volhoubare en innoverende infrastruktuur ontwikkel.

## Universiteit Stellenbosch as voorkeurwerkgever

Die Fakulteit het in die verslagjaar oor vyf uitgelese professore beskik, naamlik proff Petrie Meyer en Maarten Kamper (Elektriese en Elektroniese Ingenieurswese), prof Gideon van Zijl (Siviele Ingenieurswese) en proff Steven Bradshaw en Johann Görgens (Prosesingenieurswese). Prof Celeste Viljoen is in 2020 as die Fakulteit se Visedekaan: Onderrig en Gehalteversekering aangestel. Sy is die eerste vrou wat 'n visedekaanspos in die Fakulteit beklee.

Die Departement Elektriese en Elektroniese Ingenieurswese het in 2020 sy personeelkorps uitgebrei met die aanstelling van mnr Lanche Grootboom as 'n junior dosent in elektromagnetiese en prof Gert-Jan van Rooyen as bekleër van die navorsingsleerstool in die Internet van Dinge. Hierdie leerstoel is geskep om samewerking te verbeter tussen US-navorsingsgroepe wat slimtegnologieë gebruik om belangrike praktiese probleme op te los.

Die Departement Bedryfsingenieurswese word deesdae as die land se voorste navorsingsentrum op sy gebied beskou, en produseer die meeste geweege navorsingsuitsette in die Fakulteit. Sowaat 130 navorsingsmagister- en 30 PhD-studente in die Departement

is gewoonlik in enige bepaalde stadium besig om navorsing te onderneem.

Danksy die Departement Meganiese en Megatroniese Ingenieurswese se samewerking met Rand Water borg dié waternutsmaatskappy nou 'n navorsingsleerstool in die Departement. Prof Annie Bekker beklee die Rand Water-leerstool in meganiese ingenieurswese. Sy is ook die eerste vroulike volprofessor in Meganiese Ingenieurswese aan die Universiteit.

## 'n Florerende Universiteit Stellenbosch

Die nuwe gebou van die Departement Meganiese en Megatroniese Ingenieurswese is in 2020 as deel van die Ingenieurswese Kampusvernuwingsprojek voltooi. Die opknapping van die Elektriese Masjienlaboratorium in die Departement Elektriese en Elektroniese Ingenieurswese is ook in 2020 voltooi. Hierdie laboratorium is 'n wêreldklasfasiliteit met 30 werkstasies wat vir gelykstroom- én induksie- elektriese masjiene voorsiening maak. Die Departement sal oor die volgende twee jaar die elektriese masjienkonsoles opknip om moderne beheer- en meettoerusting in te sluit.

## Toekomsblik

Met uitsonderlike akademië en bekwame professionele ingenieurs aan die stuur, is die Fakulteit Ingenieurswese stewig veranker in die wetenskap, en terselfdertyd onwrikbaar daartoe verbind om werklike, praktiese probleme die hoof te bied deur eersterangse gegraduateerde en ingenieursoplossings op te lewer.

Met die bykomende uitdaging van die COVID-19 pandemie het die Fakulteit in 2020 sy bedrywighede verder gestroomlyn, sy navorsingswerk uitgebrei en by 'n nuwe normaal aangepas. Hierdie verbeterde vermoëns sal Ingenieurswese goed te pas kom om die samelewing 'n buitengewone tyd te help oorbrug deur buitengewone, onkonvensionele oplossings te voorsien. Dit sal die Fakulteit doen deur innoverende onderrig, leer en navorsing in gevestigde ingenieursdissiplines, sowel as op ontluikende, toekomsgerigte terreine soos datawetenskap en -ingenieurswese en die Internet van Dinge te onderneem.

Die Dekaan van Ingenieurswese, prof Wikus van Niekerk, is as eregenoot van die Suid-Afrikaanse Instituut vir Meganiese Ingenieurswese (SAIMechE) verkies.

The Dean of Engineering, Prof Wikus van Niekerk, was elected an honorary fellow of the South African Institution of Mechanical Engineering (SAIMechE).



# Overview

In 2020, the COVID-19 pandemic has changed the face of teaching at Stellenbosch University (SU), including in the Faculty of Engineering, in many ways. Our staff responded exceptionally well in pivoting to fully online learning and addressing its associated challenges. We completed the 2020 academic year despite the many disruptions and changes in regulations. We will undoubtedly use the many lessons learnt to improve on and expand our hybrid teaching and learning activities in future. In addition, the Faculty increased the diversity of its students and staff over the past year. We also continued to deliver on the University's core strategic themes, notably by doing research for impact.

As we look back on 2020, we have many highlights and successes to celebrate, despite the challenging and complex circumstances we had to navigate. A few of these highlights are summarised below, organised according to the University's core strategic themes.

## A transformative, inclusive student experience

The events of 2020 allowed academic staff across the Faculty to become proficient in online learning. All departments successfully implemented SU's emergency remote teaching, learning and assessment (ERTLA) strategy, taking a leading role to implement innovative online offerings.

Lecturers in the Faculty believe the move towards online and augmented learning supports the University's strategic theme of offering a transformative student experience.

Inclusivity and diversity too have further improved in the reporting year. In the Department of Process Engineering, for instance, black African, coloured, Indian and Asian students from South Africa now make up more than 40% of the undergraduate student cohort. This percentage is higher than that of any other department in the Faculty. Equally encouraging is the fact that more than half of undergraduates in the Department are female.

## Networked and collaborative teaching and learning

In support of SU's strategic theme of providing networked and collaborative teaching and learning, the Department of Electrical and Electronic Engineering in 2020 welcomed its first intake of 37 students for the new undergraduate programme in Data Engineering, exceeding its initial target of 30.

Industrial Engineering is becoming a popular choice among prospective students. The quality of academic programmes in the Department of Industrial Engineering is an important focus, and its full programme offering has maintained Engineering Council of South Africa (ECSA) accreditation.

Prof Tobi Louw, an associate professor in the Department of Process Engineering, won the Faculty's Distinguished Teacher of the Year award as well as the University's Developing Teacher award. This was the third year in a row that a staff member from Process Engineering received the latter award, illustrating the Department's commitment to excellence in teaching.

## Research for impact

The COVID-19 pandemic was a major driver behind the activities of the Department of Mechanical and Mechatronic Engineering in 2020. Staff responded to the national call for help in addressing the urgent need for ventilators by participating in ventilator development projects.

The Department of Process Engineering continually grows its research activities in increasingly relevant areas such as bioprocess engineering, machine learning and waste valorisation.

International collaboration is essential for the work of research groups as well as for staff development in the Department of Civil Engineering. Nevertheless, impact on local communities and South African society remains the Department's overarching aim.



Matthew Brandon Baas (middle) received Stellenbosch University's coveted Chancellor's Medal in 2020. He is flanked by Prof Wim de Villiers (Rector and Vice-Chancellor) (left) and Prof Wikus van Niekerk (Dean: Engineering) (right).



## Purposeful partnerships and inclusive networks

In 2020, the Department of Industrial Engineering continued building on its existing research partnerships. It also forged new ones with partners such as Imperial, First National Bank (FNB), the Passenger Rail Agency of South Africa (PRASA), DeltaV Aerospace and a number of small and medium-sized enterprises.

The Department also strongly believes in collaboration across disciplines. Over the past year, it strengthened its partnership with the Department of Electrical and Electronic Engineering, which led to the establishment of a new joint research chair in the Internet of Things. In addition, the Department of Industrial Engineering expanded its research on data science and logistics in partnership with the Department of Logistics.

The Department of Civil Engineering's vision is to be a centre of excellence that welcomes a diverse community of students and staff, provides stimulating learning opportunities and develops leaders in the field of sustainable and innovative infrastructure through smart engineering.

## Stellenbosch University as employer of choice

The Faculty had a total of five distinguished professors in the year in review, namely Profs Petrie Meyer (Vice-dean: Research and Industry Liaison) and Maarten Kamper (Electrical and Electronic Engineering), Prof Gideon van Zijl (Civil Engineering) and Profs Steven Bradshaw and Johann Görgens (Process Engineering). Prof Celeste Viljoen was appointed as the Vice-Dean: Teaching and Quality Assurance in the Faculty in 2020. She is the first female to hold a vice-dean position in the Faculty.

In 2020, the Department of Electrical and Electronic Engineering grew its workforce with the appointment of Mr Lanche Grootboom as a junior lecturer in the field of electromagnetics and Prof Gert-Jan van Rooyen as incumbent of the research chair in the Internet of Things. This chair has been created to encourage collaboration between SU research groups who all use connected technologies to solve prominent real-world problems.

The Department of Industrial Engineering has turned into the country's prime research location in its field. The Department produces the highest number of weighted research outputs in the Faculty. At any given time, the Department typically has 130 research master's students and 30 PhD students busy conducting research.

The Department of Mechanical and Mechatronic Engineering's cooperation with Rand Water led to

the water utility sponsoring a research chair in the Department. Prof Annie Bekker was appointed as incumbent of the Rand Water chair in mechanical engineering. She also became the first female full professor of Mechanical Engineering at the University.

## A thriving Stellenbosch University

As part of the Engineering Campus Renewal (ECR) Project, the new Department of Mechanical and Mechatronic Engineering building was completed in 2020.

The refurbishment of the Electrical Machines Laboratory, situated in the Department of Electrical and Electronic Engineering, was also completed in 2020. This laboratory is a world-class facility with 30 workstations that accommodate both direct-current and induction electrical machines.

## Looking forward

With top-class academics and accomplished professional engineers at the helm, the Faculty of Engineering is both firmly rooted in science and strongly committed to addressing real-world problems by delivering first-rate graduates and engineering solutions.

The added challenge of the COVID-19 pandemic has seen the Faculty further streamline its operations, expand its research efforts and adapt to a new normal in 2020. These enhanced capabilities will stand Engineering in good stead in helping society overcome unusual times by delivering unusual, unconventional solutions. This it will do through innovative teaching, learning and research in both established engineering disciplines, as well as emerging, future-oriented fields such as data science and engineering as well as the Internet of Things.



Prof Wikus van Niekerk  
Dean: Engineering.  
Dekaan: Ingenieurswese.

# Faculty Management



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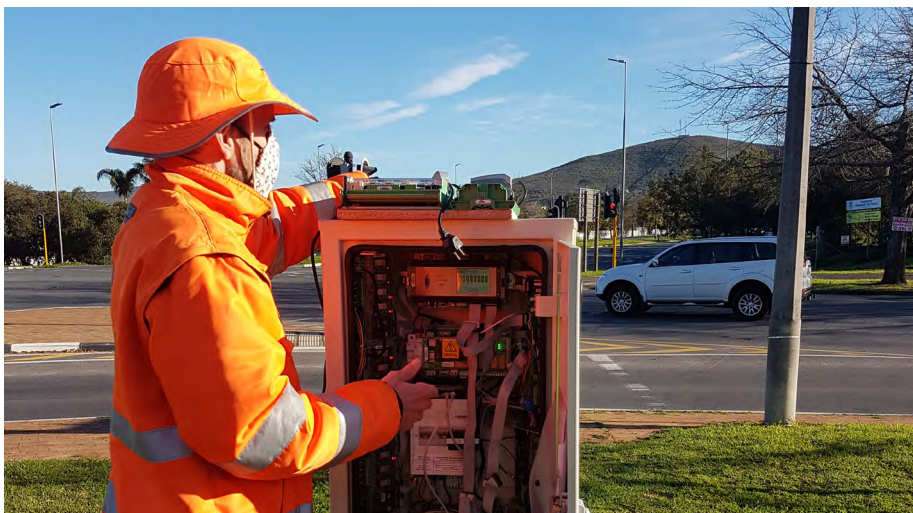
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## Civil Engineering



The Department of Civil Engineering strives to produce graduates that will play a fundamental role in society through the development of local and international infrastructure. As the Civil Engineering Industry is continuously changing to adapt to new needs and technology, the department is committed to keeping our offerings relevant and aligned with present-day trends. Therefore, postgraduate studies form a growing part of the department's activities with bespoke courses focussing on several specialized fields within the Civil Engineering sphere. The above image is one of many examples of the renowned work produced by our local Civil Engineers.





Mr Patrick Beyer from Syntell switching signal control from fixed-time to the TASC system at the R44/Van Rheeде Road intersection.

## Moving beyond road congestion with real-time traffic control

Traffic congestion in cities is becoming progressively more concerning as travel demand exceeds roadway capacity, impacting mobility, productivity and the environment.

Prior to the COVID-19 pandemic, this was also evident in Stellenbosch. On any given day, it was a nightmare to traverse across town along the R44.

In many cases, infrastructure upgrades that physically increase capacity are not viable solutions to solve congestion.

"More and more, traffic engineers are employing technology to amplify the capacity of road networks," says Prof Johann Andersen who heads up Intelligent Transportation Systems and the Stellenbosch Smart Mobility Lab in the Department of Civil Engineering.

The application of traffic-adaptive signal control (TASC) is an application of technology to assist in addressing everyday congestion.

TASC refers to the real-time control of signalised intersections, based on the provision of current detector data. This enables the real-time adjustment of signalisation parameters in order to increase vehicle throughput and reduce congestion, rather than relying on often outdated pre-set configurations that do not take current traffic conditions into account.

Not only does such a system rely on real-time traffic data input, but also on a traffic model that

simulates several signalisation options to generate a suitable allocation of green-time shares within the network.

TASC can optimise the flow of traffic at an individual intersection while simultaneously coordinating the traffic flow on a network level.

The Stellenbosch TASC project started as a research project at the Stellenbosch Smart Mobility Lab at Stellenbosch University. The project is executed in partnership with Stellenbosch Municipality, the PTV Group, Syntell and Techso.

Initially, only the R44 corridor in Stellenbosch was simulated with TASC control with an average delay reduction of up to 32% and an average increase in vehicle speed of up to 49% in specific peak periods.

Real-world implementation of this system is underway. The municipality aims to roll out this system across the network.

The project represents the first real-world test of TASC in Africa.

## New modern, spacious Pavement and Geotechnical Research Laboratory commissioned

After two months of decanting from the old Civil Engineering building to its reestablishment in the Pavement and Geotechnical Research Laboratory, the PGRL finally became operational in July 2020. Prof Kim Jenkins, incumbent of the SANRAL Chair in Pavement Engineering says: "The new PGRL

that will support the SANRAL Chair, will provide a stimulus for fundamental and applicable research that stands to benefit our infrastructure in South Africa.

In 2016, the South African National Roads Agency Ltd (SANRAL) provided an endowment of R30 million for the continuation of the Chair in Pavement Engineering, which was established in 2001.

Since its inception the SANRAL Chair has delivered more than 100 postgraduate degrees in Pavement Engineering, including 7 PhDs. Prof Jenkins adds: “The rising student numbers in this field have led to a great need for a larger, more modern laboratory that can handle the volume and scope of the research in pavement and geotechnical engineering.

The new laboratory is purpose designed. It has spacious facilities; in fact, it is almost four times larger than the previous laboratory. The PGRL can accommodate up to 80 students in the soils laboratory and more than 60 delegates in the asphalt laboratory.

Not only is the PGRL more conducive to delivering quality research, but it also provides safety in the workplace.

He concludes with this remark: “This new Pavement and Geotechnical Research Laboratory will lay the foundation for a younger generation to carry the baton forward with research in this important field, for many decades to come.”

### Civil Engineering student victorious at SU’s FameLab heat

Thabani Mtsi, a Master’s student in Civil Engineering at Stellenbosch University (SU), won the SU heat of the 2020 national FameLab science communication and public speaking competition. The virtual event took place on 14 October 2021. Considered one of the biggest science communication competitions in the world, FameLab creates a platform for young scientists to speak to public audiences about their work.

Mtsi and 23 other postgraduate students were given only three minutes to share their research with the audience. He spoke about ways in which the minibus taxi industry user experience can be improved. As the winner of the heat, Mtsi will represent SU at the national final in April 2021

where he will compete against the winners of heats at other universities in South Africa.

Commenting on his win, Mtsi, said “my life purpose is to inspire and edify those within my sphere of influence and everything I do is in service of this purpose. It is imperative that we use our academic pursuits to build the communities that built us because we are because of them. I was clothed, fed and raised by the taxi industry and so ‘isintu’ has it that I reciprocate that benevolence.”

Regarding the importance of science communication, he said “Science that is circumscribed to the bounds of scientific journals and papers has stifled societal applicability. The gap between science and society needs to be bridged so that we can co-create solutions — particularly on the African continent.”

Mtsi also boasts a Mandela Rhodes Scholarship and two Rector’s Awards for Excellence, among others. His undergraduate thesis was named the best in South Africa by the South African Institution of Civil Engineering for 2018/2019.

The winner of the South African final will compete against participants from 30 countries at the international FameLab competition.

Research Output	
Journal Articles (subsidised)	61
Proceedings International	17
Books	1
Doctoral completed	6
Master’s completed	36



Prof Gideon van Zijl  
Chair: Civil Engineering.

## Trailblazing academic receives coveted award



The 2019/2020 NSTF-South32 for TW Kamule-NSTF Award Emerging Researcher was won by Prof Richard Walls who established the Fire Engineering Research Unit (FireSUN) at Stellenbosch University.

Prof Richard Walls, who heads up the Fire Engineering Research Unit at Stellenbosch University (FireSUN), was the joint winner in the TW Kambule-NSTF Awards Category: Emerging Researcher at the 2019/2020 National Science and Technology Forum (NSTF)-South32 Awards. There were 20 nominees in this category.

Regarded as the most sought-after accolades of their kind in the country, these annual awards recognise individuals, teams, and organisations' outstanding contributions to science, engineering, and technology.

Among the competitors (in 13 categories) were experienced scientists, engineers, innovators, science communicators, organisational managers and leaders, as well as data and research managers. According to the organisers, it is an extraordinary honour to be a finalist given the quality of the nominations received every year and the fierce competition that nominees face.

Walls established the FireSUN, where he is an associate professor. This dynamic group researches informal settlements fire safety and structural fire design – both crucial to ensuring fire safety in local communities.

FireSUN recently launched a dedicated postgraduate degree programme in fire safety engineering.

Walls worked as a professional structural engineer designing industrial, petrochemical and commercial buildings before joining SU as a lecturer and researcher in the Faculty of Engineering.

His research aim is to develop fire safety engineering education while pursuing methods to improve structural design for fire safety in informal settlements. He works closely with local fire services to develop solutions for informal settlement fire problems and was involved in a large-scale analysis of the devastating Knysna fires of 2017.

Walls says: "Our team is being recognised for advancing science and engineering. Our PhD and MEng students, postdoctoral students and undergraduates have worked extremely hard, and we hope we are making an impact. I appreciate that all of their contributions were recognised in this award."

Last year, Walls also received the Faculty of Engineering's Lecturer of the Year 2020 award. With this award, in the form of a medal, the Faculty recognises contributions over a range of activities, including excellence in teaching, being a formative influence on the Faculty's students, contributing to the development of the Faculty's programmes and/or laboratories, and to the development of the Faculty in other respects.

# Research Themes

## Structural Engineering

Research is carried out on smart and green construction materials, steel and concrete structures, structural reliability, fire engineering, sustainability of the built environment, and digital construction. Structural reliability considers probabilistic load and resistance provisions, and reliability quantification. Research in fire engineering includes computational and experimental investigation of structural performance in a fire, fire spread and fire loads. Sustainability of the built environment includes durability of materials and structures, objective modelling and subsequent minimisation of environmental impact. Facilities, skills, materials development and characterisation, structural design, reliability and safe performance in fire are developed for 3D construction printing.

## Civil Engineering Informatics

Civil Engineering Informatics focuses on the needs of the civil engineering practice in an information-driven environment. Application of information technology in civil engineering is concerned with collaborative engineering, intelligent modelling of the design process in structural engineering, support systems for engineering management and technical aspects of urban engineering.

## Water and Environmental Engineering

Research fields include water resources development, flood hydrology, environmental water requirements, the design of large hydraulic structures such as dams higher than 100 m, river abstraction works and bridges, river hydraulics, sediment yield and fluvial morphology of rivers and estuaries, reservoir and harbour sedimentation, coastal engineering, port engineering and design, breakwaters, coastal and estuarine hydro- and sediment dynamics, dredging, coastal environmental studies, hydrodynamic modelling of river, lake and estuary flow patterns and water quality, water and wastewater treatment, stormwater systems and water services which include bulk water supply, water demand and water conservation, end-use modelling, alternative water sources, peak flows, stormwater quality, small-scale water treatment systems, hydraulic modelling of water systems, system pressure, pressure management, leaks and intermittent supply.

## Transportation and Geotechnics

Geotechnique research focuses include understanding the engineering behaviour of Cape Flats sands, design of settlement sensitive geodesy structures, slope stability analysis (3D vs 2D analysis, knowledge-based systems, landslide hazard communication, material point method and reliability), deep excavation design (code development and soldier pile interaction) and human factors in design (qualitative and quantitative practices in site investigation, engineering judgement, and expertise and digitisation).

In Pavement Engineering, student-orientated research includes performance evaluation of secondary materials (crushed concrete, masonry, glass, etc.) for use in roads, accelerated testing of asphalt including MMLS testing and beam fatigue tests, environment-friendly bitumen stabilised materials researched using triaxial and fatigue tests, development of a performance-related seal design method for bitumen and modified binders, and a mix design and analysis system of asphalt bases.

Within the field of Transportation, research is carried out primarily on Road Safety and Intelligent Transport Systems (ITS). Road Safety research includes road crash causation, the influence of human factors, the role of geometric design, speed, public transport safety, and pedestrian safety factors. Research in ITS focuses on public transport user information, multimodal data base development, appropriate technology applications in developing countries and freeway management information applications for travel time estimation and incident management systems.

## Construction Engineering and Management

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



# Contacts

Chair

Gideon van Zijl (PrEng)

STRUCTURAL ENGINEERING:

Computational and structural mechanics;

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Dr Isobel Brink

WATER AND WASTEWATER  
TREATMENT; ENVIRONMENTAL  
ENGINEERING:

Wastewater and potable water treatment;  
Stormwater quality; Bio-filtration.

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Prof Johann Anderson (PrEng)

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Dr Adewumi John Babafemi

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## Electrical and Electronic Engineering



The first commercially operational 'Floatovoltaic' installation in Sub-Saharan Africa at Marlenique Estate, just outside Franschoek. Ongoing research activities at the floating solar PV system will allow engineers to understand, optimise and provide accurate yield forecasts for such systems.



White Rhino in Kruger National Park: Unique and critically endangered.

## Researchers help tackle rhino poaching

Researchers in the Faculty of Engineering are developing technology that could assist conservation authorities in the ongoing fight against rhino poaching.

The greatest threat facing African rhinos is poaching for the illegal trade in their horns.

Although South Africa has made progress in protecting its rhino population in recent years, no durable solution has been found to halt the surge in poaching. Poaching gangs use sophisticated methods, including helicopters and night vision equipment to track rhinos. This means the relevant authorities need to match this level of technology to tackle the problem, alongside efforts to reduce demand for rhino horn.

Research in this Department is focused on various technology-based efforts in order to assist with the problem. The initiative is headed by Profs Thomas Niesler and Riaan Wolhuter, whose areas of interest are in Digital Signal Processing and Telecommunications. However, people engaged in technology-based anti-poaching efforts face several problems.

Prof Wolhuter says radio communication with tracking devices is tricky due to the extent and type of rhino habitat. "It is also difficult to attach such a device to the animal because of its anatomy," he says. "Together with a severely restricted on-animal power supply, these factors contribute to a difficult engineering problem."

Part of the research is the development of an advanced animal-borne tracking device to alert park

authorities to the animals displaying any abnormal behaviour. The system's biotelemetry tags can, in real-time, distinguish between classes of animal behaviour (such as standing, walking, grazing, running, and lying down).

The aim is to automatically detect a sudden, unexpected change in behaviour that may signal an imminent poaching attack, thereby providing an early warning that may save the animals.

Radio transmission and power consumption are optimised by an on-animal behaviour classification system and power saving algorithms, he explains. "The initial prototype testing was very positive," Wolhuter says. "An advanced network-based topology addresses the communications problem." The system also determines the animal's location via a global positioning system. When combined with behavioural information, this system provides valuable insights into what the animal is doing and where it displays specific behaviours.

The tracking tag is now being integrated with an advanced kinetic energy harvesting system to extend its battery life.

"This is a very exciting development," Wolhuter says. "Our research is focused on several technical aspects of the overall problem, as there is no single solution to solve the poaching crisis."

## 'Floating' solar power systems promise a greener future

Efforts are underway in the Department of Electrical and Electronic Engineering to investigate 'floating' photovoltaic (PV) systems (or, 'floatovoltaics') where solar panels are installed on large water bodies to harness solar energy.



As technology advances, innovative techniques for generating clean energy using PV systems are driving the fastest-growing form of power generation in the world.

Since more than two-thirds of Earth's surface comprises water, it makes sense to explore the concept of harnessing solar energy through means of floating PV systems. Benefits of using water surfaces include less evaporation-induced water loss and improved water quality through the hindering of algae growth. Due to the cost and availability of land, the use of water surface area is less expensive. It results in the generation of more energy per area due to improved efficiency due to the cooling effect of water.

Operating these plants with improved efficiency will potentially reduce solar energy generation costs to make it an even more attractive generation solution.

Dr Arnold Rix, the Scatec Solar Chair in Photovoltaic Systems, and other researchers in the Faculty of Engineering are investigating how these floatovoltaic systems can help address energy needs on the continent. This work includes modelling the total insolation on a collecting surface, using a varying water surface albedo model to approximate the reflected radiation.

### First intake of Data Engineers welcomed at Faculty

"In 2012 the buzz word was Data Science – in 2020 it is Data Engineering." These words were uttered by the President of the Institute of Electrical and Electronic Engineers (IEEE), Prof José Moura at Stellenbosch University in October 2019 during a combined SAIEEE/IEEE lecture on the topic of Data (Big), Computing (Fast), and Algorithms (Learning) – The New Opportunities for a Bright Future.

In February 2020 the Faculty of Engineering welcomed its first intake for the new focus area in Data Engineering. The purpose of the new focus area in Data Engineering is to prepare students for the Fourth Industrial Revolution where the work environment has fundamentally changed and there is a flood of data that needs to be structured, modelled and analysed for data-driven organisations, to discover the underlying

knowledge. Prof Herman Engelbrecht, Chair of the Department of Electrical and Electronic Engineering, the home department of this new, exciting programme, says: "Our initial target for this programme was 30 so we are very satisfied with the 37 students who registered. We believe the data engineers we deliver will be the pioneers in the new career opportunities that are created as a result of Data Science and the Fourth Industrial Revolution."

The Faculty of Engineering at Stellenbosch University also recently received confirmation that the new BEng degree in Data Engineering will be fully accredited by the Engineering Council of South Africa (ECSA) for registration as Professional Engineer.

Prof Engelbrecht concludes: "This new specialisation programme supports the School for Data Science and Computational Thinking at Stellenbosch University that was launched last year. We are preparing data engineers that can work in any organisation that has complex systems and generates data. Data Engineering offers innovative solutions to real-world challenges."

Research Output	
Journal Articles (subsidised)	42
Proceedings International	83
Chapters in Books	2
Doctoral completed	10
Master's completed	32



Prof Herman Engelbrecht  
Chair: Electrical and Electronic Engineering.



# Machine learning employed to analyse big data on Bryde's whales



A floating hydrophone system (left), developed at the Department of Electrical Engineering, recording cetacean vocalisations deployed in False Bay.



Inshore Bryde's whale (right) spotted during one of the sea trials in False Bay.

Machine learning is helping unlock new knowledge about inshore Bryde's whales in False Bay.

Prof Jaco Versfeld and his team in Stellenbosch University's (SU's) Department of Electrical and Electronic Engineering employ passive acoustic monitoring to detect, identify and track these ocean giants.

This type of monitoring allows the researchers to capture whale sounds in a non-invasive manner using underwater microphones (hydrophones).

The plethora of recorded sounds is complex to analyse manually due to many animals vocalising at the same time. There is also much man-made noise in the ocean, such as shipping noises, etc.

In this project, the first of its kind in South Africa, the researchers, therefore, employ "big data" analysis techniques to recognise and distinguish between the sounds produced by individual inshore Bryde's whales residing in the False Bay area.

Machine learning is used to help analyse the heaps of data collected through means of acoustic monitoring. The researchers create and employ computer algorithms that can be trained (with the help of data) to perform certain tasks and solve complex problems by learning from experience.

The Bryde's whale (*Balaenoptera edeni*) is one of the most poorly understood baleen whale species, found in both inshore coastal waters and open waters.

Recent research suggests that the resident inshore Bryde's whale and the seasonal offshore Bryde's whale can be split at a species level. Surprisingly

little information exists about the population dynamics and taxonomic status of inshore Bryde's whales, Versfeld says.

Versfeld says: "Once we can distinguish between individual whales, we can more accurately estimate the population size of the inshore Bryde's whales resident to False Bay."

Like other baleen whales, Bryde's whales produce low-frequency sounds described as "pulses", "moans", "pulsed moans", "sweeps" and "tonal calls" to navigate, communicate and recognise prey.

Earlier in the project, the researchers discovered an easily recognisable call of the inshore Bryde's whale. Using examples of this call and other vocalisations, they now employ techniques similar to those used for human speaker recognition to try and distinguish between individual inshore Bryde's whales.

"The ability to identify individual Bryde's whales based on their vocalisations will be an extremely powerful tool that can be used in population estimates, tracking and movement studies, as well as in other related studies," Versfeld says. "Improved knowledge about their population size will also allow us to assess anthropogenic threats to these whales, which can lead to proposed mitigation strategies, such as the recent temporary ban on octopus traps in False Bay," he says. "Scientists can use the movement data coupled with fish stock data to improve their understanding of the whales' dietary habits."

Importantly, the methods and techniques Versfeld and his team developed could be adapted and applied to research on other species and in other areas.

# 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 done as part of a larger system, students are exposed to 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 include 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 focuses in 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. In renewable energy, the focus is on photovoltaic solar energy, wind generator systems, system identification and grid integration. The 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 amongst others advanced insulator tests and research.

## Telecommunications and Informatics

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

## Telecommunications and Informatics

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# Industrial Engineering



Industrial engineers are the mavens who set out to optimise systems and processes by creatively designing solutions that integrate people, processes, and technology. Stellenbosch University's programme for Industrial Engineering aims at equipping students with the necessary knowledge and skills to become technological pioneers. The undergraduate programme follows a holistic approach to ensure that every graduate is familiar with all the skills necessary in the business world. Students can also further their knowledge through the various specialised postgraduate programmes that the Department offers. It is the Department's belief that students with a degree in Industrial Engineering have a wide choice in terms of work environment and opportunities. The world-class education that our students receive makes them valuable assets in our local – and global – industries.



Data science can be used to understand and monitor critical data such as the heatmap visualising the spread of a disease.

## Taking the lead in Data Science

In a year of unprecedented events, the Department of Industrial Engineering introduced two new structured postgraduate programmes with a focus on data science. The first intake comprised 27 students for the structured master's degree programme and 22 students for the postgraduate diploma. Each programme consists of eight modules that are presented over block weeks. The programmes allow for full-time and part-time options in that they are structured to serve both individuals from industry and students who graduated recently.

Directed by Prof Andries Engelbrecht, the Voigt Chair in Data Science in the Faculty of Engineering, these programmes focus on teaching students innovative optimisation and machine-learning techniques to produce novel, efficient and robust data-science technologies for use in industrial engineering, engineering management and related applications.

Great endeavours are bound to face some challenges, such as the impact of Covid-19. However, the data science team's determination fuelled by their collective vision and their concerted efforts to find solutions enabled them to tackle, overcome and ultimately embrace the challenges that came their way. In response to the challenges that the pandemic posed to learning and teaching, an online teaching and learning environment was created. This way the data science team could continue in their pursuit of providing first-class lectures to student cohorts. For the 2021 intake, 65 master's programme students and 40 postgraduate diploma students have been accepted.

Prof Engelbrecht is also the recipient of an A1 grading by the National Research Foundation (NRF), which is the highest achievable grading in the NRF's grading system. Researchers in this category are honoured by their peers for the quality and impact of their recent research outputs. They are further recognised as leading scholars in their respective disciplines. Prof Engelbrecht was accredited by the NRF in 2004 for the first time, with a Y1 grading at the time. Since then, his ranking has steadily improved, with a B2 grading in 2009 and an A2 grading in 2015. Gradings are valid for six years. According to Prof Engelbrecht, his goal is "simply to continue as I did in the past, to work hard to maintain excellence in research, to stay at the cutting edge of research in my discipline, to be a lodestar to my students and to produce research that will continue to form the foundation for future research endeavours."

## Prof Jan van Vuuren wins prestigious award

Prof Jan van Vuuren (Department of Industrial Engineering) is the recipient of the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (South African Academy of Arts and Science) Douw Greefprys. This prestigious prize is awarded for a research or review article of outstanding scientific quality published in the SA Tydskrif vir Natuurwetenskap en Tegnologie (SATNT) (Journal of Natural Science and Technology) during the year preceding the award was published. His winning article was titled "Die effek van veelvuldige lynverwydering op die onafhanklikheidsgetal van 'n asikliese grafiek".

## Industrial engineers develop model to address urban water scarcity

Conventional water management strategies, where water is extracted, used and then disposed of, are no longer enough to address water shortage in cities.

A system dynamics model of the City of Cape Town's water system serves as a case study in this regard. This model helps to evaluate policy interventions to extract value from retainable and recyclable water sources to address water shortages in cities.

A combination of conservation management, rainwater harvesting, greywater reuse, and the reuse of treated effluent from centralised and decentralised facilities will help to address water scarcity over the long term, say Drs Wyhan Jooste and Amoré van Zyl from the Department of Industrial Engineering at Stellenbosch University and the South African Air Force respectively.

Their model provides insight into the potential long-term effects of water retention and recycling within the City's urban water system. The findings of their study were published in the journal Development Southern Africa.

The researchers say that only a combination of conservation management and water retention and recycling will reduce water stress over the long term.

Currently, only 5–10% of the wastewater (sewage water) received by the City's water reticulation system is treated and reused for daily consumption.

"Our results show that policy interventions for retention and recycling of water within the urban system have the potential to contribute to alleviating water stress over the next 20 years," Jooste says.

Water from wastewater treatment plants, rainwater and stormwater harvesting, and greywater reuse are plausible alternatives to constrained surface and groundwater supply sources.

"Although several of these waste streams are reused on a small scale, our model allows for the investigation of impacts associated with larger,

policy-driven changes to the urban reuse system," Jooste says.

Their results (based on 2017 data) show that the City could have achieved a potential saving of 57,3 million cubic meters of water in 2017 with water conservation measures, planned augmentation of water supply, and installed systems for rainwater harvesting, greywater reuse, and decentralised wastewater reuse.

## Top student receives PhD degree

Three years after obtaining her BEng degree and the Chancellor's Medal, the highest honour bestowed on a student by Stellenbosch University, Jacqueline Kazmaier received her PhD in December 2020.

*Title: A framework for evaluating unstructured text data using sentiment analysis.*

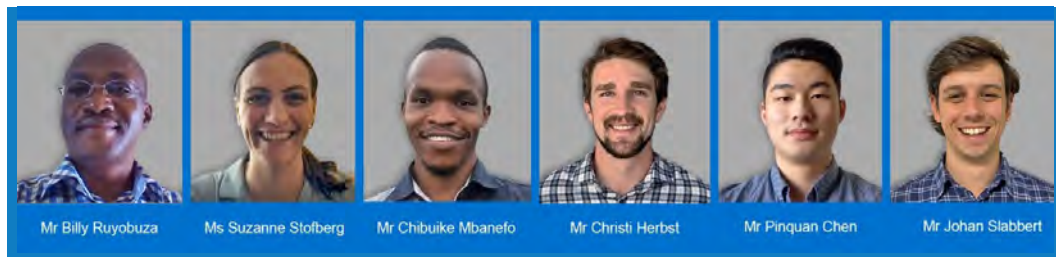
In this dissertation, a generic framework for sentiment analysis is proposed, facilitating a robust model development process and a deep, versatile analysis of model results by utilising a data mining approach. The framework can aid organisations in successfully leveraging unstructured, opinion-bearing data in combination with structured data sources to inform decision making.

Research Output	
Journal Articles (subsidised)	72
Proceedings International	40
Proceedings National	6
Books	1
Chapters in Book	2
Doctoral completed	8
Master's completed	28

Prof Corne Schutte  
Chair: Industrial Engineering.



## Imperial and SU collaborate to address climate change impact



Stellenbosch University (SU) has entered a high-profile collaboration with Imperial, one of the top logistics service providers in Africa.

"The initiative creates wonderful opportunities for staff and student research to have large-scale and real-world impact," says Prof Sara Grobbelaar, an associate professor in the Department of Industrial Engineering.

Imperial has committed to a significant investment for the next three years in the form of bursaries for a group of multidisciplinary postgraduate research students at SU.

"We expect that the investment will provide bursaries for ten doctoral and master's students over this three-year period," Grobbelaar says. "There is also an opportunity to involve as many final-year and honours students as possible over the period."

Six students are already participating in this initiative: Billy Ruyobesa (Industrial Engineering), Suzanne Stofberg (Department of Logistics), Chibuike Mbanefo (Institute for Biomedical Engineering), Christi Herbst (Industrial Engineering), Pinquan Chen (Department of Logistics) and Johan Slabbert (Industrial Engineering).

Imperial has established an operating base for the students and their academic supervisors at its Technopark office near Stellenbosch, providing infrastructure and support to help create an enabling environment for students.

"Imperial's collaboration initiative with Stellenbosch University is focused on investing in the future of Africa," says Cobus Rossouw, Executive Vice President: Digital & IT at Imperial. "The spirit of the bursary initiative is one of collaboration, focusing on the exchange of ideas and knowledge between the University, the students and Imperial."

Although Imperial focuses on a wide range of sectors, including healthcare, consumer, automotive, chemical, and industrial and commodities, this collaboration's immediate focus is on healthcare supply chains and the carbon footprint of fresh food supply chains. Imperial recently identified possible research topics in collaboration with the Department of Industrial Engineering and the Department of Logistics (in the Faculty of Economic and Management Sciences). One of these is scaling and digitising the Unjani Clinic network, one of Imperial's CSI beneficiaries. These black women owned and operated primary healthcare clinics provide accessible, affordable and quality healthcare to communities in low-income areas.

Grobbelaar explains: "We have to grapple with the research question: 'How do we ensure that we develop relevant capacity and infrastructure to respond to the pandemic, but also ensure that health system improvements are sustainable, relevant and useful post-COVID-19?'. From a climate change and carbon footprint perspective, the main question is: 'How do we plan for the impact of climate change, and do our bit to reduce our contribution to the overall impact?'. The aim here is to collectively develop relevant capacity and infrastructure to convert mobility energy needs into specific solutions for cold chain transport."

This multi-disciplinary research project aims to address and resolve challenges in the logistics and supply chain industry, ensuring cross-pollination between the industry and academia, and inter-field collaboration. "Aside from linking students to our in-country operations, our long-term goal for this collaboration initiative is to identify talent and further cement Imperial's position as a partner of choice for employees, clients and suppliers," concludes Rossouw.



# Research Themes

## Engineering Management

- Enterprise Engineering: - enterprise analysis (design, implement, operate), knowledge-, innovation-, financial- and technology management.
- Sustainable Systems: - transition to sustainability, placing emphasis on management, planning and design of infrastructure/technology.
- Health Systems Engineering: - engineering solutions to challenges facing the healthcare sector.
- Innovation for Inclusive Development: analysis, development and evaluation of inclusive innovations- and inclusive innovation systems.
- Industrial Policy and Beneficiation: how mineral rich countries might improve their sustainable development.
- Management of technological innovation, innovation strategy, dynamics of technological change and the impact of emerging technologies.

## Manufacturing

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

The focus areas of Additive and Subtractive Manufacturing are used to manufacture customised products, prototypes and novel materials for several industries including medical, aerospace, manufacturing and mining.

- Micro-manufacturing, which encompasses: The micro-machining (milling and turning) and micro-assembly of micro-products in which micro-material handling systems are utilised.

## Operations Management

Operations & Supply Chain Management focuses on process excellence from both intra-organisational and inter-organisational points of view.

- Asset Management: The coordinated activities of an organisation to realise value from assets.
- Supply Chain Management: A key focus is on the digitalisation of impact of 4IR technologies on improving operations and supply chains.
- Sustainable Freight Transport: Facilitating decarbonisation of freight transport activities focussing on modal shift and vehicle technology.
- PRASA Engineering Research Chair: Analysis of PRASA operations to improved efficiency and effectiveness.

## Systems Modelling, Operations Research and Decision Support

Focuses on the development of mathematical models and their incorporation into computerised systems aimed at supporting effective decisions in industry. These models draw from the areas of applied mathematics, statistics, industrial engineering and computer science and are applicable to complex problems which admit a large variety of trade-off solutions. Examples include:

- Routing & scheduling decisions for fleets of delivery vehicles.
- Employee duty roster/timetabling construction.
- Optimal production facility layout.
- Simulation.
- Spatio-temporal modelling using machine learning.
- Sentiment analysis.

## Data Science

Focuses on the development of machine learning and optimisation techniques to produce novel, efficient and robust data science technologies. 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

Focuses on automating industry and society using large-scale machine-to-machine communication, sensors, actuators and other connected devices (the "Internet of Things"). This allows "smart machines" that can autonomously interact with other machines or humans. Examples include:

- Smart vehicles that can sense environmental conditions and participate in agriculture.
- Sensors that help large communities (school, hospitals) reduce the usage of energy/water.
- Real-time digital modelling of devices and industrial processes, using this digital "twin" for monitoring, diagnostics and prediction.



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## In Memorium

Dr Japie van Zyl, who passed away on 26 August 2020, is a celebrated alumnus of Stellenbosch University, Faculty of Engineering. He obtained an BEng (Hons) in Electrical Engineering (cum laude) at Stellenbosch University in 1979, whereafter he enrolled at the California Institute of Technology, Pasadena, USA where he earned a Master's degree (1983) and PhD in Electrical Engineering (1986).

He is best known for his work at NASA's Jet Propulsion Laboratory (JPL), a division dedicated to the construction and operation of planetary robotic spacecraft as well as Earth-orbit and astronomy missions. During his time at JPL, Dr Van Zyl was involved in many ground-breaking missions such as the Shuttle Radar Topography Mission (2000), the Kepler (2009) and Spitzer (2013) and the launch of the robot, Curiosity, to Mars in 2012. He was also responsible for the acclaimed JPL2025 strategy, that has led to unprecedented prosperity for the JPL and a significant increase in their number of NASA funded missions. Prior to his retirement in 2020, Dr Van Zyl served as director of the solar system exploration at the JPL, where he was responsible for all the missions to planets in the outer part of the solar system.

Dr Van Zyl's legacy is interwoven with many anecdotes, all commending his gregarious spirit, intellect and adored quirks. His extraordinary mind and achievements distinguish him as one of the Faculty's greatest graduates and he is fondly remembered as an admirable teacher, mentor, colleague and friend.



The late Dr Japie van Zyl, alumnus of the Department of Electrical and Electronic Engineering, Stellenbosch University.

## Mechanical and Mechatronic Engineering



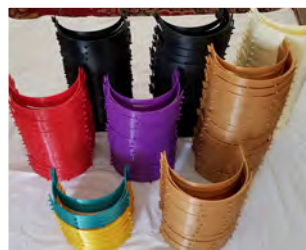
Construction of the Mechanical and Mechatronic Engineering building started in November 2018 and was completed by September 2020. These renovations are all part of the larger Engineering Campus Renewal (ECR) project. The photograph (top left) shows the renovated entrance to the Mechanical and Mechatronic Engineering building (top right). The graphic (bottom) depicts the concept of the M&M building



# Highlights



To aid the fight against COVID-19, the departments of Mechanical and Mechatronic Engineering, and Industrial Engineering used their state-of-the-art 3D printers (pictured above) to manufacture the plastic headband component (insert) of face shields for Tygerberg hospital's medical staff.



## Faculty employs 3D printing in the fight against COVID-19

Several projects were undertaken in the Faculty of Engineering to prevent the spread of the COVID-19 virus or to help treat seriously ill patients.

Facial mask headbands for the medical staff at Tygerberg Hospital were 3D printed in the Department of Mechanical and Mechatronic Engineering and the Department of Industrial Engineering during the early stages of lockdown.

In a collaborative project, a team within the department printed headbands for plastic face shields to be used as protective gear for healthcare workers dealing with COVID-19 patients. This project was led by Dr Rudolph Venter, an orthopaedic surgeon and lecturer in clinical anatomy in the Faculty of Medicine and Health Sciences (FMHS).

The printing of the headbands was done using the department's 3D printers. This type of printer can print objects using a variety of materials including plastics. 3D printing is the process of making 3D, solid objects from a digital file, explains Kevin Neaves, chief technical officer in the department who played a key role in the 3D printing of the headbands.

A 3D computer model of the face shields was uploaded to the printers' software and sliced into layers during print preparation.

"The finished product consists of a clear plastic sheet and an elastic strap that is attached to the parts (headbands) that we printed," Neaves says. "The final assembly of shields was done on the Tygerberg campus by a group in the FMHS."

"The University is doing its collective best to battle COVID-19 and to protect the community," Neaves says. "It was truly inspirational to see skills, knowledge and technology come together towards this good cause."

## Rand Water Chair focuses on 'digital twin' for water utility

Efforts are underway to establish a niche competency in 'digital twin' technology for Rand Water in the Department of Mechanical and Mechatronic Engineering.

A digital twin is a digital representation that reflects the state and behaviour of a real asset in its operational context.

Prof Anriette (Annie) Bekker, the newly appointed Rand Water Chair in Mechanical Engineering, says that digital twin technology could strengthen the utility's decision-making capabilities by providing operational intelligence on water distribution assets.

Rand Water's distribution network comprises 3 056 kilometres of pipeline and 58 reservoirs. It supplies more than 3,6 billion litres of water daily to its customers in Gauteng and parts of Mpumalanga, the Free State and North West.

Bekker aspires to explore the massive benefits of digital twins towards improved asset management in pilot projects in pump monitoring and leak detection for the water utility.

Bekker also hopes to leverage the knowledge and networks of the “sister” Rand Water Chair in Public Health at the Stellenbosch University Water Institute (SUWI), which includes the new Fraunhofer Innovation Platform (FIP). The platform aims to address the wide spectrum of water and energy security challenges in Southern Africa. It involves Stellenbosch University's Faculties of Engineering, Science and AgriSciences, under the auspices of the SUWI and the Centre for Renewable and Sustainable Energy Studies (CRSES), as well as four Fraunhofer institutes.

A digital twin pump test laboratory will be established on campus. Bekker proposes that this will help to pilot digital twin concepts and models in a controlled environment whilst establishing a demonstration and training laboratory for this technology. This will be a team effort with Dr. Karel Kruger and Prof Johan van der Spuy in the Department of Mechanical and Mechatronic Engineering.

“This pairing of the virtual and physical worlds allows monitoring systems and the analysis of real-time data to head off problems before they occur, and for planning for the future,” Bekker says.

Apart from the Rand Water project, she has also been involved in setting up digital twin solutions for South Africa's polar supply and research vessel, the SA Agulhas II, within the South African National Antarctic Programme. This full-scale measurement project — which involves taking engineering measurements on the ship during operation — kicked off in 2012. The vessel now helps to accumulate the world's most comprehensive open-source data set on ice-going vessel operations.

In 2020, Bekker became the first female professor in the Department of Mechanical and Mechatronic Engineering. She also heads up the Sound and Vibration Research Group in this department. Her

research focuses on obtaining automated intelligence from digital twins by exploring the coupling of operational sensor data with physics-based and data-driven engineering models.

### M&M moves into renovated building

After two years of being accommodated in temporary offices, personnel of the Department of Mechanical and Mechatronic (M&M) Engineering were overjoyed to start moving back into their newly-renovated building. The refurbishment of the M&M building started in November 2018 as part of the larger Engineering Campus Renewal (ECR) project spanning from 2016 until 2026. M&M now

occupies the whole building which they shared with the Department of Industrial Engineering for 34 years until mid-2018. The new building boasts several electronic classrooms, the Faculty's computer user area, FIRGA, and a magnificent Mechatronics Laboratory (with 51 workstations for 102 students). There is

a large executive committee room as well as a smaller one, and modern well-equipped lecture rooms. Closed and open-plan offices on several levels will house personnel. Postgraduate students will be accommodated in special areas near their supervisors. To have their students close by will certainly be an interesting new experience for academic staff.

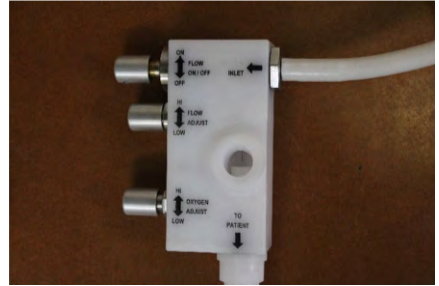
“It is wonderful to welcome everybody back,” says Prof Kristiaan Schreve, departmental Chair. “The one aspect of the new building that stands out is the better utilisation of space”.

Research Output	
Journal Articles (subsidised)	26
Proceedings International	17
Patents	2
Doctoral completed	8
Master's completed	37

Prof Kristiaan Schreve  
Chair: Mechanical and Mechatronic Engineering.



## Department of M&M Engineering assists with National Ventilator Project (NVP)



In April 2020, with the country under hard lockdown, the Department of Mechanical and Mechatronic Engineering assisted government's national ventilator project (NVP) with the testing of a continuous positive airways pressure (CPAP) device (right).

A very basic laboratory setup was prepared and a number of personnel volunteered to assist (left).

In early April 2020, the South African Department of Trade, Industry and Competition mandated the South African Radio Astronomy Observatory (SARAO) to manage the local development of ventilators in support of the government's response to combat the COVID-19 pandemic. The National Ventilator Project Manager, Willem Esterhuysen from SARAO, approached the Department of Mechanical and Mechatronic Engineering to assist with the testing of a concept Continuous Positive Airways Pressure (CPAP) device for this purpose. As the name implies, a CPAP device ensures a continuous supply of pressurised air to assist with the breathing process of a patient.

A very basic laboratory set-up was prepared with assistance from Dr Johan van der Merwe of the Biomedical Engineering research group in the Department and a number of personnel were asked to voluntarily provide assistance to the project on very short notice.

Since the country was still under stage 5 lockdown, special permission had to be obtained from the relevant authorities for persons to travel to and enter the University premises. Thanks to remote assistance from the administrative personnel in the Department, it was possible to source and purchase items like medical oxygen, oxygen sensors, tubing, flow sensors and regulators. A number of components had to be manufactured in the Mechanical and Mechatronic Engineering Workshop and Ferdi Zietsman from the workshop gave on-site assistance to the project while testing took place. Cobus Zietsman assisted with the sourcing of instrumentation from the Department's instrumentation store.

The specific CPAP device that was tested was manufactured from a design that was published on-line by engineers from University College London (UCL) and Mercedes Formula One. The device works on the principle of air-entrainment. The pressurised oxygen supply is accelerated through a very small nozzle (the actual design specifies a hypodermic tube) that entrains atmospheric air into the gas stream before it is supplied to the patient. By regulating the oxygen supply, along with an adjustable Positive End Expiratory Pressure (PEEP) valve, the pressure, flow rate and oxygen content of the gas supply can be adjusted. The device can therefore be used to supply a pressurised oxygen-rich gas stream to a patient without the need for an additional compressed air supply. The tests showed that the device performed as expected.

Although the Department played a minor role in the overall NVP, the test results obtained from these experiments enabled the engineers from SARAO to form a clear and accurate picture of the capabilities of the specific CPAP device and to enable them to evaluate the results obtained from other devices developed by industry.

The devices that were tested, were manufactured in the workshops of the South African Astronomical Observatory (SAAO) under the guidance of Ockert Strydom. The costs for the assistance provided by the Department were carried by the Vice-Rector (Research)'s special COVID-19 fund. Mention should also be made of the Clinical Engineering Department at Tygerberg Hospital and Arrabon Medical Solutions who assisted with the supply and loan of equipment to the project on very short notice.

# Research Themes

## Energy and the Environment

In close collaboration with the Centre for Renewable and Sustainable Energy Studies, the Department contributes towards 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. Uniquely South African solutions to concentrating solar thermal power and energy storage systems are researched. 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 special fans, compressors and turbines, e.g. ocean current, wind, and solar energy exploitation-, and air-cooled 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

Activities are divided into fundamental research on materials, 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 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 of composite materials and fracture and creep deformation of steels are researched.

## Mechatronics, Automation and Design

Diverse mechatronic systems such as reconfigurable manufacturing systems, unmanned aerial vehicles, robots and medical devices are researched. Practical solutions to the challenges of Industry 4.0 are found. It finds applications in automation of assembly systems, digital twins, inspection and quality control using machine vision and calibration and maintenance of heliostats for concentrating solar power systems.

## 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 mining and earthmoving equipment, particle dampers, conveyors, etc. The optimisation methods are often linked to 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 with emphasis on 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 is developing innovative minimally invasive devices to collect healthcare information, mechatronic devices for telemedicine and finding customised solutions for the treatment of specific diseases as well as developing and testing medical sensors for in vivo testing of the human knee's biomechanical properties.



## Design and Mechatronics

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### Prof Annie Bekker

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### Dr Martin Venter

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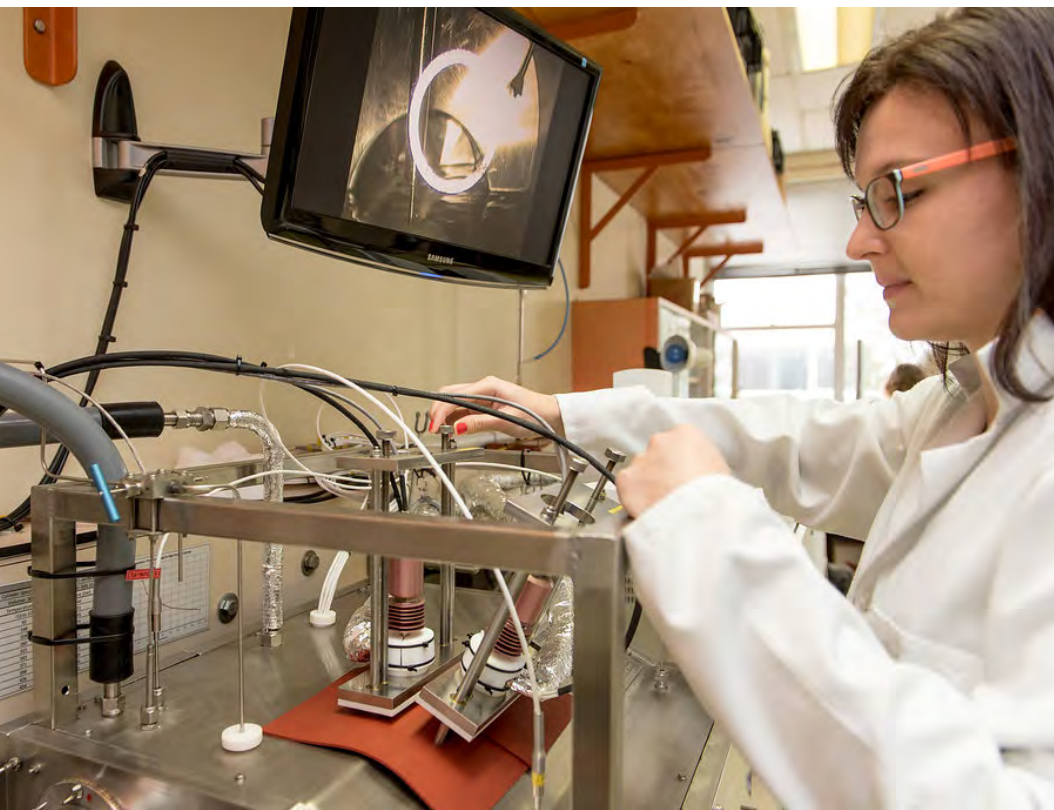


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## Process Engineering



The separations technology research group uses a state-of-the-art high-pressure variable-volume view cell to measure high-pressure phase equilibria at pressures of up to 300 bar and temperatures of up to 150°C. The unique device has two Rolsi™ samplers that can simultaneously sample from two co-existing phases, while the content is also projected onto a monitor using an endoscope camera. This picture shows Dr Carla Latsky employing the device as part of her PhD on the measurement and modelling of a quaternary system.





Prof Johann Görgens (left) and Prof Steven Bradshaw (right).

## Two academics included in group of distinguished professors

Stellenbosch University (SU) has conferred the title of Distinguished Professor upon two academics in the Department of Process Engineering.

Prof Steven Bradshaw and Prof Johann Görgens are included in a group of 37 academics from across nine faculties. The group includes new appointments and re-appointments.

The title of Distinguished Professor was created to recognise SU's very best academics who have reached the pinnacle of achievement in their university careers. The Distinguished Professors are among SU's leading academics who exhibit the ideals that SU pursues according to its Vision 2040 and the Strategic Framework 2019-2024.

Prof Görgens is the SARChI Research Chair in Sugarcane Biorefineries and has been a core member of the NRF-funded Senior Research Chair in Biofuels/Bioenergy (CoER) since 2007. He is one of the recent recipients of the Chancellor's Award to staff.

He also played a key role in establishing SU's African Research Universities Alliance (ARUA) Centre of Excellence (CoE) in Energy and was the Director of this centre until 2019. Prof Görgens was a finalist in the National Science and Technology Forum (NSTF) Awards in 2016 and the winner of the South African Cleantech

Competition in 2011. He previously also received the Vice-Rector's Award for Research Output at SU.

Prof Bradshaw received the Faculty of Engineering's Lecturer of the Year Award in 2016 and has over 1 500 citations to date. His research focus is on mineral processing, hydrometallurgy, machine learning and computational fluid dynamics.

## Dr Margreth Tadie selected to participate in Future Professors Programme

Dr Margreth Tadie, a lecturer in the Department of Process Engineering, was selected as a participant in the Future Professors Programme (FPP), which is a new initiative of the Department of Higher Education and Training (DHET) that aims to prepare promising and productive early career academics to become a new cohort of South African professors.

Initiated by the former Minister of Higher Education and Training, Dr Naledi Pandor, this distinct capacity building, national programme aims to fast-track senior researchers to full professorship at South Africa's public universities.

Regarding her selection as a FPP participant, Dr Tadie says: "I am excited and honoured to be selected to be part of the programme. I am looking forward to the mentorship and interaction with

colleagues from all over the country. I am expecting that the programme will strengthen my contribution in society as an academic.”

Candidates are ideally lecturers or senior lecturers in possession of a doctorate and who have already been able to demonstrate significant academic achievement beyond the doctoral degree.

Nominations were received from 26 universities and only 29 candidates were selected. Dr Tadie is one of two Stellenbosch University candidates to have been accepted.

The FPP uses the National Research Foundation (NRF) rating system to identify talented young academics, who then follow a structured curriculum of intensive seminars followed by international placement to prepare them for a career as research professors.

Dr Tadie was appointed lecturer in the Department of Process Engineering on 1 January 2016. She obtained her master’s degree from the University of KwaZulu-Natal and her PhD from the University of Cape Town. Her research fields cover sustainable extraction of minerals and valorisation of mining waste.

In 2019 she was one of 30 scientists in Africa to have been selected for the FLAIR (Future Leaders – African Independent Research) fellowships. FLAIR is a two-year programme of The African Academy of Sciences (AAS) and the Royal Society, with support from the United Kingdom’s Global Challenges Research Fund (GCRF) and is designed to help talented early-career researchers whose science is focused on the needs of the continent, establish independent careers at African institutions and ultimately, their own research groups. Each scientist receives £300,000 over the two-year fellowship to help them with independent research. She was part of a competitive pool of 700 applicants across the continent.

Dr Tadie concludes: “I have been privileged to have the opportunities that I have to use my research and engineering skills to address development issues in South Africa and Africa as a whole. I hope to be a role model to future academics in the country and encourage research which addresses Africa’s problems.”

## Process engineer recognised for teaching excellence

Prof Tobi Louw, an associate professor in the Department of Process Engineering, was a recipient of Stellenbosch University’s Developing Teacher Award last year.

The SU Teaching Excellence Awards 2020 we conferred on eight lecturers. These awards acknowledged lecturers in two categories, ‘Distinguished Teacher’ and ‘Developing Teacher’, based on their experience and leadership in the scholarship of teaching and learning.

The year 2020 was the third in a row that a staff member from this department received this specific award, illustrating the Department’s commitment to excellence in teaching. Previous winners were Prof Robbie Pott (2019) and Prof Lidia Auret (2018).

The SU Teaching Excellence Awards acknowledge excellent teaching at an institutional

level and offer lecturers and management an opportunity to value reflective and contextually aware teaching.

Candidates were nominated by their faculties based on their teaching portfolio. The applications were then evaluated by an institutional selection committee.

All teaching staff – full-time as well as contract appointments – are eligible for these awards.

Research Output	
Journal Articles (subsidised)	43
Proceedings International	1
Chapters in Books	4
Doctoral completed	9
Master’s completed	30



Prof Christie Dorfling  
Chair: Process Engineering.

# Prof Neill Goosen first full-time Director of ARUA Centre of Excellence (CoE) in Energy



Prof Neill Goosen (far left).

A significant engagement mechanism is the ARUA CoE in Energy website (left) which was finalised and launched during 2020 (<https://arua.sun.ac.za>).

The first full-time Director of the ARUA Centre of Excellence (CoE) in Energy, Associate Professor Neill Goosen, started his term in January 2020. Prof Goosen says: "Stellenbosch University is part of the African Research Universities Alliance (ARUA) launched in 2015. The ARUA network consists of 16 research intensive African Universities from sub-Saharan Africa, and the network is mobilising to increase the quality and quantity of research done on the continent."

"The ARUA CoE in Energy aims to be a multi- and interdisciplinary platform to foster collaboration at Stellenbosch University and with African partners around the theme of renewable energy, but also aims to link other Stellenbosch University (SU) researchers with possible collaborators in the ARUA network," he added.

Participating countries include South Africa, Nigeria, Ghana, Tanzania, Kenya, Rwanda, Senegal, Uganda and Ethiopia.

In order to facilitate research networks, ARUA identified thirteen research areas that are important for the future development of the continent and awarded Centres of Excellence (CoE) in these fields to partner universities. In the Natural Sciences CoE's are in Climate Change, Food Security, Non-Communicable Diseases, Materials Development and Nanotechnology, Water Conservation, Energy, and in the Humanities and Social Sciences the CoE's are in Mobility and Migration, Poverty and Inequality, Unemployment and Skills Development, Notions of Identity, Good Governance, Post-Conflict Societies and Urbanisation and Habitable Cities.

In the latter part of 2017, ARUA launched the call for ARUA members to indicate their interest to host the secretariat of a CoE. Following the internal and external evaluation of the applications, it was recommended that SU host the Secretariat of the ARUA Energy CoE. This was ratified at the

Vice-Chancellors' meeting in January 2018, and Profs Johann Görgens and Sampson Mamphweli are appointed as part time co-Directors of the CoE in Energy. During August 2018 the CoE is officially launched during a collaboration meeting in Stellenbosch, bringing together close to 60 African researchers from ARUA member institutions.

As member of ARUA, Stellenbosch University actively participates in activities of the alliance with no less than 45 researchers identified in the various research fields. In addition, as part of the governance structure of ARUA, Vice-Chancellors of the partner universities also actively participate in the alliance, with Prof Wim de Villiers (SU Rector and Vice-Chancellor) regularly attending meetings. The coordination and administrative support for the SU ARUA research group is provided by the SU International Office, through the Centre for Collaboration in Africa (CCA).

Prof Goosen completed all his studies at Stellenbosch University and holds a BEng, MScEng and PhD in Chemical Engineering. As Director of the ARUA CoE in Energy, he is seated at the Centre for Renewable and Sustainable Energy Studies (CRSES) in the SU Faculty of Engineering.

He elaborates about his task as Director of the Energy CoE: "The CoE is an important vehicle for us to strengthen collaboration with other African Universities, and to do research that leads to real impact. To make such a real impact one requires excellent science (which at Stellenbosch we believe we can deliver, along with our collaborators), but also non-academic partners to make use of the research and to promote it further. The CoE creates the opportunity and platform to draw in all these different role players and to focus on solving an important problem facing society, and I see some exciting times ahead."

## 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 both natural ore bodies and complex engineered wastes requires a wide range of 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 the use of energy and water.

## Waste Valorisation

The successful valorisation of wastes will allow closing the loop in the circular economy, moving closer to a sustainable future. Key challenges include separation and concentration of valuable products as well as functionalisation of relatively inert chemicals. Main focus areas include:

- Waste tyre and waste plastic conversion to high-value chemicals.
- Electronic waste processing for metal recovery (lithium, gold, copper).

## 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 is focused on the separation of 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

To ensure a sustainable future, biological resources need to be used optimally. This group focuses on developing industrial bioprocesses that are safe, sustainable and profitable, either through processes that employ biological resources (e.g. live organisms or active biological molecules) to transform raw materials into valuable products, or production processes that use biological raw materials as inputs. There is a strong interdisciplinary focus within the group, and frequent collaboration occurs with other disciplines at Stellenbosch University and with leading foreign institutions.

## Water Technology

The group focuses on research and development aimed at addressing local and international challenges in water provision. The objective is to improve existing water treatment technologies as well as develop new technologies that will contribute to addressing this global challenge. The group's strengths include membrane technology (microfiltration, ultrafiltration, reverse osmosis, forward osmosis, membrane distillation and Donnan Dialysis), and in technologies that will be applicable in 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 the efficiency, sustainability and profitability of chemical engineering processes. This group focuses on the use of machine learning techniques to improve the operation and control of chemical plants, with an emphasis on producing industry ready solutions. Applications include fault detection and diagnosis, causality analysis, operational state identification and actionable advisories.



## Chair

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# Outreach Programmes



SUNSTEP offers learners the opportunity to build their own photovoltaic cellphone chargers. The learners pictured here were making final adjustments before putting their chargers to the test.

## Open Day

The annual Open Day makes learners, parents and the general public aware of the interesting world of the engineer and the vast career opportunities in this field.

Enquiries: Ms Tanya Ficker

Tel: +27 21 808 9403, e-mail: [tanya@sun.ac.za](mailto:tanya@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. Due to COVID-19 lockdown restrictions this event did not take place in 2020.

Enquiries: Ms Portia Adonis

Tel: +27 21 808 4203, e-mail: [winterweek@sun.ac.za](mailto:winterweek@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, lecturers and students address them. Due to COVID-19 lockdown restrictions this event did not take place in 2020.

Enquiries: Mr August Engelbrecht

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## Top Achiever Sessions

During sessions presented in Stellenbosch and various major cities countrywide, top achievers (Grade 11 and 12) and their parents are informed about engineering as a career and the Faculty's degree programmes. Due to COVID-19 lockdown restrictions an online webinar took place in June 2020. Programme specific webinars were held to market engineering, and to increase registrations.

Enquiries: Mr August Engelbrecht

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## First Generation Experience

Universities can be quite daunting if you have no experience of academic or tertiary institutions. In 2018 the Faculty launched this new 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 feel the exciting vibe of campus, hear about the Faculty's degree programmes and other SET fields of study and meet the Dean. Due to COVID-19 lockdown restrictions this event did not take place in 2020.

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## Talent Development Programme

This school holiday enrichment programme was initiated by the Department of Science & Technology in collaboration with the Department of Education and SUNCEP (Stellenbosch University). It is rolled out in all nine provinces. Eighty top 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. Due to COVID-19 lockdown restrictions in 2020 we have reached these learners through online presentations.

Enquiries: Mr August Engelbrecht

Tel: +27 21 808 4739, e-mail: [august@sun.ac.za](mailto:august@sun.ac.za)

## Buddy Programme to facilitate integration

Engineering is a demanding and challenging programme and many first-generation students (in particular those who do not stay in a university residence) find it difficult to adapt to the new environment and academic culture. During the first semester, senior students act as the students' "buddies" to facilitate their smooth integration. Due to COVID-19 lockdown restrictions and to limit personal contact, one virtual session was held with students to discuss their challenges and work through possible solutions.

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## TRAC South Africa

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

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E-mail: [debbey@sun.ac.za](mailto:debbey@sun.ac.za)

## Minquiz

Minquiz (organised by Mintek) is a science and technology quiz for Grade 12 learners that promotes careers in science and technology, especially in mining, mineral processing and geology. The Department of Process Engineering provides assistance in the Boland and the Western Cape.

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## CRSES Schools' Programme

This programme, run by the Centre for Renewable and Sustainable Energy Studies, provides professional development and learning material (free of charge) to assist educators in teaching renewable energy topics. The learning material is in line with South Africa's Curriculum and Assessment Policy Statement (CAPS).

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## SUNSTEP

The SUNSTEP Programme provides learners the opportunity to build their own working electronic circuits. There are also workshops for educators. Our flagship and most popular project is to teach learners to make their own cell phone charger, using a solar panel as power supply. This is an excellent way to learn about electronics and renewable energy.

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An excited group of learners finding out more about the Faculty of Engineering at the University's 2020 Open Day, hosted weeks before the national lockdown was imposed.

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Liesel Koch, Carla Nel, Jorisna Bonthuys, Hendrien Swanepoel

Design & Layout | Ontwerp & Uitleg: African Sun Media