SU Solar Thermal Spoke Topics 2014

A subset of all the M&M topics related to STERG.

Note: for purpose of NRF spoke scholarships, please disregard the “Funding available” category for each project.

Note: The NRF scholarships are only applicable to RSA citizens and permanent residents.

PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr Jaap Hoffmann

ONDERWERP / *TITLE:*
Solar receiver optimization

Beskrywing van onderwerp / navorsingsveld: / *Description of topic / research field:*
The SUNSPOT cycle is based on a Brayton cycle for its primary loop. Poor heat transfer characteristics of gases, combined with high heat fluxes in solar receivers can lead to excessive thermal stresses. A suitable objective function need to be defined, whilst material properties impose several constraints on the design. The shape of the receiver (tube) is not fixed. It is envisaged that a combination of CFD and FEA will be used to generate data points. This make for very expensive function evaluations. Selection of existing optimizer or development of new optimizer is critical to the problem.

Spesifieke voorvereistes: / *Specific requirements*:
CFD, FEA

Befondsing beskikbaar / *Funding available:*
None

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr Jaap Hoffmann and Dr Annie Bekker

ONDERWERP / *TITLE:*
Modal analysis of heliostat

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Flow separation under high wind speeds may lead to severe vibrations, and ultimately failures of heliostats. Do a modal analysis of an existing heliostat structure on the solar roof, envelope conditions that may lead to potentially damaging vibrations, and suggest design remedies.

Spesifieke voorvereistes: / *Specific requirements*:
CFD, FEA

Befondsing beskikbaar / *Funding available:*
None

PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

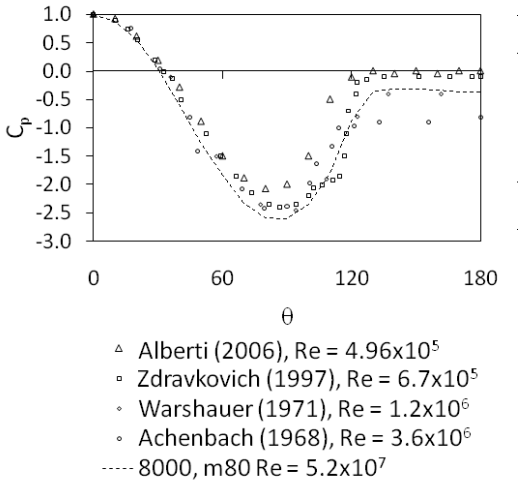
Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

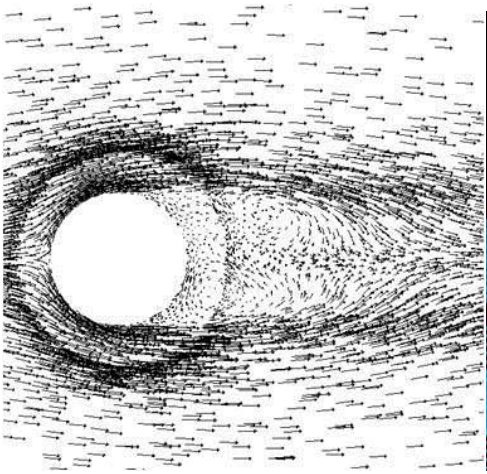
Dosent / *Lecturer:*
Prof HCR Reuter

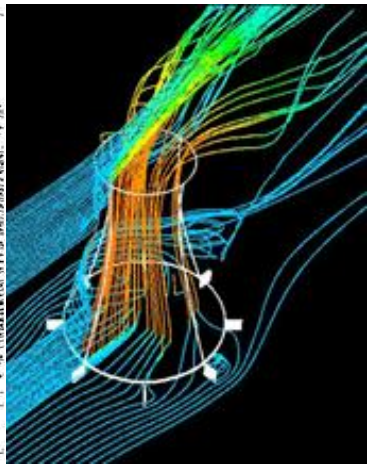
ONDERWERP / *TITLE:*
CFD investigation of the effect of cross-winds and temperature inversions on the performance of natural draft cooling towers

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Wind and temperature inversions can dramatically reduce the performance of large cooling towers as found in power, petro-chemical and process plants, significantly affecting plant performance. To maintain output, more coal must be burnt leading to increased pollution.

Numerical (CFD) investigation of the air flow patterns about and through such plants is required to determine the influence of distorted air flow patterns on the performance. By introducing practical and cost effective modifications to such cooling towers (extended platforms, windscreens, etc.) significant improvements in performance and a corresponding reduction in pollution should be possible.







Spesifieke voorvereistes: / *Specific requirements*:
An excellent academic record and a passion for Computational Fluid Dynamics (CFD).

Befondsing beskikbaar / *Funding available:*
Funding is available for 1 student - Terms and Conditions apply

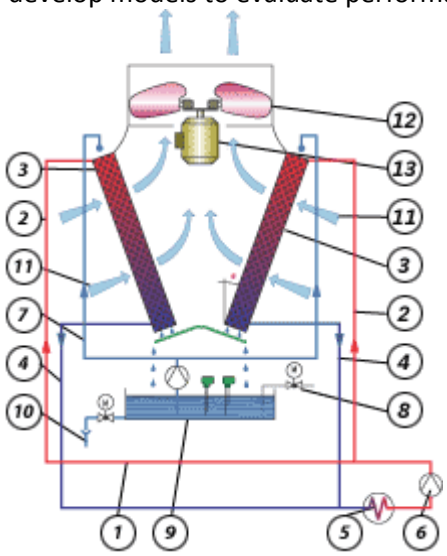
PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

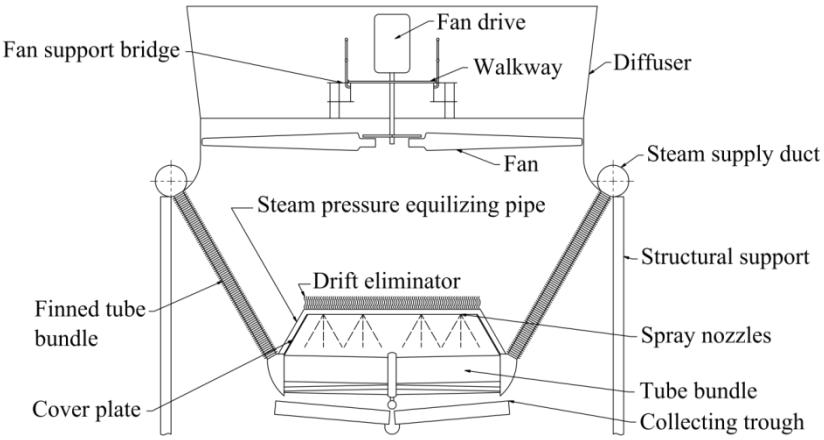
Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Prof HCR Reuter

ONDERWERP / *TITLE:*
Performance evaluation and enhancement of hybrid or deluged cooling systems

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Hybrid or deluged dry-cooling systems are currently considered to be the leading water re-cooling technology when ground space is limited, water-costs are high, and visible plumes are not tolerated. The general objective is to investigate the performance characteristics of different finned and bare tube bundles with and without deluging and to develop models to evaluate performance.





Spesifieke voorvereistes: / *Specific requirements*:
An excellent academic record and a passion for experimental work in a laboratory.

Befondsing beskikbaar / *Funding available:*
Funding is available for 1 student - Terms and Conditions apply

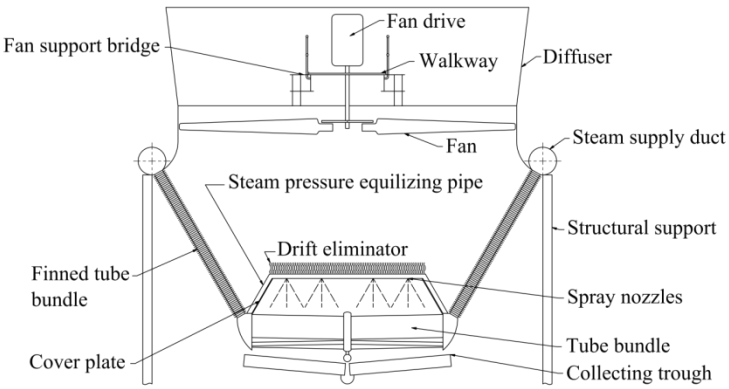
PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

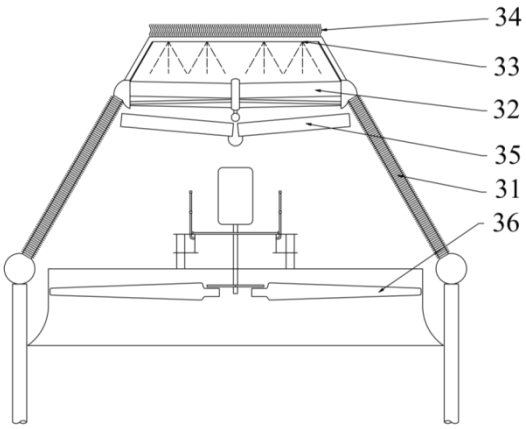
Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Prof HCR Reuter

ONDERWERP / *TITLE:*
Investigation of flow patterns and performance characteristics for the condensation of steam in horizontal tubes

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Eskom Matimba Power Station is currently the largest dry-cooled power station in the world with two larger power stations, Medupi and Kusile, currently under construction. Stellenbosch University (SU) is considered to be a world leader in the field of industrial air-cooled heat exchanger and cooling tower performance. To improve the performance of such dry-cooled power plants, a new improved hybrid (dry/wet) dephlegmator design has been developed and patented at SU, as shown schematically below. To optimise the bundle design, the thermal performance of the tube bundle needs to be investigated. This project entails the design and manufacture of a test rig to measure the performance of air-cooled heat exchanger tubes deluged with water. Tests will be conducted on different heat exchanger tube geometries to evaluate their performance.





Spesifieke voorvereistes: / *Specific requirements*:
An excellent academic record and a passion for experimental work in a laboratory.

Befondsing beskikbaar / *Funding available:*
Funding is available for 1 student - Terms and Conditions apply

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

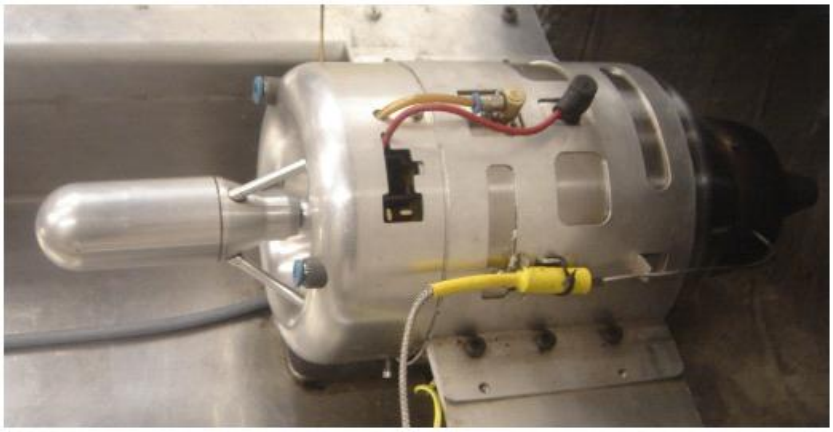
Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr SJ van der Spuy

TITEL / *TITLE:*
The manufacturing of the compressor stage of a micro gas turbine

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:

The use of micro gas turbines (MGTs) for the propulsion of aerial vehicles holds specific advantages. Previous investigations looked at the development of a small diameter compressor and turbine stage that could typically be used in a MGT.



This project will investigate the manufacturing of the compressor stage of an MGT and consider both the manufacturing process and material used to date and look at possible alternatives. The investigation will include the manufacturing and testing of various prototypes, considering both their mechanical and aerodynamic performance.

Spesifieke voorvereistes: / *Specific requirements*:
Meganiese Ing.
CFD and FEM 414

Befondsing beskikbaar / *Funding available:*
Volle projekkostes en beursgelde (onderhewig aan bevestiging vanaf die WNNR)

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

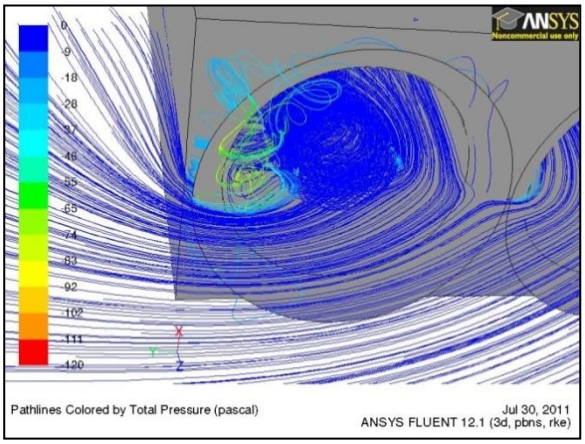
Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

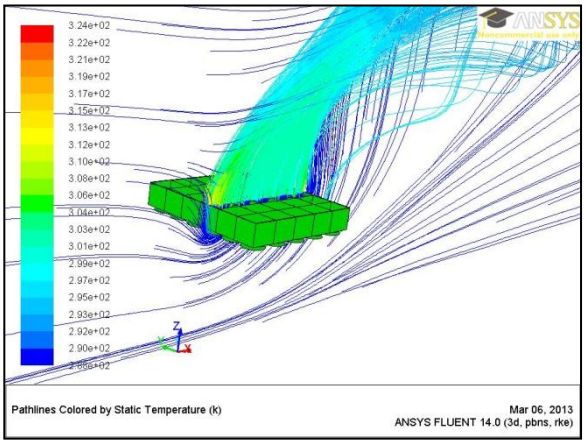
Dosent / *Lecturer:*
Dr SJ van der Spuy

TITEL / *TITLE:*
The derivation and application of a simplified fan model for simulation of an air-cooled condenser

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:

The use of direct dry-cooled condensers in power generation systems is a means of ensuring sustainable water usage. The accurate prediction of axial flow fan operation in the air-cooled condenser (ACC) is essential during the design phase of such a system. Computational Fluid Dynamic (CFD) simulations are often used to simulate the ACC.





The large size of an ACC means that the effect of the axial flow fans in the ACC has to be modelled using simplified numerical models. This investigation will consider the results from a current PhD study to look at the detailed flow field surrounding an axial flow fan and will derive and apply a simplified fan model for application in an ACC.

Spesifieke voorvereistes: / *Specific requirements*:
Meganiese ing.
CFD 414

Befondsing beskikbaar / *Funding available:*
Full project costs and possible bursary (pending application)

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr SJ van der Spuy

TITEL / *TITLE:*
Investigating the aerodynamic damping of a large diameter axial flow fan blade

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:

The use of direct dry-cooled condensers in power generation systems is a means of ensuring sustainable water usage. The axial flow fans that are used as part of the air cooled condenser (ACC) are subjected to a variable aerodynamic load, depending on their location within the ACC. A PhD study is currently being performed to consider the quantification of these loads and to model the vibrational behaviour of the blades of these axial flow fans.

As part of this investigation the effect of aerodynamic damping on the vibrational behaviour of an axial flow fan will be investigated. The investigation will use experimental results obtained from a flat plate fan blade and compare it to numerical results obtained from and an FSI model of the same blade. The comparison will then be used to quantify the aerodynamic damping experienced by the fan blade.

Spesifieke voorvereistes: / *Specific requirements*:
Meganiese ing.
CFD and FEM 414

Befondsing beskikbaar / *Funding available:*
Full project costs and possible bursary (pending application)

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

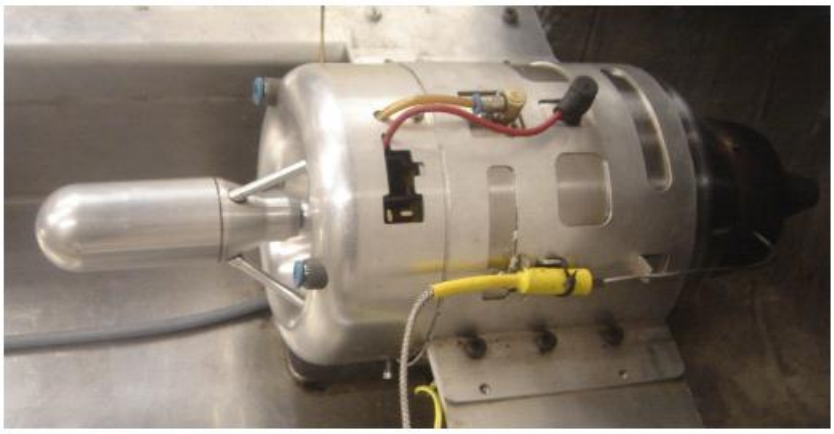
Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr SJ van der Spuy

TITEL / *TITLE:*
The development of a new shaft arrangement for a micro gas turbine

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:

The use of micro gas turbines (MGTs) for the propulsion of aerial vehicles holds specific advantages. Previous investigations looked at the development of a small diameter compressor and turbine stage that could typically be used in a MGT.



This project will investigate the rotor dynamics of the shaft of a typical MGT and consider the possible re-design of such a shaft. Specific consideration will be given to the bearing lay-out of the shaft, as well as its manufacturing and installation.

Spesifieke voorvereistes: / *Specific requirements*:
Meganiese ing.
CFD 414

Befondsing beskikbaar / *Funding available:*
Volle projekkostes en beursgelde (onderhewig aan bevestiging vanaf die WNNR)

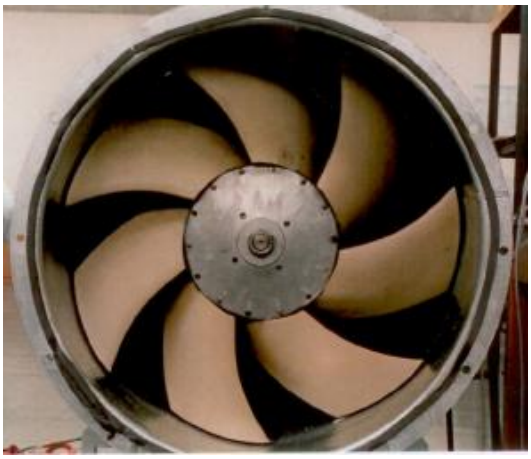
PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr SJ van der Spuy & Prof TW von Backström

TITEL / *TITLE:*
Axial flow fan blade sweep angle

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:



Blade sweep has been used in axial flow fans to reduce noise and improve efficiency. The proposed study comprises the systematic experimental and computational investigation of the effects of axial, circumferential and chord-wise sweep on axial fan performance and noise.

Spesifieke voorvereistes: / *Specific requirements*:
Meganiese ing.
CFD and FEM 414

Befondsing beskikbaar / *Funding available:*
Project costs

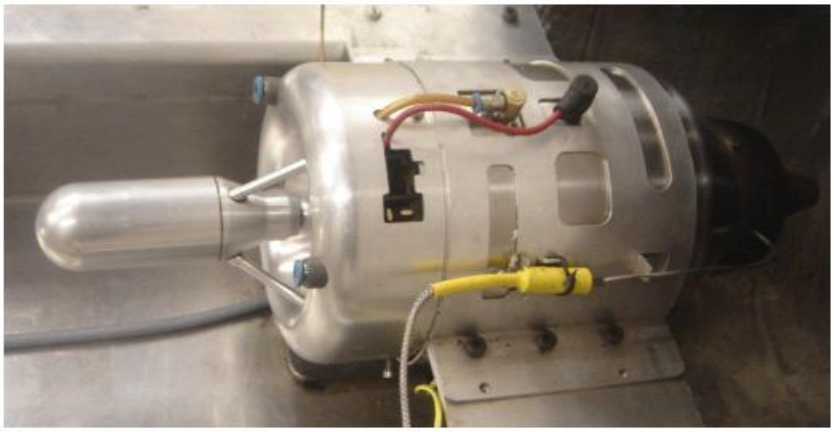
PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr SJ van der Spuy

TITEL / *TITLE:*
The manufacturing of the compressor stage of a micro gas turbine

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
The use of micro gas turbines (MGTs) for the propulsion of aerial vehicles holds specific advantages. Previous investigations looked at the development of a small diameter compressor and turbine stage that could typically be used in a MGT.



This project will re-consider the previous developments but take into account the operating envelope of the MGT and design the compressor stage accordingly. Specific consideration will be given to the meridional flow path of the compressor impeller. The project will require the modelling, manufacturing and testing of the compressor stage, where applicable.

Spesifieke voorvereistes: / *Specific requirements*:
Meganiese ing.
CFD and FEM 414

Befondsing beskikbaar / *Funding available:*
Volle projekkostes en beursgelde (onderhewig aan bevestiging vanaf die WNNR)

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Prof TW von Backström

ONDERWERP / *TITLE:*
The effect of inlet guide vanes on the performance of power station cooling fans

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Undergraduate students have started to develop inlet guide vanes to be fitted to power station cooling fans. The objective is to reduce the fan power consumption or marginally increase the power station output. The inlet guide vanes to be developed must be aimed at the fans in an existing cooling system. The work includes analytical and computational flow prediction, design of model fans and experimental and CFD investigation of model fans.

Spesifieke voorvereistes: / *Specific requirements*:
CFD module

Befondsing beskikbaar / *Funding available:*
Yes, maybe, for South African citizens.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**	X		

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Mr RT Dobson

TITEL / *TITLE:*
CO_2 based natural circulation loops

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:

1. CO_2 based natural circulation loops. Compared to water, CO_2's relatively high density at high temperatures and pressures (for instance at 550 ^oC and 20 MPa) makes it significantly more efficient as a working fluid for transcritical power generation, and also much smaller physically sized pipes and turbo machinery can be used. It is claimed that a CO_2 cycle can reduce fossil fuel consumption of a closed Brayton cycle by at least 40%, compared with helium and nitrogen! It can also be used in the process industries instead of the terribly ozone depletion potential of synthetic solvents. CO_2 thus needs be regarded as a working fluid of choice. Three specific topics have been identified as being on importance here: i) the mathematical modelling of the thermofluid behaviour of the CO_2 in a heat transfer loop, ii) the use of a vortex tube to enhance the thermal performance of a CO_2 refrigeration system, and iii) determination of the in-tube convection heat transfer coefficient for a CO_2 refrigeration plant gas coolers, condensers and evaporators.

Adequate funds are available for bursaries (and scholarships) and equipment

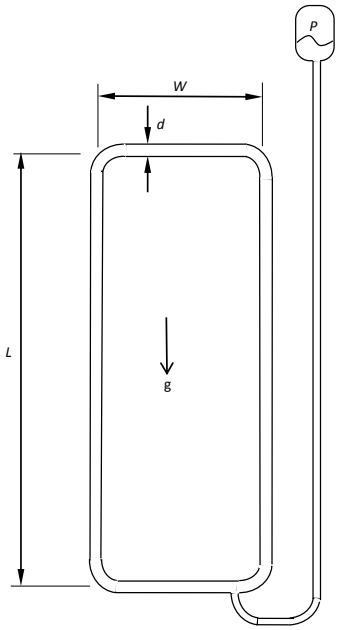


Figure 1. Constant pressure closed loop natural circulation-thermosyphon-type heat

Spesifieke voorvereistes: / *Specific requirements*:
None

Befondsing beskikbaar / *Funding available:*
Adequate funding for bursaries (and scholarships) and equipment is available

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

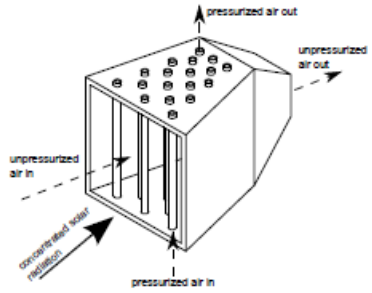
Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr Jaap Hoffmann

ONDERWERP / *TITLE:*
Heat Transfer Enhancements on the In- and Outside of Tubes in a Solar Air Receiver

Beskrywing van onderwerp / navorsingsveld: / *Description of topic / research field:*
The Solar Thermal Energy Research Group (STERG) at Stellenbosch University is pursuing novel approaches to develop cost effective, highly efficient solar receiver systems. One manifestation of such a system is the Hybrid Pressure Air Receiver (HPAR) concept, developed by Kretzschmar and Gauche (2012). The HPAR is a tubular receiver for concentrated solar radiation, which is cooled with air flows at two different pressure levels: Inside the tubes flows pressurized air and on the outside ambient air. Because of the disadvantageous heat transfer properties of air, enhancements to the smooth tube design are required. The outside further has to be suited to absorb high radiation fluxes with minimal losses.
The scope of this research is to:

- Investigate available heat transfer enhancements for the inside and outside of tubes.
- Design a tube employing both enhancements.
- Develop a thermal model of a tube and/or a bundle of tubes (for example, CFD).
- Experimentally validate the model.



Sketch of the HPAR (courtesy of H. Kretzschmar).

Spesifieke voorvereistes: / *Specific requirements*:
CFD strongly recommended.

Befondsing beskikbaar / *Funding available:*
Limited funding for experimental work only.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr Jaap Hoffmann/Prof G Venter

ONDERWERP / *TITLE:*
Structural Investigation of a Solar Air Receiver

Beskrywing van onderwerp / navorsingsveld: / *Description of topic / research field:*
The Solar Thermal Energy Research Group (STERG) at Stellenbosch University is pursuing novel approaches to develop cost effective, highly efficient solar receiver systems. One manifestation of such a system is the Hybrid Pressure Air Receiver (HPAR) concept, developed by Kretzschmar and Gauche (2012). As it is used to heat pressurized air in a Brayton cycle, high material temperatures (above 900 °C) are expected at elevated pressures. Additionally, most components of the receiver undergo extensive thermal cycling and experience high temperature gradients due to the intermittent nature of solar energy and the irradiation's angle of incidence, respectively.

The scope of this research is to:

- Develop a preliminary design of structurally challenging components, for example, the link between pipes and containment.
- Model the preliminary design and identify areas of maximum stresses.
- Experimentally validate the model.
- Improve the design under consideration of optical/thermal requirements.

Spesifieke voorvereistes: / *Specific requirements*:
FEA strongly recommended.

Befondsing beskikbaar / *Funding available:*
Limited funding for experimental work.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr Jaap Hoffmann

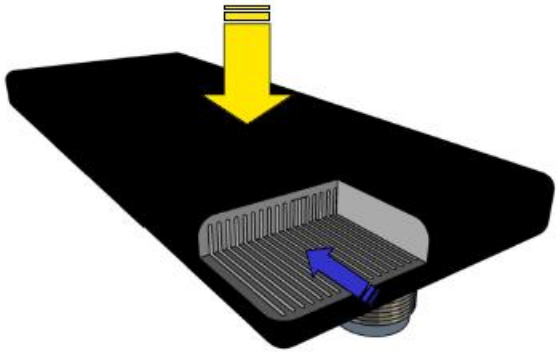
ONDERWERP / *TITLE:*
Ceramic Plate Solar Air Receiver

Beskrywing van onderwerp / navorsingsveld: / *Description of topic / research field:*

The Solar Thermal Energy Research Group (STERG) at Stellenbosch University is pursuing novel approaches to develop cost effective, highly efficient solar receiver systems. One concept of such a system is based on ceramic plates as the solar absorber, that allows for high operating temperatures and stress resistance. Optical and thermal efficiencies are enhanced by geometry, material properties and system design.

The scope of this research is to:

- Investigate the heat transfer from the absorber into the air.
- Build a thermal model of a test receiver.
- Experimentally validate the model.
- Evaluate the state of the art in ceramic technology. Investigate in manufacturing possibilities.



Example of a ceramic plate receiver module (Jensch et al., 2012).

Spesifieke voorvereistes: / *Specific requirements*:
CFD strongly recommended.

Befondsing beskikbaar / *Funding available:*
None

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr Jaap Hoffmann

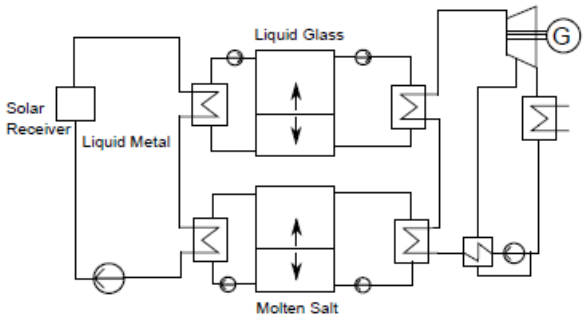
ONDERWERP / *TITLE:*
Liquid glass cycle

Beskrywing van onderwerp / navorsingsveld: / *Description of topic / research field:*

Concentrating Solar Power (CSP) plants are foreseen to contribute considerably to future electricity generation in South Africa and the rest of the world. Much of today's research in the CSP community is focused on efficiency improvement by raising thermodynamic cycles' operating temperature. However, to achieve this, high-temperature heat transfer and storage media are necessary. One conceivable high-temperature CSP cycle utilizes a cascaded thermal energy storage system with liquid glass as the high-temperature storage medium. The lower-temperature storage medium could, for example, be state of the art molten salt and the heat transfer medium could be a liquid metal, for example, sodium or a sodium-potassium alloy. An appropriate working medium in the power block could, for example, be Advanced Ultra Supercritical Steam, supercritical CO2 or air.

The scope of this research is to:

- Analyze media's thermophysical properties and choose appropriate ones.
- Investigate heat transfer between the media.
- Predict the potential of the cycle in terms of overall efficiency and cost.



Scheme of the CSP cycle employing a cascaded thermal energy storage system.

Spesifieke voorvereistes: / *Specific requirements*:
None

Befondsing beskikbaar / *Funding available:*
None

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr Jaap Hoffmann

ONDERWERP / *TITLE:*
Modelling thermal radiation in a porous medium

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
A promising concept for solar receiver is a quarts tube, filled with a porous medium. Solar radiation passes through the quarts, and is trapped in the porous medium. Heat is transfer from the porous medium to air flowing through the tube. Infra-red radiation is trapped inside the tube (greenhouse effect). A validated model is required to predict heat transfer (thermal radiation, convection, conduction?) in the porous medium.

Spesifieke voorvereistes: / *Specific requirements*:
None

Befondsing beskikbaar / *Funding available:*
Limited funding for experimental work.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**	X		

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Mr RT Dobson

TITEL / *TITLE:*
Stand-alone (off-grid) solar Stirling dish electrical power supply unit

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:

This objective of this project is to develop a stand-alone electrical power supply system for off-grid rural communities. The ultimate outcome of the project is to produce a locally manufactured knock-down do-it-yourself kit suitable for mass distribution throughout Africa. This is a relatively complex project requiring the use of a number of different disciplines.

The following projects have so far been identified:

5.1 Test and characterise the performance of a 25 $kW_{electrical}$ and 100 $kW_{thermal}$ Stirling engine 22 V 50 Hz power unit.

Cutaway of a free piston Stirling engine

5.2 Theoretically simulate, design manufacture and test a 3 kW free piston Stirling engine electrical power generating unit. (Ivan Deetlefs)

5.3 Construction and control of a 12 m^2 parabolic reflector dish for the free 3 kW free piston Stirling engine electrical power generating unit. (Gerro Prinsloo)

Reflector with power generator at focal point

5.4 Dynamic FEM structural analysis including fluctuating wind loading and structural optimisation

5.5 Make a 3 kW Eskom-grid compatible electrical supply unit.

5.6 The evaluation of a locally manufactured 3 kW solar Stirling dish system for African enlightenment.

5.7 Industrialization/commercialisation for local manufacture of a self-standing 3 kW electrical power system

5.8 CFD simulation and analysis of a Stirling Dish fluctuating under fluctuating wind conditions.

Spesifieke voorvereistes: / *Specific requirements*:
None

Befondsing beskikbaar / *Funding available:*
Adequate funding for bursaries (and scholarships) and equipment is available

PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**	X		

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Mr Paul Gauché, Prof Theo von Backström, Prof Hanno Reuter, Prof Albert Groenwold, Prof Gerhard Venter, Prof Frank Dinter, others (depending on topic suitability and availability)

TITEL / *TITLE:*
Concentrating solar power (CSP): Central receiver pilot plant component research

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
The SUNSPOT plant concept devised by Prof DG Kröger is a focus technology for the solar thermal energy research group. Research focuses on a proposed 5 MW pilot plant. Multiple projects will be available as listed here or elsewhere in the topic list.

Project 1: Thermal energy storage system using natural (eg. rock) or other sources. This project requires development of storage system concepts through theoretical and experimental work involving thermal cycling to about 600 °C. Modeling of system by fundamental analysis, DEM, CFD, Flownex or other tools. Experimental work using high temperature and flow facilities in the department and research group. Exploratory trips for materials may be required.
Project 2: Heliostat module optimization for cost based on any number of factors including structural, drivetrain, control, optical, wind loading, dual use and minimal impact of land. This project requires theoretical development/optimization as well as experimental validation using the solar roof laboratory. This project can be combined with a Sasol funded R500 000 heliostat field to be deployed in 2013.
Project 3: System thermal and thermodynamic modeling for a 5 MW SUNSPOT pilot plant. This project would be complimentary to an existing PhD project and look at more detail on the optimization of the receiver and/or storage system and/or hybridization with backup fuel. Experimental validation on some aspects may be required depending on the final objective.
Project 4: Heliostat ray tracing software development and validation continuing on a ray tracing tool developed in STERG. Parallelization, optimization and tuning for central receiver plants all potentially in scope.
Project 5: Performance evaluation of a specific low pressure air receiver. Performance modeling, design, manufacture and testing potentially in scope.

Spesifieke voorvereistes: / *Specific requirements*:
The student should be comfortable with computer programming for topics that require this. Most projects will require experimental work.

Befondsing beskikbaar / *Funding available:*
Funding for students is available from STERG for a limited number of students

PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**	X		

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Prof Thomas Harms, Prof Theo von Backström, Prof Frank Dinter, others (depending on topic suitability and availability)

TITEL / *TITLE:*
Concentrating solar power (CSP): Linear Fresnel reflector pilot plant research

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
The linear Fresnel reflector plant concept is another focus technology of the solar thermal energy research group. Research focuses on a proposed 2 MW pilot plant for the Western Cape but the technology has been identified for process heat use as well as for hybridization of existing coal power stations.

Project 1: Research and development of a direct steam receiver. Theoretical and experimental work is required to understand and control the two phase flow problem for saturated or superheated steam turbine application.
Project 2: Development of a linear Fresnel concentrator for process heat. This project is a continuation of an existing project that shows much promise.
Project 3: Power plant modeling to assess the suitability and requirements of a linear Fresnel collector field to augment energy to a conventional coal power station. This project is a continuation of a completed masters project that showed good promise.

Spesifieke voorvereistes: / *Specific requirements*:
The student should be comfortable with computer programming and experimental work.

Befondsing beskikbaar / *Funding available:*
Funding for students is available from STERG for a limited number of students

PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**	X		

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Prof Thomas Harms, Prof Theo von Backström, Mr Robert Dobson, Prof Frank Dinter, others (depending on topic suitability and availability)

TITEL / *TITLE:*
Concentrating solar power (CSP): Receiver and heat transfer fluid R&D

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
STERG is investigating several high temperature receiver concepts that work with air and perhaps other fluids like CO_2 or liquid metal. These concepts mostly relate to the SUNSPOT cycle. From 2014, STERG will deploy a receiver test facility that uses our 18m tower and Helio40 heliostat facility.Various topics are available that relate to the development and optimization of our receiver concepts and investigations into best or appropriate heat transfer mechanisms.

Spesifieke voorvereistes: / *Specific requirements*:
The student should be comfortable with computer programming and experimental work.

Befondsing beskikbaar / *Funding available:*
Funding for students is available from STERG for a limited number of students

PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**	X		

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Paul Gauche, Prof Theo von Backström , Prof Albert Groenwold, Prof Frank Dinter, others (depending on topic suitability and availability).

TITEL / *TITLE:*
Concentrating solar power (CSP): Scenario modeling for short to long term rollout of CSP in SA

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
CSP is one of the three major renewables in the South African integrated resource plan. In order for transmission and resource planning, scenario modeling is becoming increasingly important. These scenarios require a variety of disciplines and methods to be considered. These projects are by nature theoretical (typically limited or no experimental work).

Project 1: Scenario modeling with a focus on thermodynamics of plants but including consideration of other key resources and constraints. Use of geographic information systems (GIS) will be part of the modeling. Strategic assumptions for the future will be required.
Project 2: Mathematical robustness and optimization modeling considering the resources and constraints mentioned for Project 1 above.

Spesifieke voorvereistes: / *Specific requirements*:
The student should be comfortable with computer programming.

Befondsing beskikbaar / *Funding available:*
Funding for students is available from STERG for a limited number of students

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
TW von Backström, DG Kröger

ONDERWERP / *TITLE:*
Manufacturing, design, construction and testing of a pressurized central receiver system

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
A combined cycle (CC) concentrating solar power (CSP) plant provides significant potential to achieve efficiency increase and electricity cost reduction compared to current single-cycle plants. The SUNSPOT cycle (Kröger, 2012) is one manifestation of a CC plant, proposed for the South African environment.

A CC CSP system requires a receiver technology, capable of effectively transferring heat from concentrated solar irradiation to a pressurized air stream. The small number of pressurized air receivers demonstrated to date have practical limitations, when operating at high temperatures and pressures. As yet, a robust, scalable and efficient system has to be developed and commercialized. A novel receiver system, the **S**piky **C**entral **R**eceiver **A**ir **P**re-heater (SCRAP) concept has been proposed by Kröger (2008) to comply with these requirements.

Adding to other research conducted on the SCRAP receiver in parallel, this project targets to overcome the mechanical challenges associated with an environment of high temperatures, high pressure, thermal shock and vibration. The selection of materials suitable for the operating conditions of the receiver is of importance and will reflect on the manufacturing procedure to be developed for the complicated receiver structure. The project further includes the mechanical design aspects of the receiver. Following will be the construction of a test system, and conduction of tests.

Spesifieke voorvereistes: / *Specific requirements*:

Befondsing beskikbaar / *Funding available:*
Yes, for South Africans

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
TW von Backström, DG Kröger

ONDERWERP / *TITLE:*
Minimization of convective heat losses of a central receiver system

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
A combined cycle (CC) concentrating solar power (CSP) plant provides significant potential to achieve efficiency increase and electricity cost reduction compared to current single-cycle plants. The SUNSPOT cycle (Kröger, 2012) is one manifestation of a CC plant, proposed for the South African environment.

A CC CSP system requires a receiver technology, capable of effectively transferring heat from concentrated solar irradiation to a pressurized air stream. The small number of pressurized air receivers demonstrated to date have practical limitations, when operating at high temperatures and pressures. As yet, a robust, scalable and efficient system has to be developed and commercialized. A novel receiver system, the **S**piky **C**entral **R**eceiver **A**ir **P**re-heater (SCRAP) concept has been proposed by Kröger (2008) to comply with these requirements.

Adding to other research conducted on the SCRAP receiver in parallel, this project targets to reduce the natural convective heat losses and forced convective heat losses inflicted by ambient conditions.

A SCRAP receiver system will serve as the base-line for the study. In a first step the gain of adding wind-walls will be investigated. Further, a number of possibilities of utilizing high-temperature resisting quartz-glass will be pursued. The improvement of receiver efficiency is target of the research. In addition, overheating of the quartz glass needs to be avoided. The project will require good heat transfer skills, the development of sound understanding of optical reflection, refraction and absorption as well as the manufacturing processes and limitations of the quartz-glass. A systems model may be a combination of CFD software with a ray-tracer for the optical part of the study.

Spesifieke voorvereistes: / *Specific requirements*:

Befondsing beskikbaar / *Funding available:*
Yes, for South Africans

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
TW von Backström, DG Kröger

ONDERWERP / *TITLE:*
Design, construction and testing of a complete rock-bed thermal energy storage system

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Small-scale (say 1 – 3 tons of rock) design & construction of a practical thermal storage system/unit, with containment, full insulation, air inlet and outlet ducting.
Install measurement instrumentation (thermocouples and pressure taps) and measure performance characteristics at a temperature of at least 300 degC, preferably 500 degC.

This would require advance planning as to the thermal source for heating the bed – additional piping from the existing high temperature unit?

Spesifieke voorvereistes: / *Specific requirements*:

Befondsing beskikbaar / *Funding available:*
Yes, for South Africans

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			
Afdeling / *Division:* Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy			
Dosent / *Lecturer:* ***TW von Backström, DG Kröger***			
ONDERWERP / *TITLE:* **Investigation of the effect of radiation on the temperature profile in a rock bed**			
Beskrywing van onderwerp / navorsingsveld: ***Description of topic / research field:*** High temperature (400 – 600 deg C) testing in the test rig to determine the influence of radiation on heat transfer and temperature profile in the bed. How does the thermo cline region change/move as a consequence of radiation and conduction when there is no airflow through the bed? (i.e. how does the high temperature region degrade due to heat transfer into cooler regions of the bed.) Testing of different rock sizes - we have already have 26 and 50 mm rock, and some 13 mm.			
Spesifieke voorvereistes: / *Specific requirements*:			
Befondsing beskikbaar / *Funding available:* Yes, for South Africans			

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
TW von Backström

ONDERWERP / *TITLE:*
Design and construction of new impeller for existing automotive gas turbine

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Current master's students are investigating the performance of a gas turbine designed long ago to power a motor car. The objective is to ultimately develop a solar powered gas turbine. To achieve that the compressor rotor should be redesigned to generate a higher pressure ratio at an increased efficiency. Compressor analysis software and CFD will be used. The objective is to manufacture and install the rotor in the existing turbine and examine its performance experimentally.

Spesifieke voorvereistes: / *Specific requirements*:
CFD module

Befondsing beskikbaar / *Funding available:*
Yes, maybe, for South African citizens.

PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr Corné Coetzee

TITEL / *TITLE:*
The Modelling of Granular Materials

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:

Granular flow occurs in a broad spectrum of industrial applications that range from separation and mixing in the pharmaceutical industry, to grinding and crushing, blasting, stockpile construction, generic flows in and from hoppers, conveyer belts, agricultural implements and many more. The processing of granular material consumes roughly 10% of all the energy produced on this planet. As such, any advance in understanding the physics of granular material is bound to have a major economic impact. Two methods are used to model granular behaviour: The Discrete Element Method (DEM) and the Material-Point Method (MPM). **Application areas:** agricultural- and mining industries**,** renewable energy.

Mining application of the Discrete Element Method (DEM). This includes the calibration of material properties as well as the modelling of typical mining processes such as the flow of ore on conveyor belts, transfer points and hoppers. The aim of such a study would be to optimise the process in terms of mass flow rates, wear and spillage. Students holding a bursary from a mining company, and who would like to continue with a Masters study, can suggest any research topic of interest to them. The modelling of thermal rock beds for renewable energy applications is another project where DEM can be used. Energy is stored in rock beds and extracted when needed.

Agricultural application of the Discrete Element Method (DEM). DEM can be used to model fruit handling during the harvesting process as well as post-harvest. Models to predict impact damage and bruising needs to be developed and included in the DEM code. The model can then be used to model a specific harvesting and fruit handling process with the aim of improving fruit quality. The focus will be on the harvesting machines, fruit handling machines and the packaging.

The development of MPM software. The main aim of the project is the development of Material Point Method (MPM) software. MPM is a so-called meshless finite element method which can easily handle large deformation without severe mesh distortion. This project is for those interested in programming, solid mechanics and finite element methods. There is the opportunity for the student to visit Europe universities for a couple of months. The study would include software development as well as testing and validation.

Spesifieke voorvereistes: / *Specific requirements*:

Befondsing beskikbaar / *Funding available:*
Funding is being negotiated; if successful it will be possible to support 1 MEng Research and 1 PhD student.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr WJ Smit

ONDERWERP / *TITLE:*
Autonomous ground vehicle for use in a concentrated solar power plant

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Autonomous ground vehicles (AGVs) can be used in concentrated solar power plants (and other environments) to do routine checks and basic maintenance. A post-graduate student is currently building the first version of an AGV for this purpose.

The aim of *this* project is to improve on the first version. Improvements will include: (1) extending the Simultaneous Localization and Mapping (SLAM) algorithm to operate in an environment that also considers the movement of people and and other vehicles; (2) improve on the path-planning of the robot; (3) improve on the sensors and how sensor-information is incorporated in the algorithms.

Spesifieke voorvereistes: / *Specific requirements*:
Good programming skills and a an appreciation for mathematics.

Befondsing beskikbaar / *Funding available:*
Funding is available.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr WJ Smit

ONDERWERP / *TITLE:*
Calibrating a heliostat with a set of lasers and receivers

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Heliostats are mirrors that reflect the radiation of the sun onto a target. The orientation of the heliostat needs to be controlled continuously as the sun moves. Usually open-loop control is used since closed-loop control is difficult as there are hundreds or thousands of mirrors that reflect radiation onto the same target. An open-loop controller requires that the heliostat be calibrated. Calibration is the process of accurately determining a few critical parameters (such as pedestal axis tilt).
This project investigates how a heliostat can be calibrated using lasers and receivers located around a heliostat field.

Spesifieke voorvereistes: / *Specific requirements*:

Good programming skills and a an appreciation for mathematics.

Befondsing beskikbaar / *Funding available:*

Funding is available.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
<u>Design & Mechatronics</u> / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr WJ Smit

ONDERWERP / *TITLE:*
Modelling a heliostat with a neural network

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Heliostats are mirrors that reflect the radiation of the sun onto a target. The orientation of the heliostat needs to be controlled continuously as the sun moves. Usually open-loop control is used since closed-loop control is difficult as there are hundreds or thousands of mirrors that reflect radiation onto the same target. An open-loop controller requires an accurate model of the heliostat.
If the heliostat is manufactured and installed accurately, then an accurate model can be derived once the heliostat is calibrated. However, the model needs to be learned if cheaper manufacturing and installation processes are followed. This project investigates how neural networks can be used to learn the model of a heliostat, so that the learned model can be used in open-loop control of the heliostat.

Spesifieke voorvereistes: / *Specific requirements*:
Good programming skills and a an appreciation for mathematics.

Befondsing beskikbaar / *Funding available:*
Funding is available.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			
Afdeling / *Division:* **Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy**			
Dosent / *Lecturer:* ***Dr WJ Smit***			
ONDERWERP / *TITLE:* **Unmanned aerial vehicle for use in a concentrated solar power plant**			
Beskrywing van onderwerp / navorsingsveld: ***Description of topic / research field:*** Unmanned aerial vehicles (UAVs) can be used in concentrated solar power plants to do routine inspections of mirrors. A typical heliostat field in a 100MW plant will have more than 4000 mirrors. A UAV is ideally suited to identify dirty mirrors. These mirrors can then be washed by hand. This project will use an existing quad-rotor platform, add additional sensors to it and improve the existing control system. It should be able to autonomously take photographs of mirrors in a heliostat field.			
Spesifieke voorvereistes: / *Specific requirements*: A good understanding of control theory.			
Befondsing beskikbaar / *Funding available:* Funding is available.			

PhD:	X	**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division: (please underline which is applicable)*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr Corné Coetzee

TITEL / *TITLE:*
The Modelling of Granular Materials

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:

Granular flow occurs in a broad spectrum of industrial applications that range from separation and mixing in the pharmaceutical industry, to grinding and crushing, blasting, stockpile construction, generic flows in and from hoppers, conveyer belts, agricultural implements and many more. The processing of granular material consumes roughly 10% of all the energy produced on this planet. As such, any advance in understanding the physics of granular material is bound to have a major economic impact. Two methods are used to model granular behaviour: The Discrete Element Method (DEM) and the Material-Point Method (MPM). **Application areas:** agricultural- and mining industries**,** renewable energy.

Mining application of the Discrete Element Method (DEM). This includes the calibration of material properties as well as the modelling of typical mining processes such as the flow of ore on conveyor belts, transfer points and hoppers. The aim of such a study would be to optimise the process in terms of mass flow rates, wear and spillage. Students holding a bursary from a mining company, and who would like to continue with a Masters study, can suggest any research topic of interest to them. The modelling of thermal rock beds for renewable energy applications is another project where DEM can be used. Energy is stored in rock beds and extracted when needed.

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The development of MPM software. The main aim of the project is the development of Material Point Method (MPM) software. MPM is a so-called meshless finite element method which can easily handle large deformation without severe mesh distortion. This project is for those interested in programming, solid mechanics and finite element methods. There is the opportunity for the student to visit Europe universities for a couple of months. The study would include software development as well as testing and validation.

Spesifieke voorvereistes: / *Specific requirements*:

Befondsing beskikbaar / *Funding available:*
Funding is being negotiated; if successful it will be possible to support 1 MEng Research and 1 PhD student.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr WJ Smit

ONDERWERP / *TITLE:*
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Beskrywing van onderwerp / navorsingsveld:
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Spesifieke voorvereistes: / *Specific requirements*:
Good programming skills and a an appreciation for mathematics.

Befondsing beskikbaar / *Funding available:*
Funding is available.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr WJ Smit

ONDERWERP / *TITLE:*
Calibrating a heliostat with a set of lasers and receivers

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Heliostats are mirrors that reflect the radiation of the sun onto a target. The orientation of the heliostat needs to be controlled continuously as the sun moves. Usually open-loop control is used since closed-loop control is difficult as there are hundreds or thousands of mirrors that reflect radiation onto the same target. An open-loop controller requires that the heliostat be calibrated. Calibration is the process of accurately determining a few critical parameters (such as pedestal axis tilt).
This project investigates how a heliostat can be calibrated using lasers and receivers located around a heliostat field.

Spesifieke voorvereistes: / *Specific requirements*:
Good programming skills and a an appreciation for mathematics.

Befondsing beskikbaar / *Funding available:*
Funding is available.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			

Afdeling / *Division:*
<u>Design & Mechatronics</u> / Mechanics / Thermo fluids / Renewable Energy

Dosent / *Lecturer:*
Dr WJ Smit

ONDERWERP / *TITLE:*
Modelling a heliostat with a neural network

Beskrywing van onderwerp / navorsingsveld:
Description of topic / research field:
Heliostats are mirrors that reflect the radiation of the sun onto a target. The orientation of the heliostat needs to be controlled continuously as the sun moves. Usually open-loop control is used since closed-loop control is difficult as there are hundreds or thousands of mirrors that reflect radiation onto the same target. An open-loop controller requires an accurate model of the heliostat.
If the heliostat is manufactured and installed accurately, then an accurate model can be derived once the heliostat is calibrated. However, the model needs to be learned if cheaper manufacturing and installation processes are followed. This project investigates how neural networks can be used to learn the model of a heliostat, so that the learned model can be used in open-loop control of the heliostat.

Spesifieke voorvereistes: / *Specific requirements*:
Good programming skills and a an appreciation for mathematics.

Befondsing beskikbaar / *Funding available:*
Funding is available.

PhD:		**MIng Navorsing Tesis onderwerp:** ***MEng Research Thesis topic:***	X
MIng Gestruktureerd Projek: ***MEng Structured Project*:**			
Afdeling / *Division:* **Design & Mechatronics / Mechanics / Thermo fluids / Renewable Energy**			
Dosent / *Lecturer:* ***Dr WJ Smit***			
ONDERWERP / *TITLE:* **Unmanned aerial vehicle for use in a concentrated solar power plant**			
Beskrywing van onderwerp / navorsingsveld: ***Description of topic / research field:*** Unmanned aerial vehicles (UAVs) can be used in concentrated solar power plants to do routine inspections of mirrors. A typical heliostat field in a 100MW plant will have more than 4000 mirrors. A UAV is ideally suited to identify dirty mirrors. These mirrors can then be washed by hand. This project will use an existing quad-rotor platform, add additional sensors to it and improve the existing control system. It should be able to autonomously take photographs of mirrors in a heliostat field.			
Spesifieke voorvereistes: / *Specific requirements*: A good understanding of control theory.			
Befondsing beskikbaar / *Funding available:* Funding is available.			