

Postgraduate Studies: Current Research Fields in the Mechanical and Mechatronic Engineering Department

Dr Melody Neaves



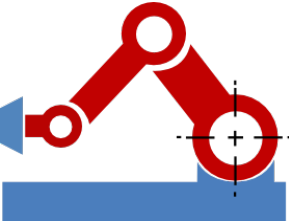
Department of Mechanical and Mechatronic Engineering
Stellenbosch University

2021

www.mecheng.sun.ac.za

Overview of departmental research themes

MECHATRONICS
AUTOMATION
DESIGN



Mechatronics,
Automation
and Design

Biomedical
Engineering




UNIVERSITEIT
iYUNIVESITHI
STELLENBOSCH
UNIVERSITY



100
1918 - 2018

forward together • saam vorentoe • masiy e phambili

BIOMEDICAL
ENGINEERING
RESEARCH GROUP



STERG
SOLAR THERMAL ENERGY
RESEARCH GROUP

Thermofluids and Fluid Mechanics

Energy and the
Environment

M&M
Research
Themes

Mechanics
and Dynamics



MATERIALS
ENGINEERING

sovvvd &
vibration

RESEARCH
GROUP



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CENTRE FOR RENEWABLE &
SUSTAINABLE ENERGY STUDIES

Modeling

MOD

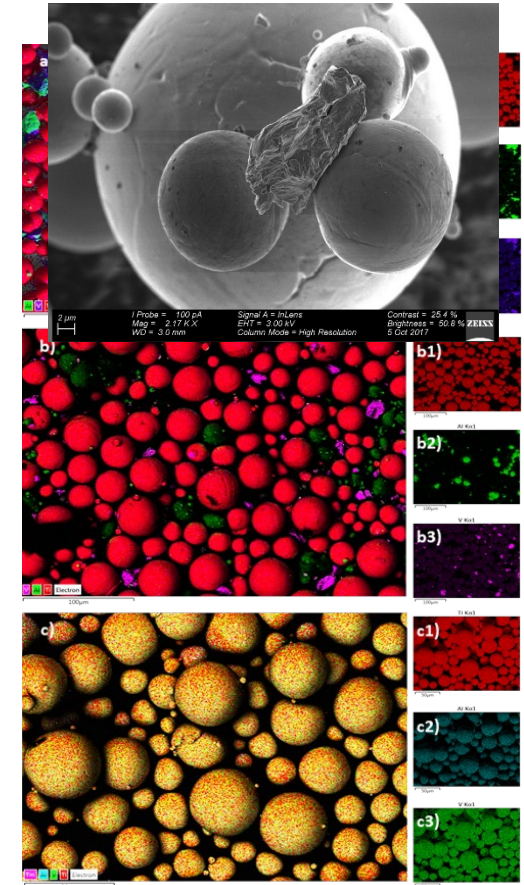
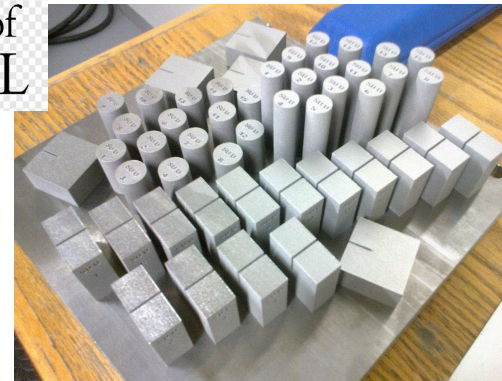
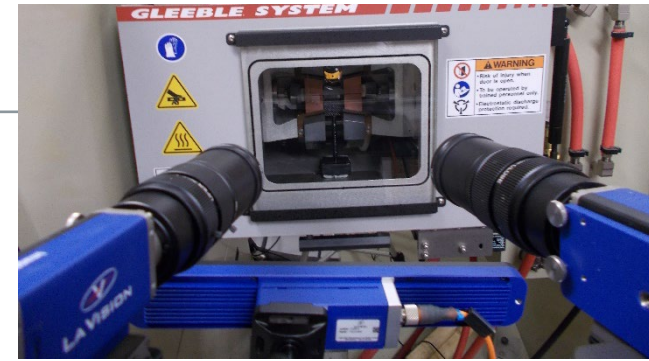
MATERIALS | OPTIMISATION | DESIGN

GMRG

Granular Materials Research Group

Materials Engineering Research Group

- Degradation of material properties using computer vision: macroscale and microscale studies
- Additive manufacturing of superalloys: Process and property optimisation for aerospace applications
- Powder characterisation and process development for metal powder technology, such as laser bed powder fusion and sintered powder metals



Contact:
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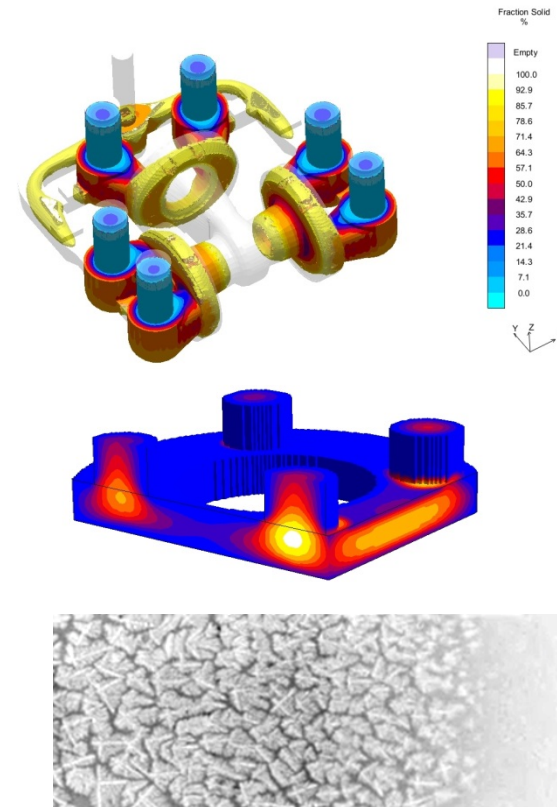


Project at Masters level:

- Microscale / macroscale modelling of dendritic growth during solidification of low carbon steels. (Solidification mechanics including diffusion of chemical elements and heat transfer; metallurgical phase transformations; microstructural analysis; mechanical testing).

Facilities:

- Software for metal casting process simulation
- DICTRA software for diffusion analysis
- Thermo-Calc for phase transition analysis
- Microstructure assessment equipment (various facilities including those at Central Analytic Facility).
- Heat Treatment facilities
- Sand casting facilities at partner institution (University Ismail Moulay – Morocco).



Prof Nawaz Mahomed
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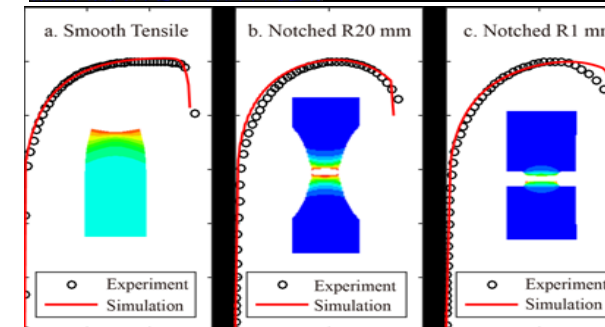
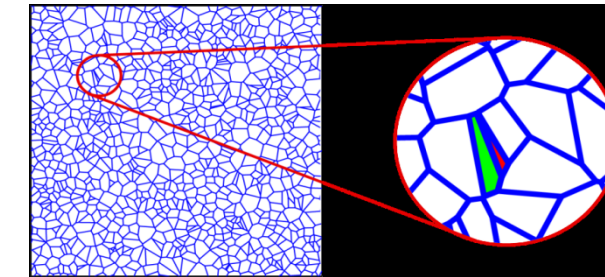
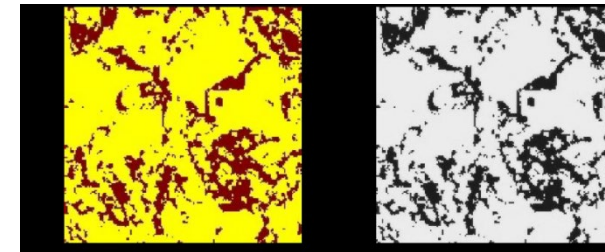


Project at Masters level:

- Micro-Mechanical Modelling of Surface Hardening of Stainless Steel by Induction Heating. (Solidification mechanics including diffusion of chemical elements and heat transfer; metallurgical phase transformations; microstructural analysis; mechanical testing). Opportunity to improve the impact strength and wear resistance of duplex stainless steel and 3Cr12, diversifying its applications.

Facilities:

- COMSOL software for micro-mechanical modelling of metallurgical transformations during induction heating.
- Thermo-Calc for phase transition analysis
- Microstructure assessment equipment (various facilities including those at Central Analytic Facility).
- Heat Treatment facilities (including a newly acquired Induction Furnace)
- Facilities at partner institution (Université de Technologie de Compiègne - France).



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Data-driven fatigue and slamming analysis on the SA Agulhas II

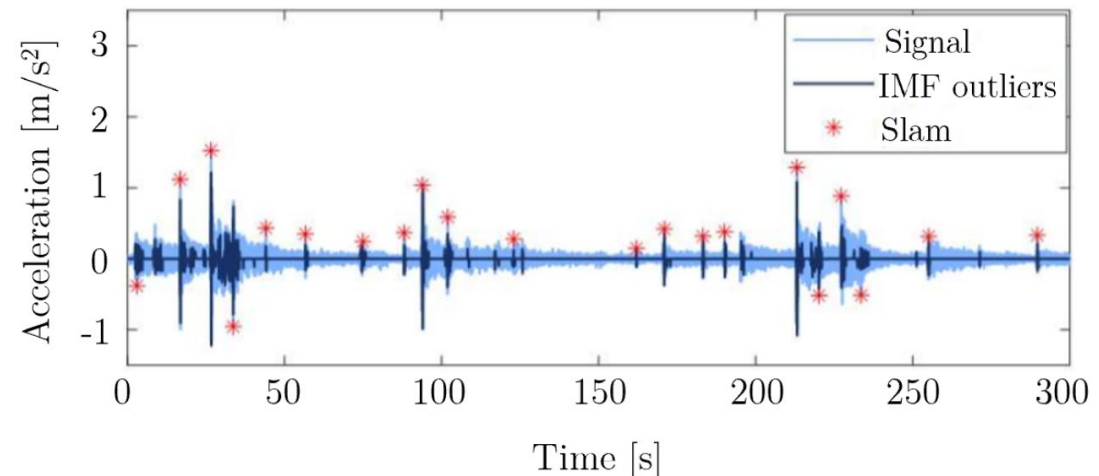


ENGINEERING
INJINELI
EURESWES

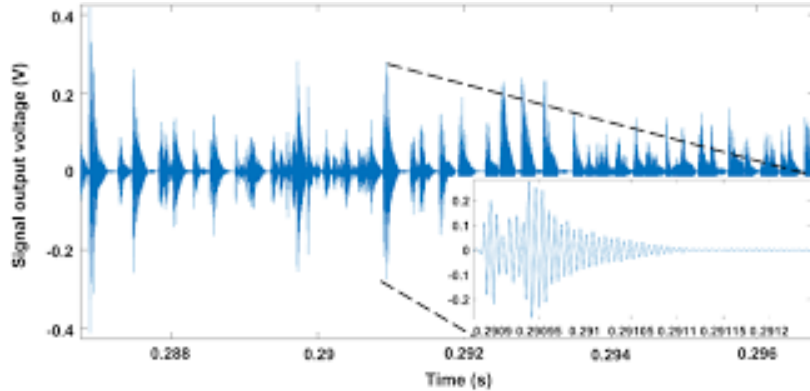


Supervisor: Prof Annie Bekker

The ship is prone to wave slamming which causes “jellyship”, a lasting vibration of her structure. In July 2022 she will undertake a research voyage to the Southern Ocean with a team of scientists on board. Participate in this voyage and be responsible for slamming measurements and observations in the Stellenbosch research team (students from Stellenbosch, Norway and Germany). Data-driven techniques and analysis will be investigated to predict slamming and damaging conditions and avoid this in operation.

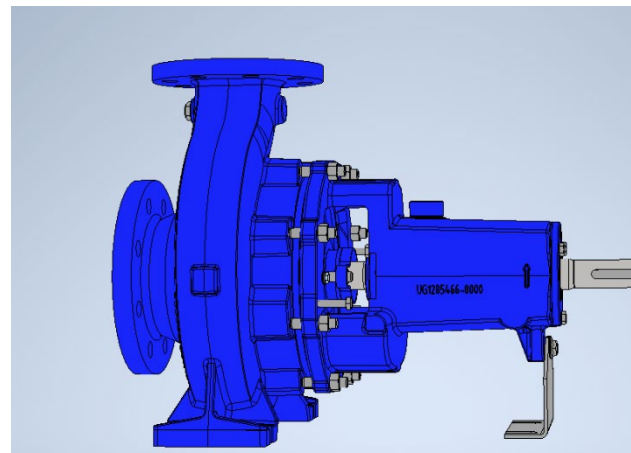
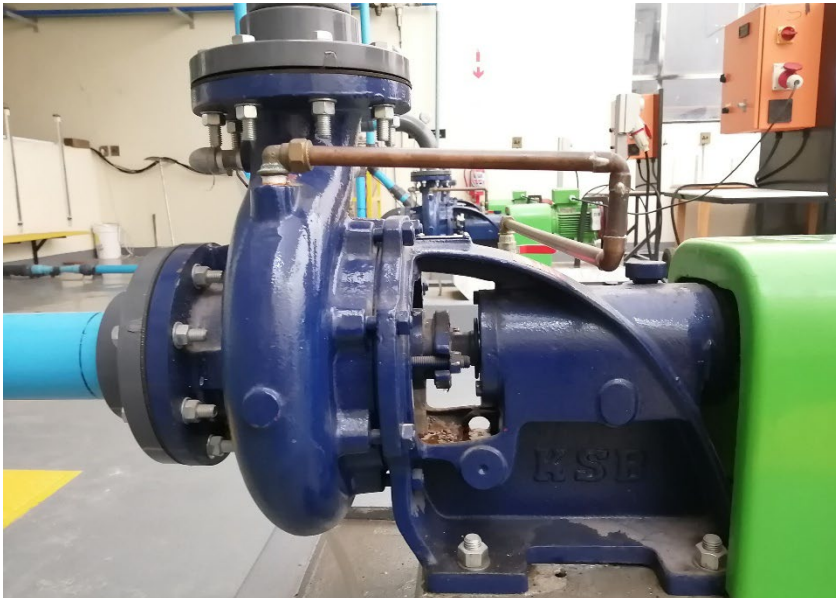


A digital twin pump laboratory for water asset management

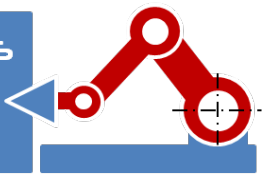


Supervisor: Prof Annie Bekker

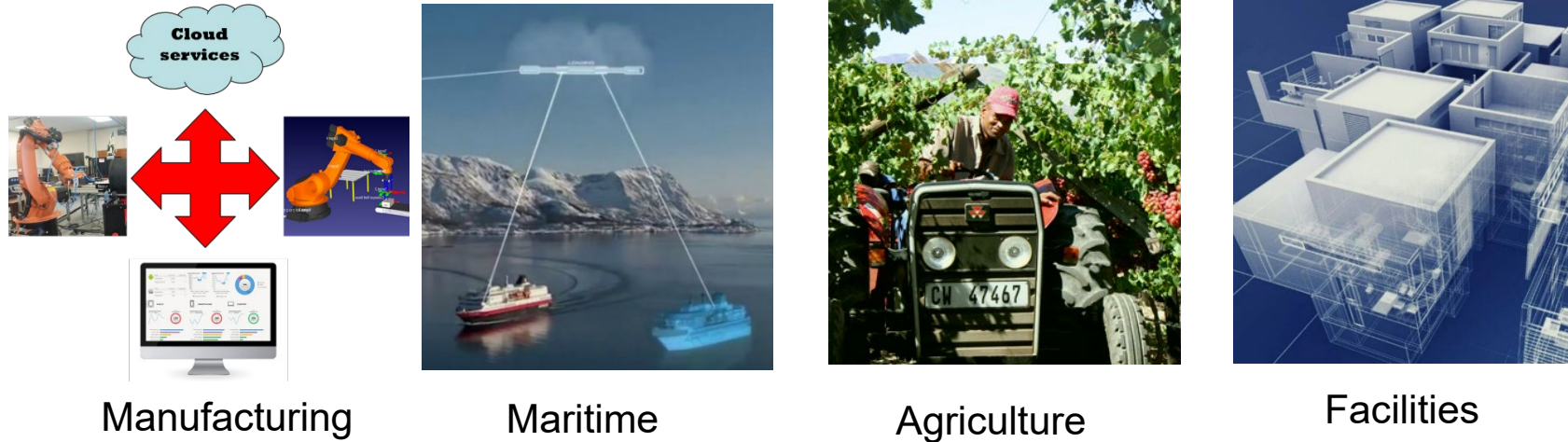
Complex systems are increasingly digitized to assist in operational decision aiding. In smart cities the real-time state of water distribution networks is increasingly monitored through sensor observations and entanglement with digital models. The digital twin pump laboratory at Stellenbosch University has been established to mimic a water distribution network. Fault detection and diagnosis will be investigated through the integration of several models. The traction of these approaches will be evaluated in collaboration with Rand Water.



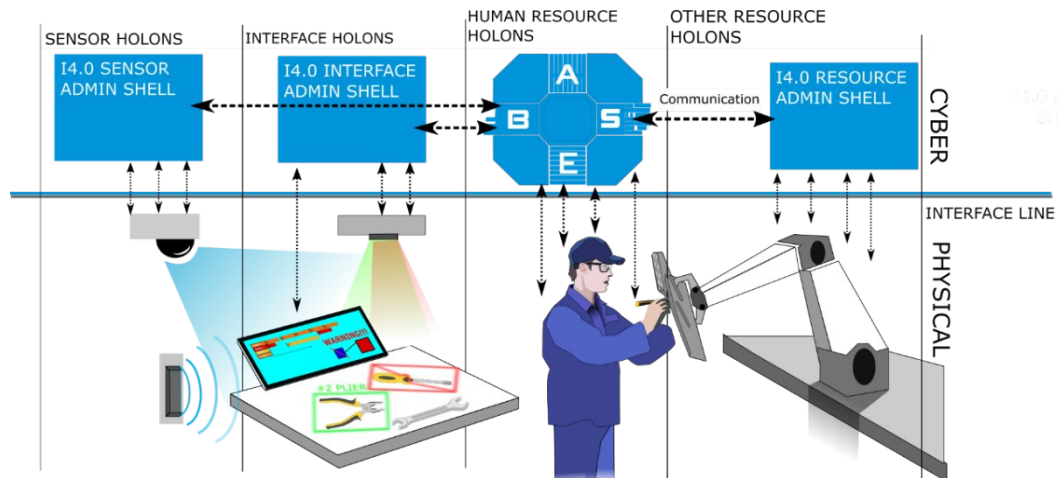
MAD group: Industry 4.0 in the South African context



→ Digital twin based solutions for industrial systems



→ Integration of humans within cyber-physical I4.0 environments



Dr Karel Kruger (kkruger@sun.ac.za)



Prof Anton Basson (ahb@sun.ac.za)



The research group's members work on a diverse group of projects related to **structural analysis and optimisation**. Finite element analysis, numerical design optimisation, material characterisation for numerical modelling purposes, meta-modelling, etc. are all of interest.



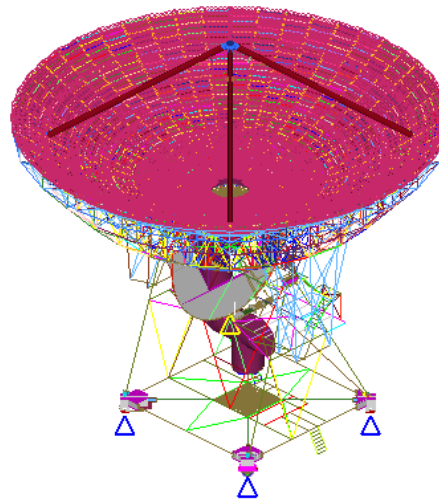
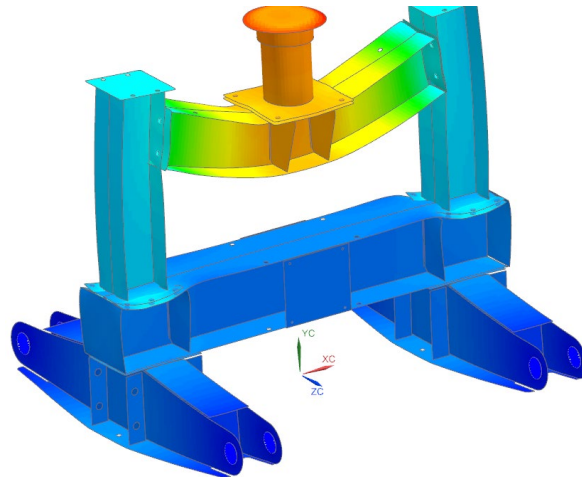
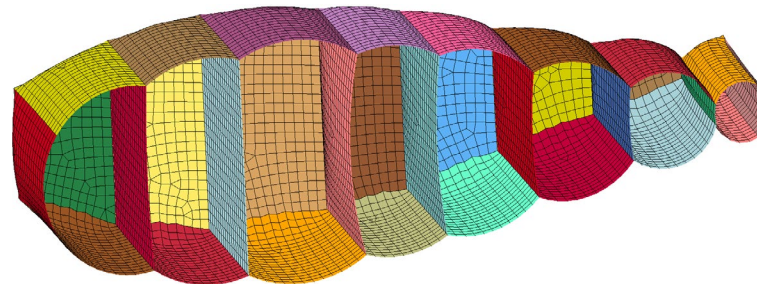
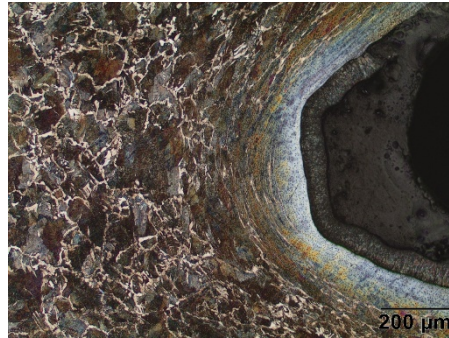
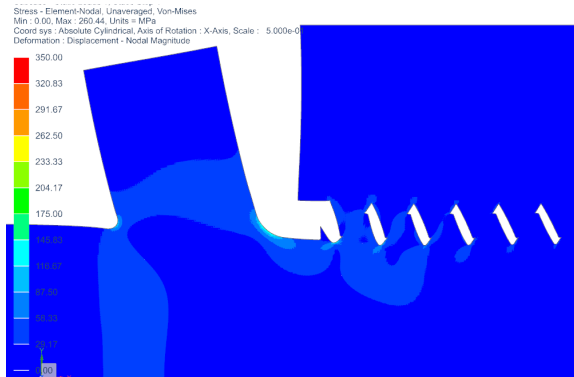
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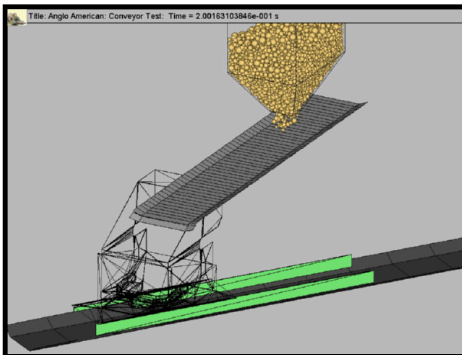
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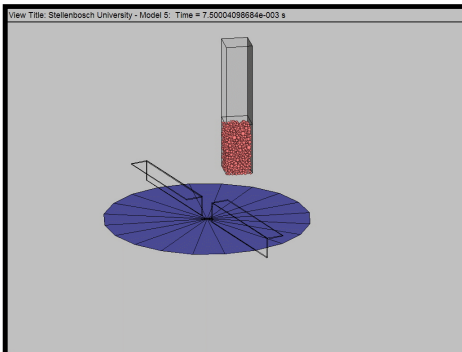
Bulk Materials Handling using the Discrete Element Method (DEM)

- 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 industry and international universities
- Possible funding for Master and PhD students

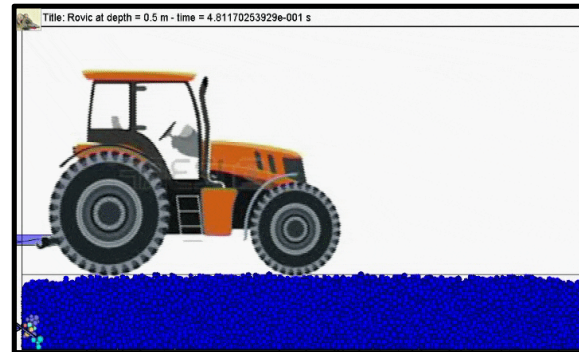
Prof Corné Coetzee
ccoetzee@sun.ac.za



Discrete Element Modelling of Conveyor and Transfer Chute



Discrete Element Modelling of Fertiliser Spreader

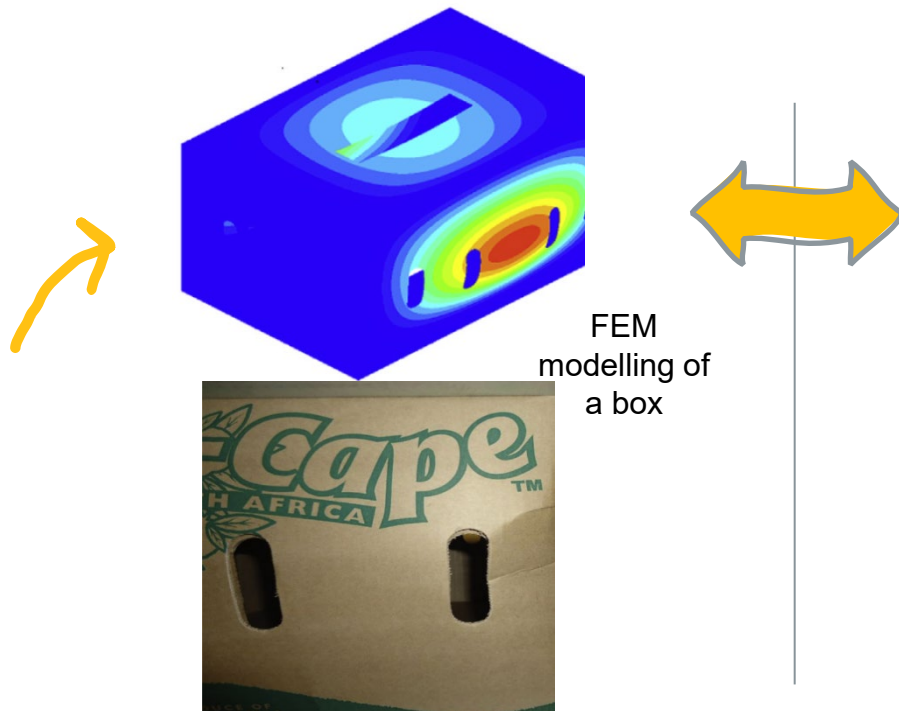


Discrete Element Modelling of Soil Tillage

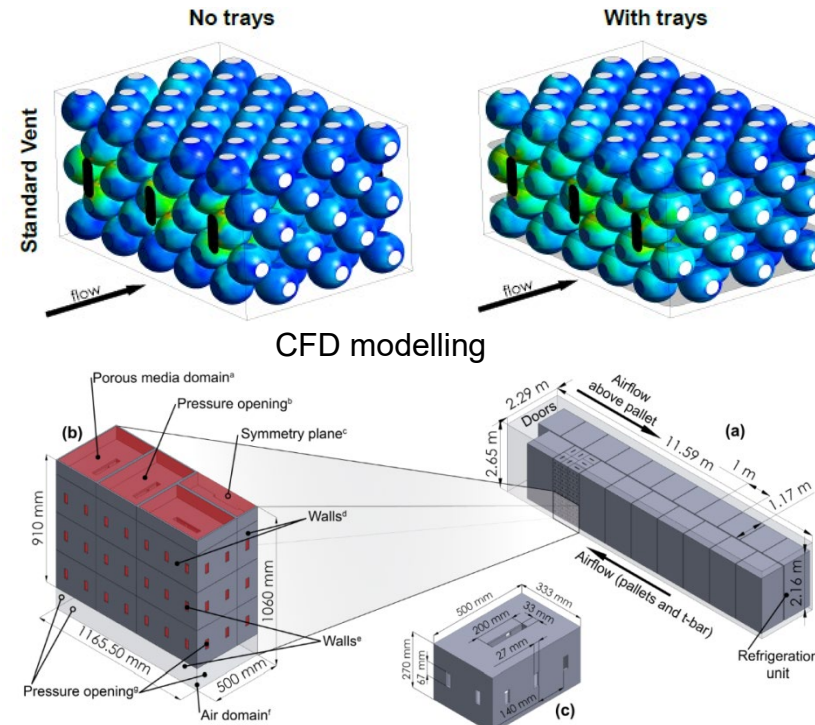


- The optimisation of packaging for fruit and vegetables: existing and new
- Finite element modelling (FEM) to investigate and improve the structural integrity
- Computation fluid dynamics (CFD) to analyse and improve the cooling efficiency
- Close collaboration with the department of horticultural sciences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

Prof Corné Coetzee
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FEM
modelling of
a box

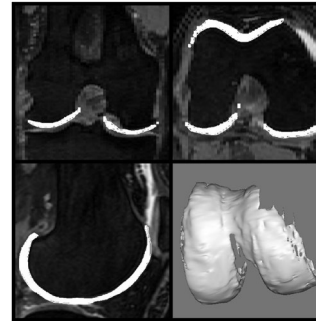


CFD modelling



ORTHOPEADIC ENGINEERING

- Develop solutions for the treatment of musculoskeletal disorders:
 - Implant design and qualification
 - Medical image processing
 - Patient-specific isogeometric analysis
 - Surgical planning and navigation
- Focus on the South African population and healthcare.
- Collaborate with industry and surgeons.



CONTACT

For general enquires:



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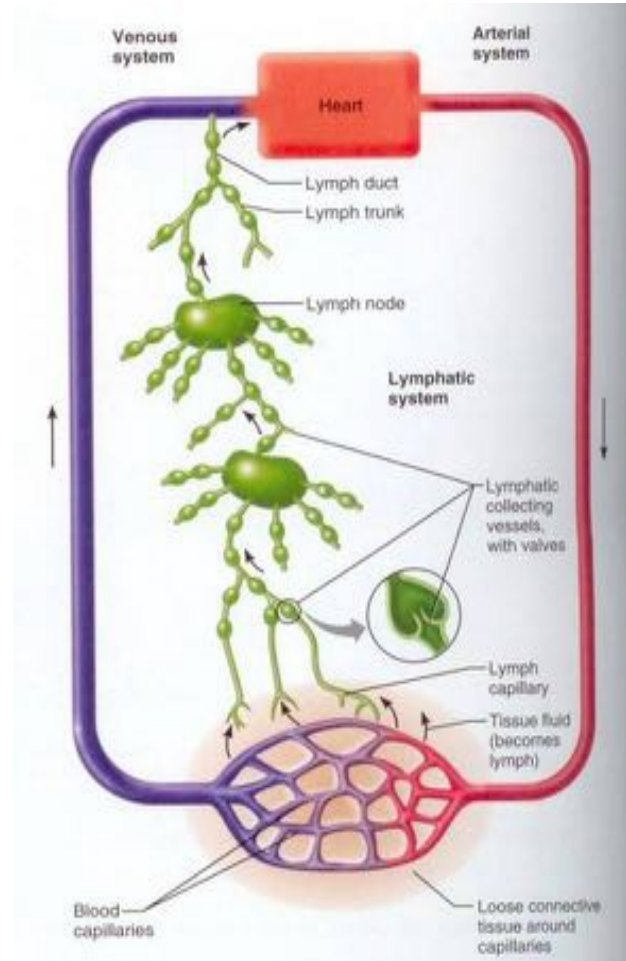
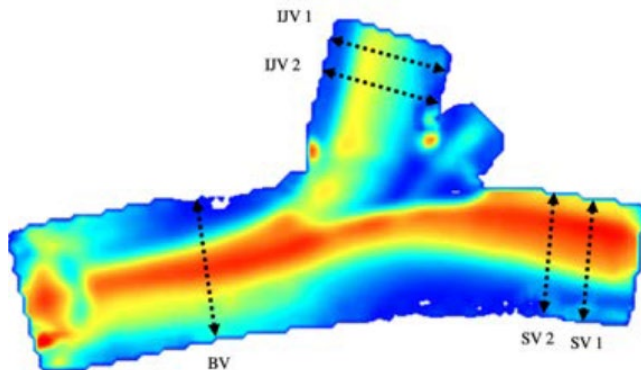
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Prof Kristiaan Schreve
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Liora Ginsberg

- Investigations into
 - Initial lymphatics
 - Lymph fluid propulsion
 - Pressure gradient of the lymphatic system
 - Use of FlowNex / CFD / similar



CONTACT



Mrs Liora Ginsberg

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1.

POLICY GUIDING STUDIES

- Solar fuels/hydrogen
- CSP for peaking power
- Carnot batteries



2.

CST FOR MINERALS PROCESSING

- Sinter plants
- Low melting metals
- Preheating
- Thermal treatment of ores



3.

MEDIUM SCALE CONCENTRATING SOLAR THERMAL (CST)

- Steam piston generators
- Supercritical CO₂ cycles
- Dry-cooling
- Solarized gas turbines



5.

AUTONOMOUS CSP SERVICES

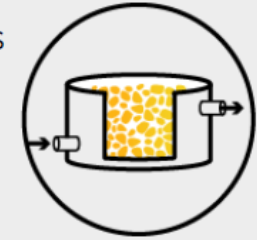
- Drone positioning
- Photogrammetry measurements
- Drone targets



4.

THERMAL ENERGY STORAGE (TES)

- Rock bed TES
- Engineered packing for TES



South African and
International collaborators

Heliogen

 Sandia
National
Laboratories

 Fraunhofer
CHILE

 DLR

 KTH
KTHENSKA
TEKNIKA
HOGSKOLEN

 ICWA POWER
قوة بالور

 UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
UNIBESITHI YA PRETORIA

 MINTeX

 STASA
SOUTH AFRICAN THERMAL ENERGY STORAGE ASSOCIATION

 STASA

 RWTH AACHEN
UNIVERSITY

 Fraunhofer
ISE

 Hochschule Esslingen
University of Applied Sciences

 UNIVERSIDADE
DE EVORA

 SolarPACES
Solar Power & Chemical Energy Systems

 GeoSUN
AFRICA

 SASEC 2021
SOUTHERN AFRICAN SUSTAINABLE
ENERGY CONFERENCE

 FOCAL
SUN

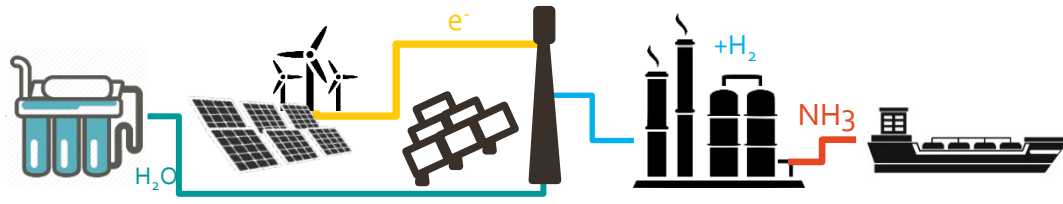
 UNIVERSITY OF
Southampton

 Atlantica
Sustainable Infrastructure

STERG: Infrastructure & resources



Prof Craig McGregor: Solar thermal energy, green hydrogen production

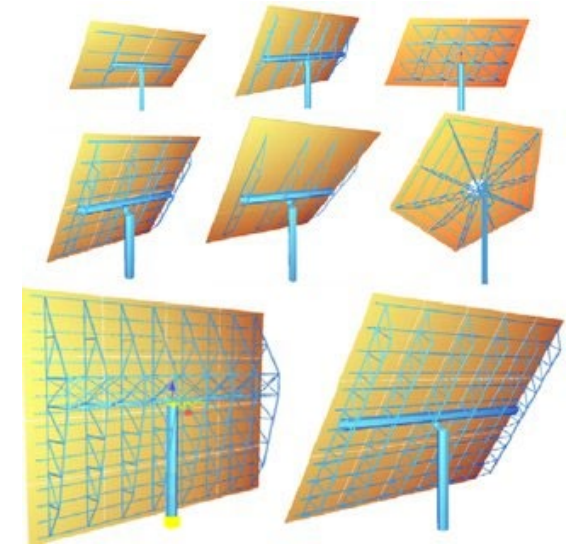


Topics

- new heliostat designs
- digital camera-based feedback control
- solar thermal for industrial process heat
- photochemical reactors for green hydrogen production
- green hydrogen system energy studies
- high-density pumped hydro storage

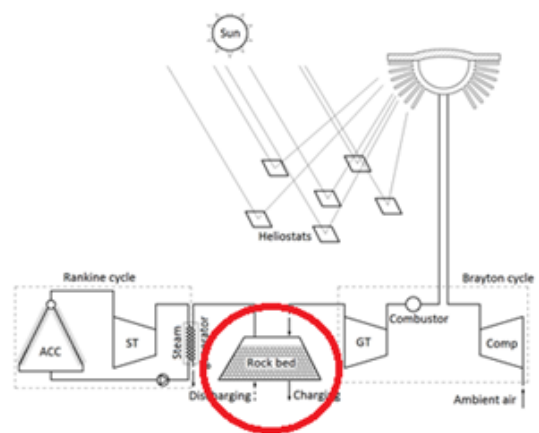


Prof Craig McGregor
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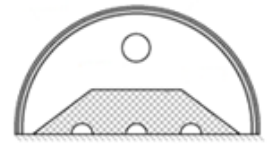




Prof. Jaap Hoffmann
Thermofluids Division/STERG
Solar thermal energy
Rock bed energy storage
Solar hydrogen production
Solar water desalination



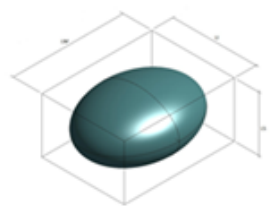
Prototype testing



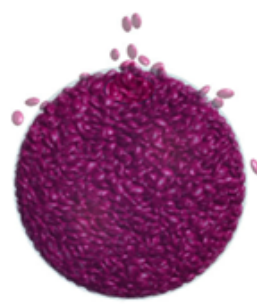
Packed bed design



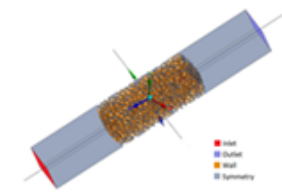
Particle characterization



Packing structure



Pressure drop and



heat transfer

Dr Willie Smit: Drone Services & Automation

- Measuring the optical quality of a heliostat
- Closed-loop control of heliostats



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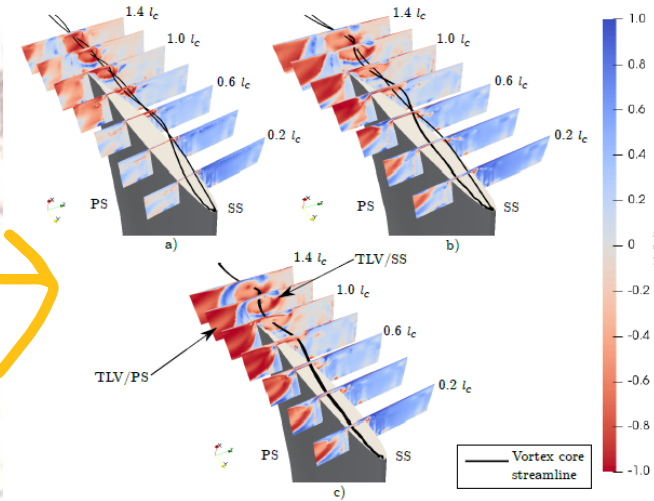


Johan van der Spuy: Large diameter axial flow fans, micro gas turbines

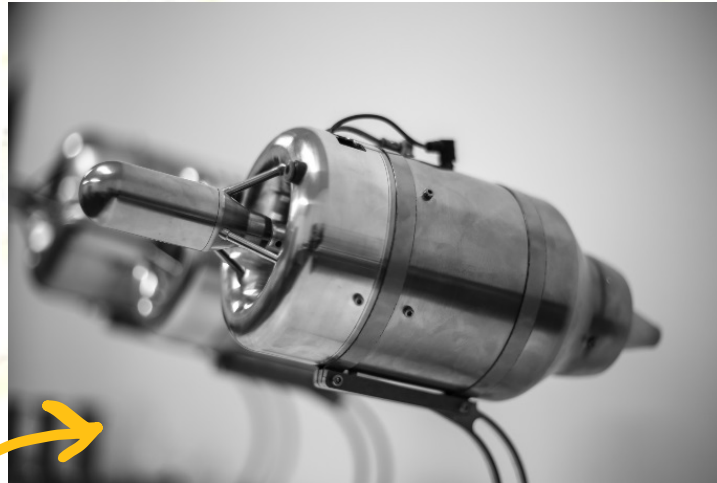


Prof Johan van der Spuy
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- Simulating and testing large diameter axial flow fans for application in air-cooled condensers.
- The development of micro gas turbines for propulsive and renewable power generation purposes.



MinwaterCSP project



Website: Cape Aerospace (CAT)



Research

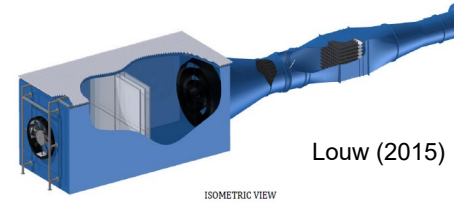
- Dry cooling systems for power generation
- Axial flow fan performance
- Effect of wind on PV panel performance
- Thermo-economic evaluation on CSP / PV power plants

Fundamentals

- Thermodynamics
- Fluid Dynamics
- Heat Transfer

Methods

- 1D simulation models
- Computational Fluid Dynamics
- Experimental testing (fans)
- Thermo-economic analysis



Louw (2015)

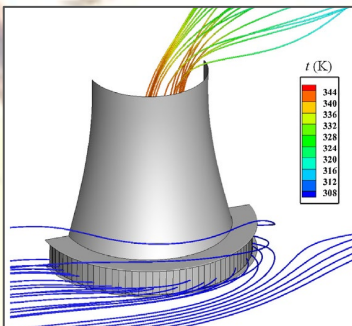
Dr Hannes Pretorius

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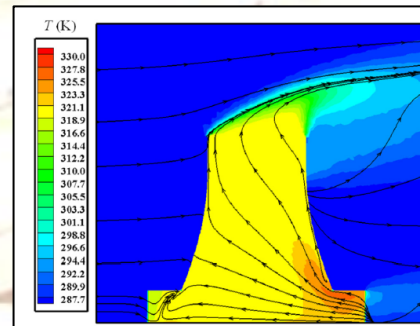
jpp@sun.ac.za



Augustyn (2017)



Kong et al (2018)



Imechc.org



lemco.co.za

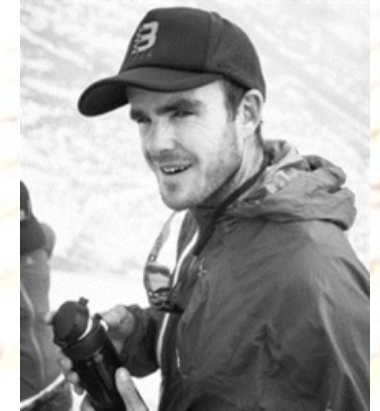
RESEARCH AREAS

- **Heat transfer and fluid dynamics**
- **Industrial heat exchangers**
 - Dry, wet and hybrid cooling
- **Renewable and sustainable energy**
 - Reducing energy related water consumption
 - Solar energy applications
- **Energy efficient buildings**
 - Thermal performance of buildings



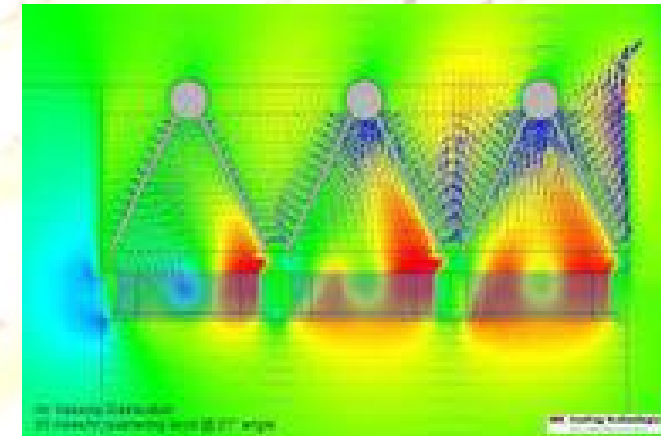
Dr Mike Owen

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POST-GRAD OPPORTUNITIES

- **ACC fan performance**
 - Numerical and experimental work
 - Wind screens, inlet configurations and more
- **Hybrid condensers**
 - Primary experimental work
 - Performance characterisation
- **Other**
 - Anything rad, come and talk to me. Bring coffee.





"Passion is energy. Feel the power that comes from focusing on what excites you."

~Oprah Winfrey