Postgraduate studies: Should I pursue a Masters in Mechanical or Mechatronic Engineering?

Thorsten Becker

Department of Mechanical and Mechatronic Engineering
Stellenbosch University
Why would you want to do a postgraduate degree?

What type of research does our department do?

What is a postgraduate study and how does it work at Stellenbosch University?

How do I go about getting information on a Master topic?

Funding.

Supervisor(s).

Information submitted by various research groups.

Final remarks.
Why a postgraduate degree?

www.spacex.com
Why a postgraduate degree?

www.engineer4free.com
We do groundbreaking research.
## Citations per faculty.

<table>
<thead>
<tr>
<th>Rank</th>
<th>University</th>
<th>Overall Score</th>
<th>Academic Reputation</th>
<th>Employees Reputation</th>
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Source: [www.topuniversities.com](http://www.topuniversities.com)
Departmental research themes.

- Computational Modelling
- Energy and the Environment
- Mechanics & Dynamics
- Biomedical Engineering
- Mechatronics, Automation and Design
Research groups.

Biomedical Engineering
Biomedical engineering (BERG) involves applying the concepts, knowledge and approaches of virtually all engineering disciplines to solve or improve healthcare related problems. Biomedical engineers use their expertise in biology medicine ...

Renewable Energy
The Centre for Renewable and Sustainable Energy Studies (CRSES) acts as a central point of entry into Stellenbosch University for the general field of renewable energy. Some contract research projects are completed within CRSES ...

Solar Thermal Energy
The Solar Thermal Energy Research Group (STERG) was the first university research group in the country to focus on solar thermal energy research. A main objective of the group is to train students to deliver research outputs in CSP.

Thermodynamics and Fluidmechanics
Current project title: Minimized water consumption in CSP plants (MinWaterCSP) Project duration: 36 months, started 01/01/2016
Consortium: 12 partners from 6 countries Demo sites: South Africa, Morocco and Spain Academic Institution partners: Fraunhofer ISE, Stellenbosch University, University of Rome, IRESEN

Sound and Vibration
The Sound and Vibration Research Group (SVRG) is situated in the Department of Mechanical and Mechatronic Engineering at the University of Stellenbosch. The SVRG has established expertise, equipment and laboratory facilities ...

Mechatronics, Automation and Design
The Mechatronics, Automation and Design (MAD) Research Group focuses on product design and manufacturing systems that combine controllers, sensors, actuators and/or mechanisms, such as reconfigurable manufacturing systems and ...

Materials Engineering
The Materials Engineering group is working with many of the leading national and international institutions in the area of materials engineering. The level of contact varies from fully funded research projects, through to partial funding of projects ...

Materials, Optimisation and Design (MOD)
The Materials, Optimisation and Design research group work on a diverse group of projects related to structural analysis and optimisation. The primary goal of which is producing or facilitating advanced engineering design
What is a postgraduate study?

Masters in Mechanical or Mechatronic Engineering.
- Research Masters (typically a 2 year program, full time):
  - 1 semester of course work at an advanced level.
  - 2-3 semesters of research.
  - Submission of a research thesis.
  - Submit a research article for publication.
- Structured masters (CRSES, typically a 1 year program):
  - 2 semesters of course work at an advanced level.
  - Project.

PhD in Mechanical or Mechatronic Engineering.
- 3 year program (full time).
- 36 months of research.
- Novel and groundbreaking.
- Submission of a research thesis.
- Publication numerous research articles and conference talks
Ask yourself three questions.

What type of project will get me up in the morning?

Who would you prefer to work with in the department? i.e. who will be your supervisor?

Do I require financial assistance / funding?
Listen. Let me tell you how it works.

Art and Research have a lot in common...

Art: Searches for truth, values originality and creativity, makes the world a better place.

Research: Searches for truth, values originality and creativity, makes the world a better place.

Really hard to get funding for:
Some research projects are funded. Some are not.

Sometimes you can be lucky and become part of a well funded research program, sometimes you need to organize your own funding through scholarships and bursaries.
Supervisor(s).

HOW YOU SEE YOURSELF:

- Complex human being
- Hopes
- Dreams
- Aspirations

HOW MOST PROFESSORS SEE YOU:

- Brain
- "So, how's research?"
- Stick
You require a supervisor from our department. You can have co-supervisors from any other department or university.

- Someone that is an expert in your intended field of study.
- Someone who understands you and whom you understand.
- Someone who will encourage and assist you to develop standards of achievement that will result in a thesis of merit.
- Someone that does not do the work for you.
- Someone that you can arrange to meet regularly (i.e. has time for you).
- Someone that gives you feedback and critique.
- Someone that can help mediate in certain situations.
I finally read that e-mail you sent me.

Uh, which one?

The one with potential ideas for a project.

I sent that e-mail three years ago.

Well, it didn't improve with age.

https://www.sun.ac.za/english/faculty/eng/mechanical-mechatronic/Pages/postgraduate-research-topics.aspx
Materials Engineering group

- Qualification of 3D printed titanium parts for Medical Implants and Aerospace components.
- Degradation of material properties using computer vision.
- Resource efficient process chains for titanium products: near net-shape preforms using powder metallurgy
- Collaboration with local university (UCT, CUT, CSIR) and international Universities (Oxford, Leuven).

Contact:
Assoc. Prof Thorsten Becker tbecker@sun.ac.za
Assoc. Prof Debby Blaine dblaine@sun.ac.za
www.sun.ac.za/mateng
DIGSAA - Digital twin solutions for the SA Agulhas II
Topics – DIGSAA

Contact: Annie Bekker
Supervisors:
Annie Bekker, Chris Meyer, Jacques Muiyser

Topics:
• Wave slamming
• Rigid body motion
• Scale modelling

Techniques:
Measurement, Signal processing, Modelling, Advanced data analytics, Multivariate models, augmented reality

Bursaries:
Masters R 70k + top up, PhD R100k + top up
Industry 4.0 in the South African context

→ Development of frameworks for “digital twins” of systems

→ Development of frameworks for “digital twins” to integrate humans with I4.0

1 Masters bursary available!!
Bulk Materials Handling using
the Discrete Element Method (DEM)
Prof Corné Coetzee (ccoetzee@sun.ac.za)

- The modelling of granular materials with the focus on bulk materials handling
- Applications in the mining and agricultural sectors: design of new and improving of existing systems and equipment
- Collaboration with local companies and international universities
- Possible funding for Master students
Agricultural Engineering
Postharvest Technologies
Prof Corné Coetzee (ccoetzee@sun.ac.za)

- The optimisation of packaging for fruit and vegetables: existing and new
- Finite element modelling (FEM) to investigate and improve the structural integrity
- Computation fluid dynamics (CFD) to analyse and improve the cooling processes
- Close collaboration with the department of horticultural sciences at Stellenbosch and local manufacturers of packaging materials
- Possible funding for Master and PhD students
Gerhard Venter

• Part of MOD research group
• Linear and non-linear FE analysis
• Numerical design optimization and related technologies
• Application to a wide range of real world problems
• Mostly funded from industry
• Currently: material characterization and load recovery using inverse FE analyses
• Contact: Prof Gerhard Venter
gventer@sun.ac.za
Wind mitigation for air-cooled condenser fan systems

Dr Jacques Muiyser
jmuiyser@sun.ac.za

Multiple experimental and numerical research topics related to the performance and vibration of air-cooled condenser fan systems operating under windy conditions:

- Optimisation of wind mitigating mechanisms
- Investigation of novel wind mitigation concepts
- Numerical modelling of fans and mechanical/structural components

Figures created by Simon Marincowitz
Johan van der Spuy: Large diameter axial flow fans, micro gas turbines

- sjvdspery@sun.ac.za
- Simulating and testing large diameter axial flow fans for application in air-cooled condensers.
- The development of micro gas turbines for propulsive and renewable power generation purposes.

Website: Cape Aerospace (CAT)

Thesis: Francois Louw
Mike Owen – Thermofluids division

RESEARCH AREAS
• Heat transfer & fluid dynamics
• Industrial heat exchangers
  • Dry, wet & hybrid cooling
• Renewable & sustainable energy
  • Reducing energy related water consumption
  • Solar energy applications
• Energy efficient buildings
  • Thermal performance of buildings

POST-GRAD OPPORTUNITIES
• ACC fan performance
  • Numerical and experimental work
  • Wind screens, inlet configurations, ???
• Hybrid condensers
  • Primarily experimental work
  • Performance characterization
• Other
  • Anything rad, come and talk to me! Bring coffee.

mikeowen@sun.ac.za, M516
Solar Thermal Energy Research Group

Using the sun to supply renewable energy

We research:

- Thermodynamic cycles
- Automation of heliostat fields
- Storing heat in rocks
- Using drones to service the plants
- Implement Internet-of-Things and Industry 4.0 ideas in the plants
BIOMEDICAL ENGINEERING

OVERVIEW

- Based on the United Nations Millennium Development Goals, our vision is focused on affordable quality healthcare making life better for the 1 Billion in Africa.

  - Unique solutions
  
  - Diagnostic support
  
  - Point of care nano-sensors

CONTACT

Professor Pieter Fourie
prfourie@sun.ac.za
OVERVIEW

• Develop solutions for the treatment of musculoskeletal disorders:
  • Implant design
  • Medical image processing
  • Surgical planning and navigation
  • Computational anatomy

• Focus on the South African population and healthcare

• Collaborate with industry and surgeons

• Possible funding for Master’s students

CONTACT

Dr J van der Merwe
Office M3035
jovdmerwe@sun.ac.za
OVERVIEW

• Investigate human reaction to impact:
  • Study of injury causation / prevention
  • Human body modeling through FEA or Musculoskeletal Multibody Models
  • Relating clinical injuries to injury mechanisms (engineering “language”)
  • Matching injury mechanisms to corresponding injury tolerance limits
  • Measurement/calculation of body-specific forces/moments to be compared to tolerance limits
  • Injury prevention through innovative product design
  • Evaluation of real-world product efficacy via physical or virtual “Crash Test Dummy” analysis

• Collaborate with industry, neurosurgeons, orthopedic surgeons etc.
• Possible funding for Master’s students

CONTACT

Mr. C de Jongh, PrEng
Office M140
corneld@sun.ac.za
Artificial Intelligence, Machine Learning & Machine Consciousness

Will Robots Ever Achieve Genuine Consciousness? How Will We Know?

Paul Newman

consciousness is the most familiar aspect of life, but it is also the most mysterious. The mystery is the question of whether we can recognize genuine consciousness in it, and whether it occurs outside of ourselves. This question has gained new attention over the past decades due to the advances in Artificial Intelligence (AI) that have put us closer to this latter reality. A future society with "human-like" beings that possess genuine consciousness is one that takes moral action for itself. In this scenario, the idea of genuine consciousness is that it can be achieved through the simulation of human-like beings.

One day, we may be able to simulate genuine consciousness. In this scenario, the idea of genuine consciousness is that it can be achieved through the simulation of human-like beings.

In 1950, Alan Turing proposed a test to determine if a machine is intelligent. The Turing test envisions two judges and a machine. The judges are asked to communicate with the machine and determine if it is a machine or a human. If the judges cannot tell the difference, the machine is said to have passed the test. The test has since been adapted to various forms, including the simulation of human-like beings.
Microcirculation Flow Patterns in the Lymphatic System

- Investigations into
  - Initial lymphatics
  - Lymph propulsion
  - Pressure gradient

- Liora Ginsberg

- ginsberg@sun.ac.za
Thermofluids Division: Research on Octane Blending Behaviour

- Octane blending behaviour research done in collaboration with Sasol Energy
- Current project: Synergistic and antagonistic (+ve and –ve non-linear) octane blending behaviours of common hydrocarbon molecular classes and octane boosting additives
- Uniquely modified octane engine in Department used for testing fuel blends. Engine is one-of-a-kind in South Africa
- Funding for the next project on octane blending behaviour and modelling is available and includes a student bursary
- Students who are interested in this project or this field of research can contact Mr. Richard Haines (rhaines@sun.ac.za) for more information
We need:

• Better UAV controllers
• Drones that will wash heliostats
• Obstacle detection system for UAVs
Measurements with cameras

- Capture the motion of a mountain biker with drones
- Prof. Schreve, Dr Smit
Final remarks.