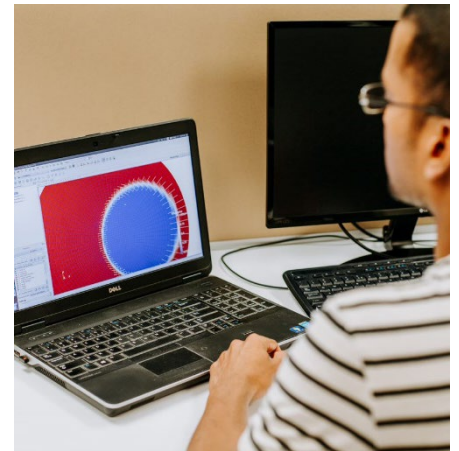
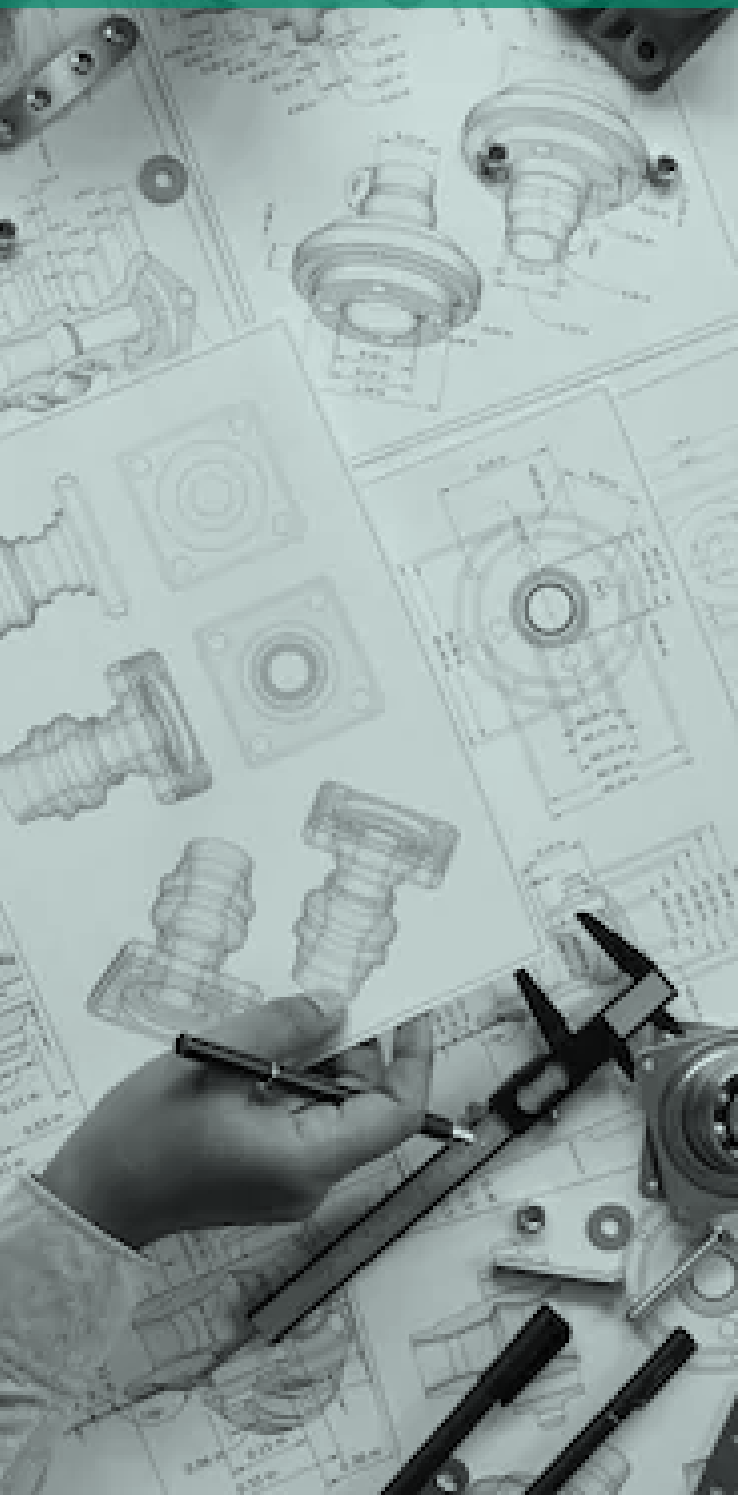
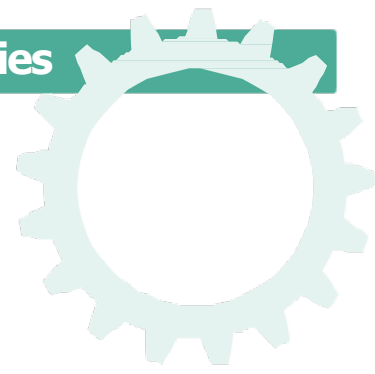


Reference Guide to Research & Development in the Department of Mechanical Engineering

University of Cape Town



Contents and Research Entities



Welcome from the Head of Department	1
Why Postgraduate Study?	2
Postgraduate Funding	3
Career Possibilities and Support	4
EBE Postgraduate Journey	5
Advanced Manufacturing Laboratory	6
Applied Thermofluid Process Modelling Research Unit (ATProM)	7
Blast Impact and Survivability Research Unit (BISRU)	8
Centre for Materials Engineering	9
Centre for Research in Computational and Applied Mechanics (CERECAM)	10
Composite Materials Laboratory and 3D Printing	11
Engineering Education	12
Engineering Management	13
Industrial Computational Fluid Dynamics (InCFD)	14
Non-Destructive Evaluation	15
Mechatronic Systems Laboratory	16
Tutoring	17
Links to Important Information	18



2022 carries with it all the possibilities for our new future. We are entering the phase of the pandemic where we learn to live with the coronavirus and where we are able to fully engage, once again, with the world around us. At this time of renewed optimism, I want to encourage you to consider your future. You have amazing career prospects once you complete your bachelor's degree. Many fantastic opportunities will come your way, but how can you ensure that you stand out from all the other excellent job applicants? One way to stand out is to obtain a postgraduate degree.

Besides the obvious benefits of gaining specialist technical knowledge and skills, postgraduate study also offers the opportunity for immense personal development. Completing a postgraduate degree will require you to develop a whole range of transferable skills in areas of problem solving, project management, communication, critical thinking, data analysis, organisation and time management. That is why we find so many engineers with postgraduate qualifications working as successful financial analysts, investment managers and CEOs of companies (and, of course, in engineering!).

As the Department of Mechanical Engineering at UCT we have compiled this Research Reference Guide to offer you the opportunity to look into postgraduate study.

I invite you to see for yourself the wide range of postgraduate research activities available. I have no doubt that this will really benefit your future!

Kind regards
Prof. Brandon Collier-Reed

Why Postgraduate Study?



Your journey with us, as an undergraduate student, has exposed you to the breadth of mechanical/mechanical and mechatronic engineering. The solid foundation in the various themes that you have explored has placed you on a firm footing for the next chapter of your career.

As you are well aware, we live and work in a very complex world. A postgraduate degree from our department will give you greater insight into your specific areas of interest and will give you an added edge for the competitive job market. Whether you choose to pursue a career in industry, academia or as an entrepreneur, postgraduate studies will empower you with skills and expertise that will help you make your mark wherever you go.

As you come to the end of your undergraduate degree, you may be wondering whether or not it makes sense to keep studying when you might have very enticing offers of work. I assure you that choosing to pursue a postgraduate degree will be very advantageous when you choose to enter the job market. The skills that you gain in having greater control over your own learning and research journey are transferable to the world of work.

Our department has prepared this guide for you. Take your time exploring the pages and also speak to individuals whose work interests you. Also take time to look for funding opportunities for postgraduate studies.

Wishing you all of the very best as you consider your next steps,
Malebogo Ngoepe

Postgraduate Funding

NRF POSTGRADUATE SCHOLARSHIP FOR FULL-TIME STUDIES IN 2023

The NRF **minimum academic requirement** for postgraduate funding is **65%**. Applicants for honours, masters and doctoral funding must be **28, 30 and 32 years of age** or younger respectively in the year of application. Successful applicants will be funded either at **Full Cost of Study (FCS)** or **Partial Cost of Study (PCS)**. The FCS funding will be awarded to South African citizens and permanent residents only, who are either **financially needy** (i.e. those whose combined household family income is less or equal to R350 000 per annum), **living with a disability** or **exceptional academic achievers**. However, the PCS funding will be awarded to **5% of international students** including South African citizens and permanent residents who could not be funded under FCS but meet other minimum requirements for the NRF scholarship funding criteria.

ELIGIBILITY CRITERIA

Honours: Only South African citizens and permanent residents are eligible for honours bursaries.

Masters and Doctoral: are open to South African citizens, permanent residents as well as a limited percentage of foreign nationals who will be registering at South African public universities in 2023 on a full-time basis only.

Scholarships are intended to support honours, masters and doctoral candidates to pursue studies in all areas of **Science, Engineering, Technology, Social Sciences, and Humanities**

Maximum period of support – Honours: 1 year, Masters: 2 years, Doctoral: 3 years, Extension funding: Six or Twelve months.

UCT INTERNAL DEADLINES:

Masters and Doctoral First-Time Applications: **tbc - likely end June 2022**

Extension Support for Master and Doctoral Applications: **tbc - likely early September 2022**

Nuffic Split-Site Doctoral Applications: **tbc - likely end June 2022**

Honours students demonstrating financial need, i.e., with family income less than R350 000 per annum are requested to submit completed applications by: **tbc - likely early August 2022**

Honours Applications (not demonstrating financial need):

tbc – likely early November 2022

IMPORTANT NOTE:

To be eligible for UCT merit and need awards, you are required to apply for these NRF scholarships. UCT will reject applications submitted after the UCT internal closing dates as indicated above.

Meameno Nepembe – PG Funding Office

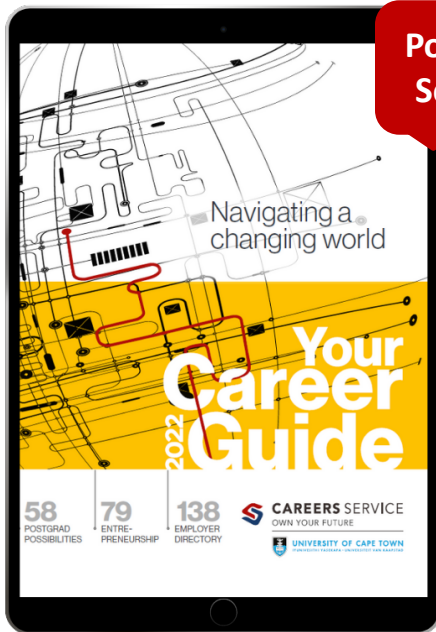
How to apply: <https://nrfs submission.nrf.ac.za>

Questions? Email : NRFFunding@uct.ac.za

Own Your Future



CAREERS SERVICE
OWN YOUR FUTURE



Postgrad
Section

[Go to 2022 Career Guide](#)

careers.uct.ac.za

mycareer.uct.ac.za

careers.service@uct.ac.za



@UCT Careers Service



@UCTCareers



@uctcareersservice

THE BENEFITS OF POSTGRADUATE STUDY

- Higher earning potential
- Enhance your employability
- Gain skills that you are not exposed to at the undergraduate level.
- Enables cross-disciplinary options
- Starting point for an academic career

OPTIONS WITH THIS DEGREE

- Graduates work in many different contexts in subject related work but also use their transferable skills and work in consulting, finance, data science and various entrepreneurial pursuits.
- Search LinkedIn for *MSc Mechanical Engineering* and select *People* to browse the profiles of graduates in jobs that interest you.



[Play Webinar](#)

HOW THE CAREERS SERVICE CAN HELP

- Job expos, company presentations and career development webinars
- Advertised opportunities on the mycareer.uct.ac.za job portal
- Help with applications, CVs, LinkedIn profiles and interview preparation
- Mock Interview Programme with feedback from employers
- One-on-one career consultations
- Entrepreneurial support



POSTGRADUATE STUDIES IN EBE

The Faculty of EBE offers a number of postgraduate degrees. These include Honours qualifications, Master of Science (MSc), Master of Engineering (MEng), Master of Philosophy (MPhil) and Doctor of Philosophy (PhD). These qualifications are locally and internationally acclaimed.

THE BENEFITS OF STUDYING POSTGRAD

A postgraduate degree gives you a framework to critically and creatively solve issues faced by society. It deepens your knowledge of your chosen research area and increases your employability. Apart from the many career benefits, an EBE postgraduate degree strengthens personal growth, improves written communication, creativity and networking skills.

SKILLS AND TOOLS GAINED AS A POSTGRAD

- Working collaboratively with people from different backgrounds.
- Cost-effective way to build networks.
- Creative problem solving.
- Applying critical research and enquiry skills.
- Independent thinking and critical evaluation.
- Effective communication.
- Personal growth.
- Building professional credentials.
- Time management skills.

POTENTIAL PITFALLS AND HOW TO AVOID THEM

As a postgraduate student you have increased self-accountability. You have the freedom to work at your own pace. However, this freedom comes with the responsibility of being disciplined and having to take initiative. Another important element is consistent and honest communication with your supervisor.

Kamvelihle Masomelele Tabata – EBE Postgraduate Student Council Academic Chair 2022

MSc (Eng) in Structural Engineering Specialisation

Advanced Manufacturing Laboratory



**High
Speed
Machining**



**Polishing with
Flexible
Abrasives**



**Nickel-Diamond
Electroplating of
Grinding Wheel**

WHO WE ARE & WHAT WE DO

The Advanced Manufacturing Laboratory (AML) is committed to enhancing the competitiveness of South African industry through the development of high value manufacturing technology as well as through growing people talent.

The main research focus is on high performance machining, polishing technologies, manufacturing process optimization, intelligent manufacturing systems and laser processing technologies. Since its inception, the AML has developed expertise that has assisted South African precision engineering, aerospace, tooling and automotive companies to improve their manufacturing processes.

Growing R&D manpower for South African industry is achieved through the development of high calibre graduates and postgraduates and offering training to various industrial partners. The AML is committed to creating intellectual capital and contributing to industrial know how through critical research and development in the materials machining and manufacturing arena.

CURRENT RESEARCH FOCUS

- High performance machining
- Polishing technologies
- Manufacturing process optimization
- Intelligent manufacturing system 4.0
- Hybrid manufacturing technologies
- Failure analysis on manufacturing tools and processes

RECENT RESEARCH PUBLICATIONS

- Ramesh Kuppuswamy and Fungai Jani and Samiksha Naidoo and Quintin de Jongh, A study on intelligent grinding systems with industrial perspective, The International Journal of Advanced Manufacturing Technology, 115, 3811–3827 (2021). <https://doi.org/10.1007/s00170-021-07315-9>
- Ramesh Kuppuswamy, Matthew Titus, Quintin de Jongh Polishing of a Selective Electron Beam Melting Processed Tungsten Carbide Punch through High Velocity Impinging of Flexible Media", Journal of the Brazilian Society of Mechanical Sciences and Engineering (BMSE)" accepted for publication ref: BMSE-D-21-01253R1
- Ramesh Kuppuswamy , Samiksha Naidoo, Fungai Jani and Quintin de Jongh , Towards configuration and development of an Augment Reality (AR) enhanced Intelligent Grinding System (IGS) for Ti6Al4V alloy, 8th International Conference on Competitive Manufacturing, (COMA'22), 9-10 March 2022 , Stellenbosch, South Africa
- Ramesh Kuppuswamy, Sofian Eljzoli, A Kinematics Study of Diamond Abrasives and Nickel-Ions on an Electroplating Process towards Enhancing the Quality of a Super-abrasive Grinding Wheel, 8th International Conference on Competitive Manufacturing, (COMA'22), 9-10 March 2022 , Stellenbosch, South Africa

CONTACT DETAILS

A/Prof. Ramesh Kuppuswamy B.Eng. (Hons), M.Tech, PhD (Singapore)
Email: Ramesh.kuppuswamy@uct.ac.za Phone:+ 27 21 650 4872

ATProM Research Unit

WHO WE ARE

Prof. Pieter Rousseau, A/Prof. Wim Fuls, Priyesh Gosai and Colin du Sart.

WHAT WE DO

Rising energy demand and the imminent threat of climate change are critical issues in society today. Thermofluid systems provide the backbone of almost all energy conversion processes for renewable and conventional power generation, as well as heating and cooling systems such as heat pumps and refrigeration cycles.

The Applied Thermofluid Process Modelling Research Unit (ATProM) specialise in modelling these systems to evaluate novel technologies, improve the efficiency and control of processes, and detect anomalies for condition monitoring purposes.

Fundamental models are built using detail computational fluid dynamics and integrated one-dimensional thermofluid networks. These are often combined with advanced optimization techniques and data-driven models such as multi-layer perceptron, convolutional-, recursive- and variational auto encoder neural networks, that are derived via machine learning techniques.

This unique combination of fundamental thermofluid principles and artificial intelligence techniques enable the development of accurate and computationally inexpensive numerical tools to address industry needs.

CURRENT RESEARCH FOCUS

- Supercritical CO₂ (sCO₂) Concentrated Solar Power (CSP) plants.
- Biomass energy conversion.
- Energy storage systems.
- Physics informed neural networks (PINN) application to energy systems.
- Flexibility of fossil fired plants (coal, gas turbines and combined cycles).
- Optimization of heat pump systems.

SPECIALISED FACILITIES

- Specialized CFD and thermofluid process modelling software.
- Access to high performance computing centre.
- Access to measurement facilities at real power plants.

RECENT PUBLICATIONS

- Laubscher R and Rousseau PG, 2022. Application of a mixed variable physics-informed neural network to solve the incompressible steady-state and transient mass, momentum, and energy conservation equations for flow over in-line heated tubes, Applied Soft Computing, 114, 108050.
- Rawlins, B.T., Laubscher, R. and Rousseau, P., 2022. Application of Computational Fluid Dynamics and Process Modeling to Investigate Low-Load Operation of a Subcritical Utility-Scale Boiler. Journal of Thermal Science and Engineering Applications, 14(10), p.101008.
- Ross M.A.J. and Fuls W.F., Development of a dynamic turbine expansion model using a paired thermofluid and FEA methodology, ASME Turbo Expo 2022, Rotterdam, 2021.
- Du Sart CF, Rousseau PG and Laubscher R, 2021. Cycle selection and system-level optimisation of a 50 MWe sCO₂ CSP plant, 15th Int. Conf. On Heat Transfer, Fluid Mechanics and Thermodynamics (HEFAT 2021), 25-28 July.

WEBSITE: www.atprom.uct.ac.za **EMAIL:** atprom@uct.ac.za

WHO WE ARE & WHAT WE DO

The Blast Impact and Survivability Research Centre (BISRU) focuses on the fundamental understanding of blast and structural impact scenarios. BISRU currently operates a unique suite of blast impact assessment equipment located at its own test facility. Our research focus seeks to save lives and reduce the risk of injuries that may arise from extreme loading events in addition to understanding the mechanics and dynamics of blast and impact loads. Our research activities are aimed at promoting the investigation and understanding of impact dynamics through both analytical, numerical simulation and laboratory based studies. BISRU is involved in several multi year programmes to study the loading and damage caused by explosions and to develop blast resistant lightweight materials or structures. Research in our facility also seeks to understand the properties of homogeneous materials as well as biological, cellular and multi layered materials under blast and impact conditions.

CURRENT RESEARCH FOCUS

- Blast characterisation
- Material characterisation at very high strain rates (including bio-materials)
- Structural response to blast and impact loading
- Buried charges (landmines)
- Energy absorbers in crashworthiness and blast application
- Prediction and measurement of human body response to blast and impact events

KEY RESEARCH COLLABORATORS

- Beijing Institute of Technology (China)
- Saint Cyr Military Academy (France)
- University of Sheffield (UK)
- University of Southampton (UK)

SPECIALISED FACILITIES

- Computational software for finite element analysis
- Blast chamber
- Ballistic pendulum
- Drop testers
- DIC systems
- Pressure transducers
- Composite manufacturing equipment
- Gas gun for ballistic penetration studies
- Hopkinson Bar apparatus (variable configurations including tension & compression)

SAMPLE PUBLICATIONS

- Behaviour of a blast-driven ball bearing embedded in rear detonated cylindrical explosive, R. Qi, G. S. Langdon, T.J. Cloete, S. Chung Kim Yuen, IJE, Vol 146, Dec 2020.
- Numerical analysis of cladding sandwich panels with tubular cores subjected to uniform blast load, W. Cheng, X. Bin, S. Chung Kim Yuen, IJE, Vol 133, November 2019.
- Round-Robin test of Split Hopkinson Pressure Bar, M.A. Kariem, R.C. Santiago, R.A. Govender, D.W. Shu, D. Ruan, G.N. Nurick, M. Alves, G. Lu, G.S. Langdon, International Journal of Impact Engineering, Vol. 126, pp 62-75, April 2019
- The behaviour of cancellous bone from quasi-static to dynamic strain rates with emphasis on the intermediate regime, M. Prot, T.J. Cloete, D. Saletti, S. Laporte, Journal of Biomechanics, Vol 49(73), May 2016.

CONTACT INFORMATION

website: www.bisru.uct.ac.za

email: steve.chungkimyuen@uct.ac.za



WHO WE ARE



PROF THORSTEN
BECKER



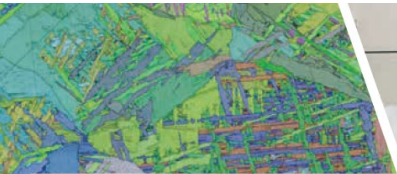
PROF ROBERT
KNUTSEN



DR SARAH
GEORGE



Mr JAMES
DICKS



SPECIALISED FACILITIES

- Gleeble 3800 thermo-mechanical processing simulator for the simulation of high temperature deformation processes, solidification and welding.
- Mechanical testing facilities for strength, fatigue and fracture studies.
- Weathering chamber and electrochemical instrumentation for surface studies.
- Advanced electron microscopy for microstructure characterization.

To see a list of current postgraduate projects visit:

<http://www.mateng.uct.ac.za/mateng/people/postgraduate-students>

Contact person: thorsten.becker@uct.ac.za

WHAT WE DO

The Centre for Materials Engineering (CME) engages in research that addresses real industry problems and, at the same time, increases the knowledge base about materials. Our primary focus is to investigate the link between the process, structure and property behaviour of a wide range of materials, including metals, polymers, ceramics and composites.

The centre supports local and international research efforts in manufacturing process optimisations and property investigations to better suit process and service requirements. We also support local industry development by improving their competitiveness in South Africa. Our extensive modern laboratory facilities enable advanced characterisation and property measurements that have resulted in the publication of frequently cited outputs.

CME is highly regarded nationally and respected internationally for its expertise and capabilities in materials-related research. Our strong academic and technical expertise underpins a thriving postgraduate activity. We want to foster the growth of South Africa's future researchers in Materials Engineering.

CURRENT RESEARCH FOCUS

- High temperature and high stress performance of materials in power plants.
- Production of titanium alloy commodity products from powder metal.
- Additive Manufacturing of titanium, nickel based super alloy and aluminium components.
- Aluminium beverage can stock process development
- Visualisation of material properties by high resolution electron microscopy.
- Biodegradable polymers and foams derived from vegetable oils.

KEY RESEARCH COLLABORATORS

- ESKOM (SA)
- Hulamin (SA)
- Council for Scientific and Industrial Research (SA)
- Universities of Oxford, Glasgow, Bristol (UK)
- KU Leuven (BE), TU Delft (NL)
- CERECAM (UCT)
- BISRU (UCT)
- Stellenbosch University (SA)
- Nelson Mandela University (SA)
- Central University of Technology (SA)

RECENT PUBLICATIONS

I. Vazirgiantzikis, S. George and L. Pichon, **Surface characterisation and silver release from Ti64 and anodic TiO2 after ion implantation**, Surface and Coatings Technology (2022), 433, 128115.

S. von Willingh and R.D. Knutsen, **Effect of prior austenitisation temperature on creep rupture in Grade 22 steel**, Materials at High Temperatures (2022), 1.

CERECAM

WHO WE ARE & WHAT WE DO

The principal objective of the Centre for Research in Computational and Applied Mechanics (CERECAM) is to provide a coherent focus and point of interaction for research in the area of non-linear mechanics, by promoting and supporting fundamental research and applied research. A major area of interest is in computational mechanics i.e. the computational simulation of flow, deformation and failure in natural processes, engineering components or artefacts. Other research interests focus on theoretical studies in solid and fluid mechanics, partial differential equations, computational algorithms and experimental studies. CERECAM has as a key objective to be the centre of expertise in SA in its area of research, to provide a link between industry and academia, and to provide postgraduate training in such a form that its graduates make a real contribution to SA industry.

CURRENT RESEARCH FOCUS

Computational solid mechanics and fluid dynamics

Dynamic deformation of metals
Hot rolling of aluminium
Process modelling
Single-crystal and polycrystalline plasticity
Strain-induced crystallisation of polymers

Biomechanics

Biomimetics of turtle shells
Blood flow and clotting in disease
Behaviour of bone at intermediate strain rates

Finite element and related methods

Discontinuous Galerkin method
Virtual element approaches in nonlinear elasticity

RESEARCH COLLABORATORS

- Blast Impact and Survivability Research Unit BISRU (UCT)
- Cardiovascular Research Unit (UCT Medical School)
- Centre for Materials Engineering (UCT)
- Centre for Minerals Research (UCT)
- Glasgow University (UK)
- Hulamin
- Universities of Munich / Erlangen- Nuremberg / Hanover, Wuppertal (Germany)
- Universities of Pretoria , Stellenbosch and the Witwatersrand
- University College London
- UCT Medical School (Human Biology, Medicine, Surgery)

RECENT PUBLICATIONS

Alheit B, Bargmann S and Reddy BD, **Dynamic mechanical behaviour of suture interfaces as inspiration for architected hierarchical interlocking composites.**

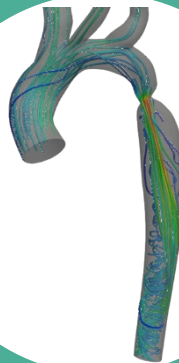
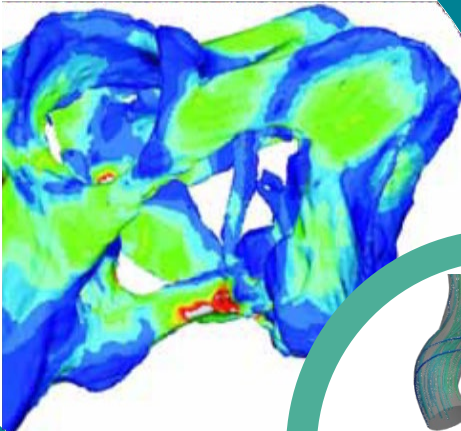
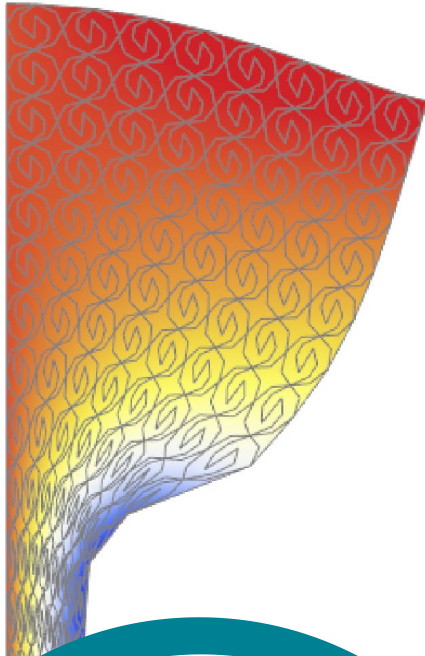
Journal of the Mechanics and Physics of Solids 157 (2021) 104620

Hume S, Tshimanga JMI, Geogheghan P et al., **Effect of Pulsatility on the Transport of Thrombin in an Idealized Cerebral Aneurysm Geometry.** *Symmetry* 14 (2022) 133

CONTACT DETAILS

Website: www.cerecam.uct.ac.za

Email: cerecam@uct.ac.za



Composite Materials Laboratory and 3-D Printing

WHO WE ARE

A/Prof. Chris von Klemperer (Liquid resin moulding methods, Mouldless manufacture, 3D Printing of Fibre reinforced Polymers)

Dr Reuben Govender (BISRU, Delamination, Fracture, Multiaxial loading, 3D printing methodologies and materials)

Mr Sa-aadat Parker (Numerical Optimisation, Optimum Stacking Sequence Design, Composite Material Characterisation)

Mr Shivasi Mashau (Blast response of FRP laminates and residual strength of FRPs after blast)

WHAT WE DO

The Composites Laboratory initiates research on all aspects of the manufacture, processing and optimisation of composite materials. Specialised test specimens for use in non-destructive testing research and blast impact evaluation are created and the resulting damage and test results are analysed.

Research within the laboratory also focuses on optimising composite materials processing, including using vacuum infusion manufacture to make composite components with a particular focus on low cost and Mouldless Manufacture of FRP composite structures..

3D Printing research focuses on the manufacture of 3D printed polymeric structures and designs as well as the development of 3D Printers and materials.

CURRENT RESEARCH FOCUS

- Blast response of composite materials and structures.
- Mouldless manufacture and low cost FRP manufacturing
- Numerical optimisation of composite laminate structures
- Continuous Fibre Reinforced Polymer 3-D Printing
- Embedded 3D Printing with liquid and gel inks and resins

SAMPLE PUBLICATIONS

- Sherlyn Gabriel , Christopher J. von Klemperer, Steeve Chung Kim Yuen and Genevieve S. Langdon . Towards an Understanding of the Effect of Adding a Foam Core on the Blast Performance of Glass Fibre Reinforced Epoxy Laminate Panels. *Materials* 2021, 14(23), 7118.
- Sherlyn Gabriel, Genevieve S Langdon, Christopher J von Klemperer and Steeve Chung Kim Yuen. Blast behaviour of fibre reinforced polymers containing sustainable constituents. *Journal of Reinforced Plastics and Composites* 2022, pp.1–20
- Govender, R.A., Langdon, G.S., Nurick, G.N. and Cloete, T.J., 2013. Impact delamination testing of fibre reinforced polymers using Hopkinson pressure bars. *Engineering Fracture Mechanics*, 101, pp.80-90.

KEY RESEARCH COLLABORATORS

- Centre for Materials Engineering - University of Cape Town
- Blast Impact Survivability Research Unit – University of Cape Town
- University of Stellenbosch (Mechanics Division)
- University of Sheffield (Department of Civil and Structural Engineering)

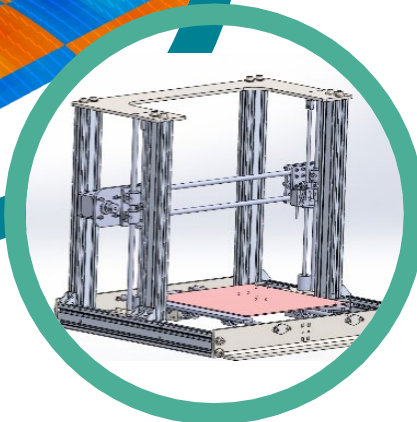
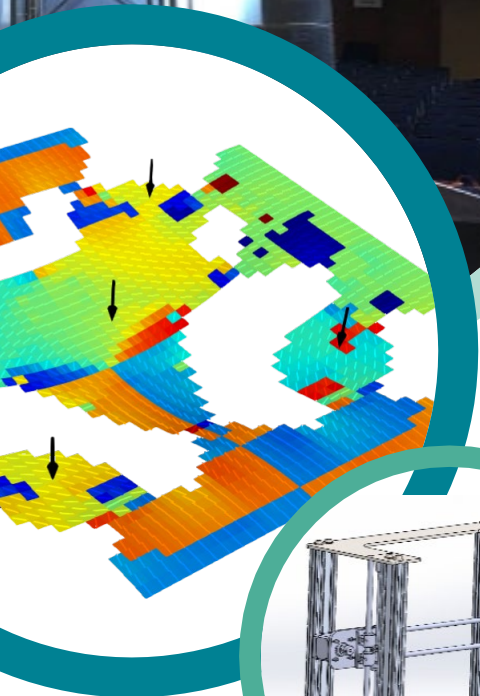
SPECIALISED FACILITIES

- Dedicated composites processing facility with oven and vacuum bag facilities
- CNC Router
- 20 ton press
- FDM 3D Printers.

CONTACTS

Chris.vonKlemperer@uct.ac.za
Shivasi.Mashau@uct.ac.za

Reuben.Govender@uct.ac.za
Sa-aadat.Parker@uct.ac.za



Engineering Education

Prof Brandon Collier-Reed Dr Bruce Kloot Dr Corrinne Shaw

WHAT WE DO

Engineering Education research focuses on education scholarship that includes researching teaching and learning, curricula, and other topics that contribute to advancing the understanding of the education of engineers in undergraduate and postgraduate programmes, and in practice.

A team of researchers within the Department, who hold engineering education as their research focus, participate in a number of research projects that include research into teaching and learning practice, tutoring and mentoring systems, curriculum design and the social structure of higher education in the South African context. This work is undertaken in collaboration with local, national and international engineering education scholars.

CURRENT RESEARCH FOCUS

- Understanding the role of academic literacy and language in student access and success
- Pathways into and through engineering programmes in higher education
- Where do they go? Understanding graduate destinations using social media platforms
- Transitions :
 - Into first year engineering, and
 - Into the engineering workplace
- Students' experiences of complementary studies in engineering education
- Workplace knowledge and learning
- Social responsibility and ethics in engineering education
- Systemic approaches in engineering education research

KEY RESEARCH COLLABORATORS

- Centre for Research in Engineering Education and Centre for Higher Education Development (UCT)
- University of Johannesburg,
- Virginia Tech (USA),
- University of Twente (The Netherlands)
- SEFI (European Society for Engineering Educators).

SAMPLE PUBLICATIONS

- Ahmed, N., Kloot, B., & Collier-Reed, B. I. (2015). Why students leave engineering and built environment programmes when they are academically eligible to continue. *European Journal of Engineering Education*, 40(2), 128-144.
- Ngoepe, M. Le Roux, K., Shaw and Collier-Reed, B. (2022). Conceptual Tools to Inform Course Design and Teaching for Ethical Engineering Engagement for Diverse Student Populations. *Science and Engineering Ethics* 28(2). DOI: [10.1007/s11948-022-00367-4](https://doi.org/10.1007/s11948-022-00367-4)

CONTACT DETAILS

Website: www.cree.uct.ac.za

Email: bruce.kloot@uct.ac.za



Engineering Management

Dr Corrinne Shaw

WHAT WE DO

Engineering Management is an active unit of applied and scholarly research in management. The research team undertakes projects designed to develop and grow management expertise and competence primarily in the South African engineering context. The research group has close links with the South African private sector and quasi-government engineering organisations.

Our research work places special emphasis on the application of management theory, and systems thinking and practice to engage with complex problems in the workplace. Approaches drawn on include systems dynamics modelling and systems methodologies (among others) with the view to contributing to improvements in efficiency and effectiveness of organisations. The working organisation is the laboratory for the research projects undertaken by our postgraduate students.

CURRENT RESEARCH FOCUS

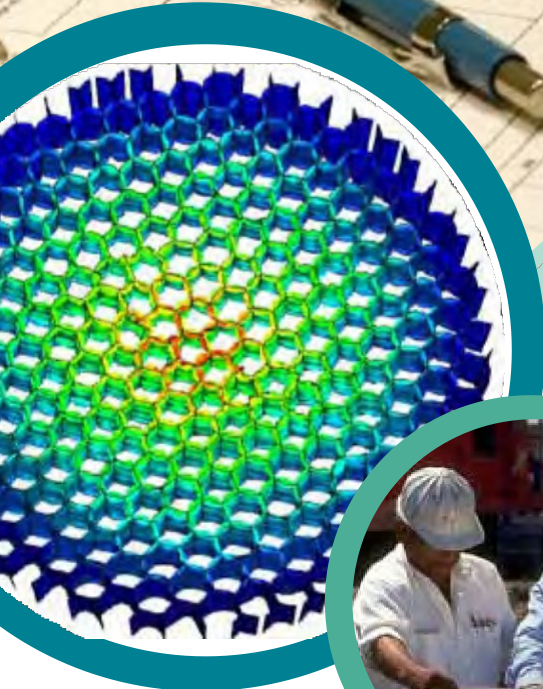
- Learning systemic management practice
- Cybernetics and organisational viability
- Applications of systems thinking in a project environment
- Operations management and lean philosophy in manufacturing
- Understanding socio-technical systems, complex systems and systems dynamics models.
- Engineering management in 4IR
- Management education and workplace learning

KEY RESEARCH COLLABORATORS

- Kalpana Ramesh Kanjee (CHED), Dr Nien-Tsu Tuan (Construction Economics and Management, UCT), Bruce Kloot, Brandon Collier-Reed, Graduate School of Business (GSB), Centre for Research in Engineering Education (CREE).
- Organisations, companies and consulting practices are the laboratory for our research projects. Postgraduate students undertaking Masters and Doctoral programmes, carry out research projects within government and commercial organisations. Typical collaborators in this management research work include consulting engineers, petrochemical plants and power utilities.


SAMPLE PUBLICATIONS

- Onyeagoziri OJ, Shaw C, Ryan T. (2021) A system dynamics approach for understanding community resilience to disaster risk. *Jamba*. 2021.
- Ngonda, T., Shaw, C. and Kloot, B. (2020). Perceived influence of mechanical engineering students' work placement experiences on their occupational competency and self-efficacy. *International Journal of Mechanical Engineering Education*. August 2020. doi:10.1177/0306419020953117.
- Shaw C and le Roux K. (2017). From Practitioner to Researcher: Designing the Dissertation Process for Part Time Coursework Masters Students. *Syst Pract Action Res* 30, 433–446 (2017).



CONTACT DETAILS: corrinne.shaw@uct.ac.za


Computational Fluid Dynamics



Prof. Arnaud Malan
Professor in Mechanical
Engineering


Research Director

South African Research
Chair: Industrial CFD




Prof. Tunde Bello-
Ochende Professor in
Mechanical
Engineering

Thermodynamics,
renewable & complex
energy systems



A/Prof. Malebogo
Ngoepe Associate
Professor in
Mechanical
Engineering

Computational
Biomechanics



Dr. Leon Malan
Senior Research
Officer

Two-phase flow
with Phase Change



WHO WE ARE & WHAT WE DO

The Industrial Computational Fluid Dynamics (InCFD) research group develops state-of-the-art modelling and simulation tools for the express support of industry. This is done via the uncompromising pursuit of innovation through fundamental research which carries the hallmark of excellence. InCFD is home to the South African Research Chair (SARChI) in Industrial CFD.

CURRENT RESEARCH FOCUS

- Volume-Of-Fluid (VOF) based two-phase flow solvers for industry
- Transonic flow aerodynamics and fluid-structure interaction (FSI)
- Reduced order models for aircraft
- Structural damping in sloshing flows
- Higher order numerical methods with shifting interfaces
- Full spacecraft models: Rigid-body and fluid coupling

KEY RESEARCH COLLABORATORS

Prof. Jan Nordström, Linköping University

Airbus (UK)

Sloshing Wing Dynamics (SLOWD) (<https://slowd-project.eu/>)

Prof. Stephane Zaleski, Institut Jean Le Rond D'Alembert

SAMPLE PUBLICATIONS

Struan Hume, Jean-Marc Ilunga Tshimanga, Patrick Geoghegan, Arnaud G. Malan, Wei Hua Ho and Malebogo N. Ngoepe; Effect of Pulsatility on the Transport of Thrombin in an Idealized Cerebral Aneurysm Geometry; *Symmetry*, (2022) 14(1), 133;

Michael D Wright, Francesco Gambioli and Arnaud G Malan; CFD Based Non-Dimensional Characterization of Energy Dissipation Due to Verticle Slosh; *Applied Sciences*, (2021) 11(10401)

Muhammad Yusufali Omar, Arnaud G. Malan, Bevan Jones, Roy Horwitz and Genevieve Langdon; An all-Mach number HLLC based scheme for Multi-phase Flow with Surface Tension; *Applied Sciences*, (2021) 11(8) 3413

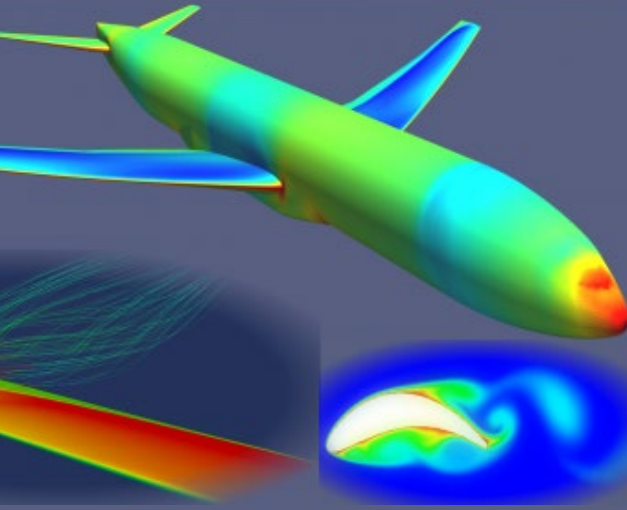
Tomas Lundquist, Arnaud G. Malan and Jan Nordström; Stable Dynamical Adaptive Mesh Refinement; *Journal of Scientific Computing*, (2021), 86-43

Malan, L.C., Malan, A.G., Zaleski, S. and Rousseau, P.G., A geometric VOF method for interface resolved phase change and conservative thermal energy advection. *Journal of Computational Physics*, 426, p.109920. (2021)

CONTACT INFORMATION

Website: www.incfd.uct.ac.za

E-mail: arnaud.malan@uct.ac.za



Non-Destructive Evaluation



Mr Dirk Findeis

WHO WE ARE & WHAT WE DO

The research and development taking place at this laboratory aims to augment the capability of industry to inspect structures non-destructively and also to enhance its capability to establish the structural integrity of components through sensor monitoring techniques.

Our primary aim is to research and perfect techniques that will allow the detection of sub surface defects in manufactured components and manufactured structures. The objective of the research is to develop non-contacting whole field inspection techniques. At the same time we are working to advance fundamental knowledge in the field of non-destructive testing of materials and manufactured items. Our research into non-contacting inspection is targeted at components manufactured from composite materials such as carbon fibre, glass fibre, reinforced plastics but also includes ferrous and non-ferrous metals.

Research is also focusing on the use of embedded sensors to enable engineers to acquire a better understanding of the response of composite sandwich laminates and materials to the influence of external forces including low-energy impact, vibration and thermal loading.

CURRENT RESEARCH FOCUS

- Non-contacting whole field inspection techniques to detect defects
- Non-destructive evaluation of composite material components
- Optical interference techniques including digital shearography, electron speckle pattern interferometry and conventional holography
- Developing portable NDT systems based on optical interference principles
- The use of pulsed thermography in parallel with shearographic inspection techniques
- Acoustic emission NDT techniques on the behaviour of composites under stress

KEY RESEARCH COLLABORATORS

- Council for Scientific and Industrial Research
- Armscor Aero Systems Division
- DFinder

SPECIALISED FACILITIES

- Portable Shearography NDT/ESystem
- Portable Electronic Speckle Interferometric NDT/ESystem
- Digital Shearography System
- Infrared Thermography Systems

PUBLICATION

D Findeis, "Delamination detection ability in composite laminated panels using infrared thermography and portable Raspberry Pi based digital shearography", presented at 5th International Conference on Mechanics of Composites (MechComp2019), Lisbon, 1-4 July, 2019

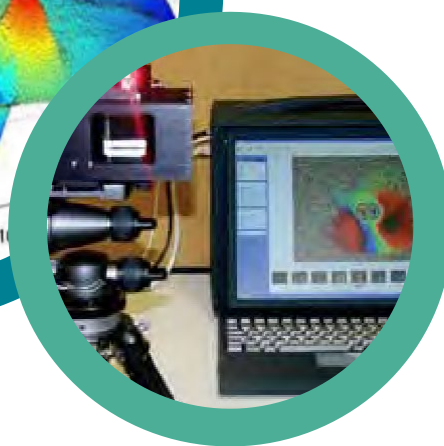
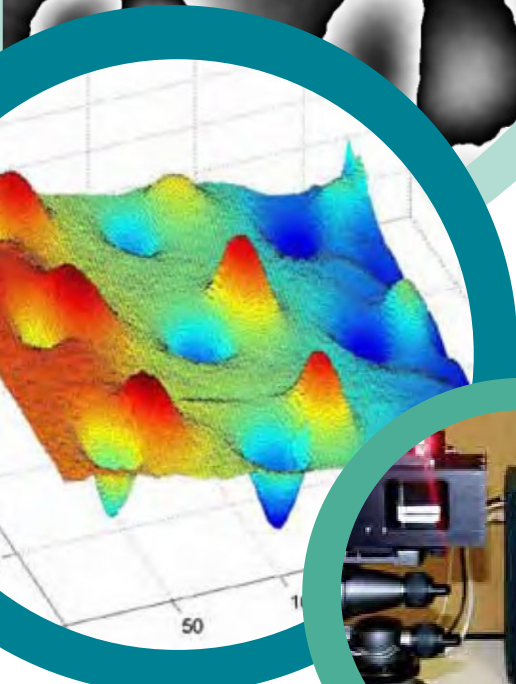
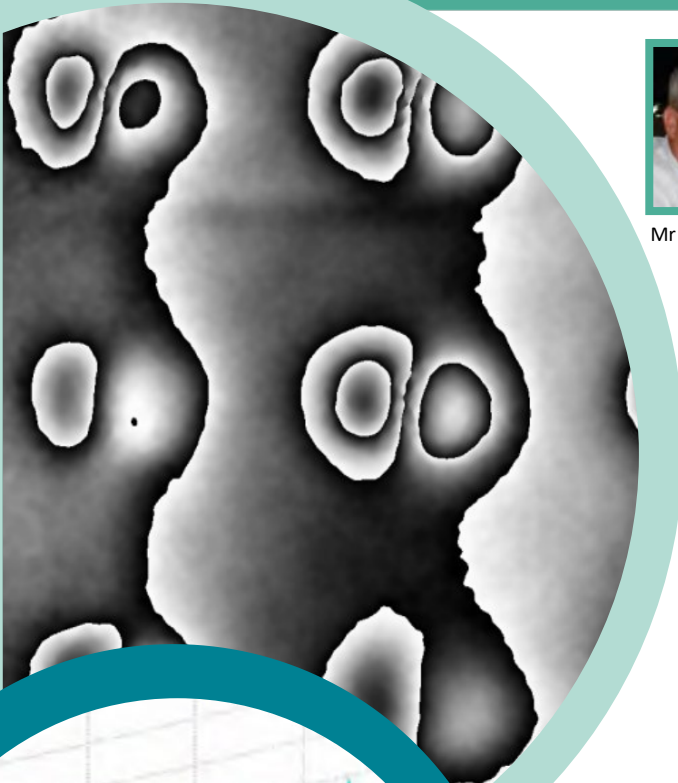
SPONSORS

- Armscor Aero Systems Division
- Airbus
- DFinder

CONTACT

Mr Dirk Findeis

Dirk.findeis@uct.ac.za



Mechatronic Systems Laboratory

WHO WE ARE



Mr Arnold Pretorius



Ms Leanne Raw



Mr James Hepworth

WHAT WE DO

Our research lab focuses on the modelling, design and realisation of complex mechatronic systems. The electromechanical nature of these systems requires an intimate knowledge of integrating hardware (mechanical and electrical), software and control systems into a cohesive whole.

A typical mechatronics project will involve: CAD design and simulation; software and hardware design; hardware-in-the-loop testing; and systems integration and implementation.

Our specialisations lie in mobile robotics (wheeled, legged, aerial, marine), robust control design, inertial stabilisation, and embedded systems.

SPECIALISED FACILITIES

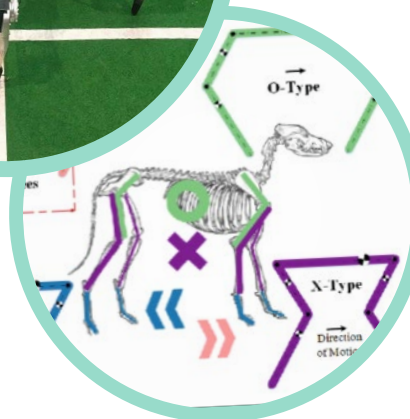
- 3 m³ water tank for testing underwater robotic systems.
- Vision-based motion capture system.
- Electronics construction and testing equipment.
- Fully equipped experimental laboratory.

CURRENT RESEARCH FOCUS

- Limbed Robotics.
- Embedded Systems.
- Environmental Sensor Networks.
- Aerial robotics.
- Robust multivariable control design.

RECENT PUBLICATIONS

- Verrinder RA, Vichi M, Jacobson J, Mishra A, Son J, Hepworth J, de Vos M, Alberello A, Toffoli A, "An observational network for synoptic observations in the Antarctic marginal ice zone" presented as a poster at the 2022 Ocean Sciences Meeting (OSM2022), March 2022
- Christopher Mailer, Geoff Nitschke, and Leanne Raw. 2021. Evolving gaits for damage control in a hexapod robot. In Proceedings of the Genetic and Evolutionary Computation Conference (GECCO '21). Association for Computing Machinery, New York, NY, USA, 146–153. DOI:<https://doi.org/10.1145/3449639.3459271>
- Pretorius, A. and Boje, E., 2020. A complementary quantitative feedback theory solution to the 2×2 tracking error problem. *International Journal of Robust and Nonlinear Control*, 30(16), pp.6569-6584.
- Raw, L., Fisher, C. and Patel, A., 2019, November. Effects of limb morphology on transient locomotion in quadruped robots. In 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) (pp. 3349-3356). IEEE.
- Hepworth, J.H. and Mouton, H.D., 2019, January. Systems development of a two-axis stabilised platform to facilitate astronomical observations from a moving base. In 2019 Southern African Universities Power Engineering Conference/Robotics and Mechatronics/Pattern Recognition Association of South Africa (SAUPEC/RobMech/PRASA) (pp. 49-55). IEEE.
- Boje, E. et al., 2019, A Review of Robotics Research in South Africa. *R & D Journal of the South African Institution of Mechanical Engineering*, 35, pp. 75–97. doi: 10.17159/2309-8988/2019/v35a9.
- Pretorius, A. and Boje, E., 2019. Robust plant by plant control design using model-error tracking sets. *International Journal of Robust and Nonlinear Control*, 29(11), pp.3330-3340.



Tutoring

WHO WE ARE

2022
Mr Colin du Sart

2023
Dr Bruce Kloot (Pictured)



WHAT WE DO

This portfolio offers students the opportunity to engage with fellow students to assist them in their academic studies. Once signed up, general training is offered to prepare tutors in general. Tutors are then assigned to the course they request. Engagement with the Course Convener of that course offers the additional preparation to meet the requirements for the activities for that particular course.

There are more than 20 courses within the Department of Mechanical Engineering that require tutors.

Benefits include:

- **Remuneration**
- **Personal skills training**
- **Opportunity to help others**

WHAT IS NEW

With the new blended learning approach, tutors have acquired a new skill of online tutoring which includes

- Online collaboration in MS TEAMS
- Zoom Meetings with students
- Online marking and interaction on VULA

TYPICAL TUTORING PACKAGE:

Tutors are paid hourly for administration duties as well as preparation for tutoring and tutoring duties.

The rate of payment is determined by UCT.

A payment scale is set out according to year of qualification (BSc, MSc, PhD etc)

CONTACT DETAILS: colin.dusart@uct.ac.za (2022) or bruce.kloot@uct.ac.za (2023)

WEBSITE: www.mecheng.uct.ac.za

Links to Important Information

2020 Research Handbook:

webcms.uct.ac.za/sites/default/files/image_tool/images/50/Research/2020%20Research%20Handbook.pdf

(2022 version not yet available)

EBE website:

www.ebe.uct.ac.za

Mechanical Engineering website:

www.mecheng.uct.ac.za

Apply now:

www.ebe.uct.ac.za/ebe/postgradstudies/apply

Funding:

www.students.uct.ac.za/students/fees-funding/postgraduate-degree-funding

National Research Foundation (NRF) deadline for first-time Masters applicants :

tbc – likely end June 2022

National Research Foundation (NRF) deadline for first-time Honours applicants (financial need) :

tbc – likely beginning of August 2022

National Research Foundation (NRF) deadline for first-time Honours applicants (not demonstrating financial need): **tbc – likely beginning of November 2022**

Postgraduate Administrator:

denise.botha@uct.ac.za