



## Route planning for trucks in delivery tasks

### Project description

It is envisioned that in the years to come, unmanned aerial vehicles (UAVs) will be used for delivering goods in combination with trucks by the logistic companies. We aim at building distributed route planning algorithms for trucks such truck-UAV teams.

### Subject of design

Optimization of delivery time through routing design for transportation tasks

### Field of knowledge

Distributed optimization and decision making

### Stakeholder company

Logistic companies





## Route planning for UAVs in delivery tasks

### Project description

It is envisioned that in the years to come, unmanned aerial vehicles (UAVs) will be used for delivering goods in combination with trucks by the logistic companies. We aim at building distributed route planning algorithms for UAVs in such truck-UAV teams.

### Subject of design

Optimization of delivery time through routing design for transportation tasks

### Field of knowledge

Distributed optimization and decision making

### Stakeholder company

Logistic companies



English required



## Optimize the number of trucks for delivery tasks

### Project description

It is envisioned that in the years to come, unmanned aerial vehicles (UAVs) will be used for delivering goods in combination with trucks by the logistic companies. We aim at develop algorithms to optimize the number of trucks of such truck-UAV teams for given delivery tasks.

### Subject of design

Optimization of the numbers of trucks for transportation tasks

### Field of knowledge

Distributed optimization and decision making

### Stakeholder company

Logistic companies



English required



## Optimize the number of UAVs for delivery tasks

### Project description

It is envisioned that in the years to come, unmanned aerial vehicles (UAVs) will be used for delivering goods in combination with trucks by the logistic companies. We aim at develop algorithms to optimize the number of UAVs of such truck-UAV teams for given delivery tasks.

### Subject of design

Optimization of the numbers of UAVs for transportation tasks

### Field of knowledge

Distributed optimization and decision making

### Stakeholder company

Logistic companies



English required





## Task assignment for unmanned aerial vehicles

### Project description

It is envisioned that in the years to come, unmanned aerial vehicles (UAVs) will be used for delivering goods by the logistic companies. We aim at building distributed task assignment algorithms for UAVs that have to visit multiple target locations.

### Subject of design

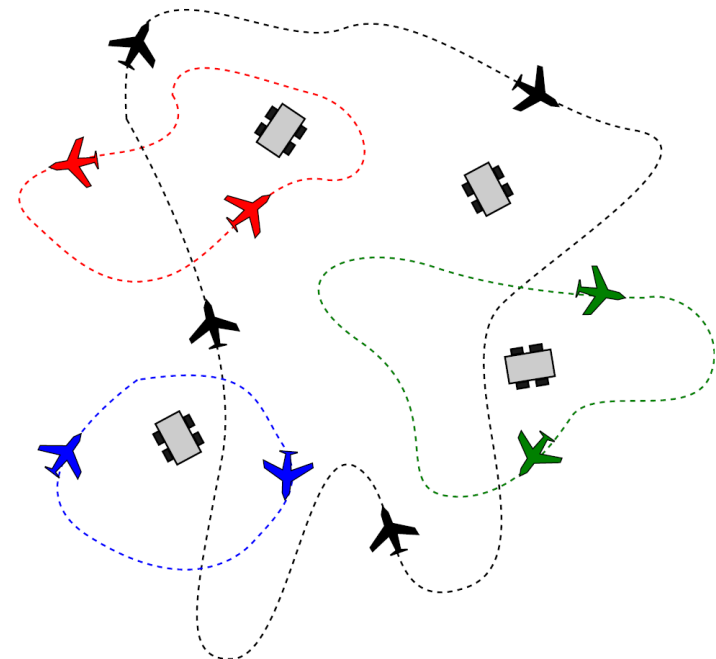
Optimization of delivery time through changing task assignment

### Field of knowledge

Distributed optimization and decision making

### Stakeholder company

Logistic companies



English required



## Task assignment for a UAV in a time-varying field

### Project description

It is envisioned that in the years to come, unmanned aerial vehicles (UAVs) will be used for delivering goods by the logistic companies. We aim at building a navigation rule for a UAV moving in a wind field that may change with time.

### Subject of design

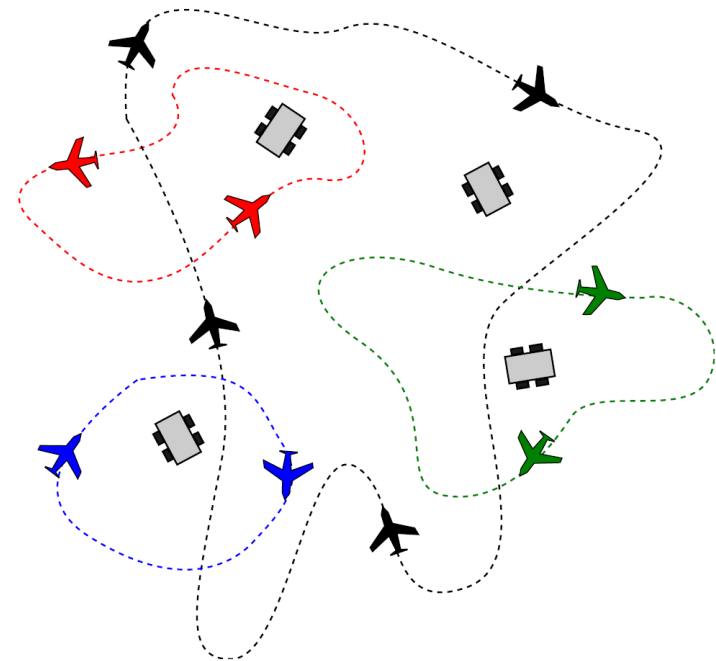
Optimization of delivery time through changing task assignment

### Field of knowledge

Distributed optimization and decision making

### Stakeholder company

Logistic companies



English required



## Design of drone-based warehouse cycle counting

### Project description

Cycle counting is an inventory auditing procedure for inventory management where the warehouse operator check regularly the physical goods in all location. This process is typically done manually and a costly procedure. A new solution is being developed at Arox Logistics where an automated drone (or groups of drones) can replace the costly manual labor work.

### Subject of design

Project design plan. It includes the typical mechatronics design V-plan and analysis of the design.

### Field of knowledge

Mechatronics, systems engineering

### Stakeholder company

Arox Logistics B.V.  
<http://www.arox.nl/>





## Mobile robots for flexible manufacturing systems

### Project description

In order to provide adaptability in a future flexible manufacturing system, the use of cooperative mobile robots (such as, Nexus mobile robots shown in the figure) is very promising. These robots can be smartly deployed in a flexible manufacturing line, catering for product variations.

### Subject of design

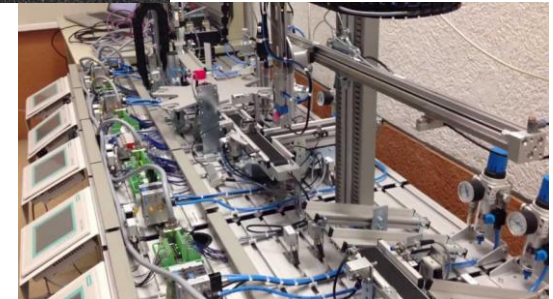
Design a use-case for the deployment of mobile robots in a flexible manufacturing setting, using also the Festo system in the lab.

### Field of knowledge

Control theory, Mechatronics

### Stakeholder company

Region of Smart Factories  
<http://www.rosf.nl/>







## Friction modeling & identification in Ocean Grazer

### Project description

In order to provide an accurate estimate the efficiency of a small-scale prototype of Ocean Grazer power take-off system in the lab, the previous bachelor IP project has identified that an accurate model of friction forces is needed. The ability to model and identify the parameters for such friction forces will enable us to estimate the real wave energy extraction.

### Subject of design

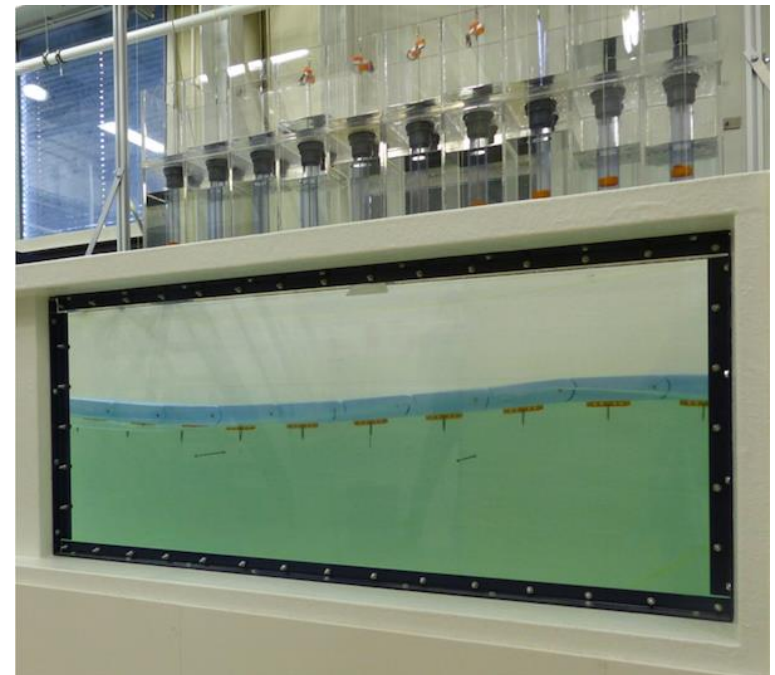
Model of the friction based on experimental data

### Field of knowledge

Control theory, Mechatronics

### Stakeholder company

Ocean Grazer group  
<http://www.oceangrazer.com>





## Modeling of novel material for smart optics

### Project description

Deformable mirrors enable active correction of large optical systems. A novel smart optics is currently being developed by the Dutch Space Research Institute, Engineering and Technology Institute and Zernike Institute for Advanced Materials using piezoelectric material.

### Subject of design

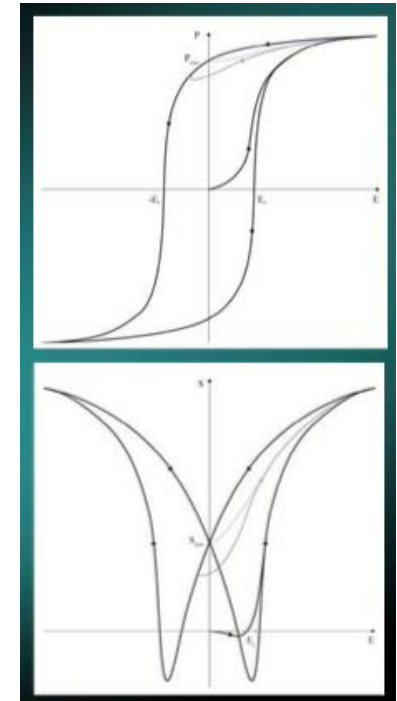
Hysteresis characterization (modeling and system identification) of novel piezoelectric material built in the lab.

### Field of knowledge

Control theory, Mechatronics

### Stakeholder company

Dutch Space Research Institute  
<http://www.sron.nl>





## Design of a robotic arm pose measurement system

### Project description

In order to provide adaptability in a future flexible manufacturing system, the use of cooperative mobile robots (such as, Nexus mobile robots shown in the figure) is very promising. These robots can be smartly deployed in a flexible manufacturing line, catering for product variations.

### Subject of design

Using open source toolbox for Kinect sensor, implement algorithm for measuring the kinematics of robotic arm.

### Field of knowledge

Control theory, Mechatronics

### Stakeholder company

Region of Smart Factories  
<http://www.rosf.nl/>





## Smart tooling system design using piezo-actuator

### Project description

In order to provide adaptability in a future flexible manufacturing system, Philips Drachten has designed a smart actuated tooling system that can adapt to the material and environmental variation in real-time. The current design includes the usage of a vision system, a motorized actuator and a simple closed-loop controller.

### Subject of design

In this project, we will retrofit / redesign the actuator in the tooling system by using a piezo-actuator system for increasing the accuracy of the tooling system.

### Field of knowledge

Control theory, Mechatronics

### Stakeholder company

Philips Drachten and Region of Smart  
Factories <http://www.rosf.nl/>



cutting

deep drawing

forging

bending



## Energy Transition: all-electric school building

### Project description

Use of DC power over AC might lead to significant energy savings. This supports the transition to all electric utility buildings, in this case with focus on a self sufficient school.

This requires a new design of the energy distribution & storage in the buildings. Furthermore all (electric) devices need to be adjusted to this new energy source.

### Subject of design

Design of the energy changeover towards all electric.

### Field of knowledge

Energy, cost & benefit quantification

### Stakeholder company

Entrance – Hanze  
Homij – technische installaties



English *not* required





## Sustainability contest: transparent wood versus glass

### Project description

Transparent wood is clear enough to be used in several applications like solar panels and semi-transparent windows and walls. Making wood transparent requires chemical treatment. The sustainability comparison to glass is yet unknown.

What is the integral balance of transparent wood versus glass?

### Subject of design

Design the two systems for glass and transparent wood production and usage.  
Compare them on sustainability.

### Field of knowledge

Sustainability, integral analysis

### Stakeholder company

Entrance - Hanze



English *not* required



## Recycling of polyester waste boats

### Project description

Plastic soup is a serious challenge. Next to cleaning we should stop further growing of plastics in the sea. One such option is in recycling of polyester waste boats. Currently no good insights exist in how to arrange this from a chemical, development, chain and business perspective.

This project aims at investigating the basis for a design of a system to recycle polyester boats. A solution should preferably be applicable in to 3<sup>rd</sup> world countries

### Subject of design

Design the basic system setup for recycling polyester boats including estimated cost & benefit analysis.

### Field of knowledge

material separation, cost & benefits analysis,  
recycling

### Stakeholder company

International Maritime  
Organization



English *not* required



## Shipping in ports: emission models

### Project description

Groningen Seaports conducted a research to emission on ship engines while docked at the harbor. This has been compared to using shore power.

The developed model is for static analysis only and is partly outdated.

The goal is to develop a more continuous (live) monitoring or dashboard of the emission at the harbor.

### Subject of design

Design a dashboard on the emission by ships at the harbor.

### Field of knowledge

ICT, emissions, shore power, ship power supply

### Stakeholder company

Groningen Seaports



**GRONINGEN SEAPORTS**



English *not* required



## Occupancy planning at University of Groningen

### Project description

Smart and sustainable building is a goal in university policy. However the occupancy of offices, classrooms and labs is rather low. Small groups are planned in large classrooms; vacant workshop rooms and places for scarce flex workers can only be found by intermediates etc. Optimization of workplace utilization is required to introduce and facilitate new ways of working and learning.

### Subject of design

Explore and design an ICT system for workplace occupancy optimization at UoG

### Field of knowledge

ICT, spatial planning

### Stakeholder company

University of Groningen, HSE  
Services



English optional



## Light over Leek

### Project description

The potential for innovation in public lighting is huge. A variety of street light designs and LED armatures allows energy savings, improving public safety, avoiding light pollution etc.

The municipality of Leek has the ambition and policy to modernize local public lighting. The municipality needs your expertise on the potential, pro/cons and costs of innovative systems.

### Subject of design

Design a public lighting (investment) plan for the municipality of Leek.  
(Your focus is open for discussion)

### Field of knowledge

Lighting technology, energy efficiency, sustainability, public safety perception

### Stakeholder company

Municipality of Leek

gemeente Leek



English *not* required





## Reducing trafficjam by smart engineering:

### Project description

Rijkswaterstaat (RWS) a department of the Ministry of Infrastructure and Environment is heading with increasing delays caused by traffic jams. There are two main causes :  
Stochastically, due to an accident the lane of a motorway has to be closed suddenly: Deterministically, due to a structural end of a lane. The principle method get in lane by zipping is not working well and causes traffic jam in stead of avoiding. RWS wants to investing on what way the “zipping” method could be improve. Two IP research project are already executed and a follow up needs to be given to the recommendations in order to achieve a final design.



### Subject of research

Research questions might be formulated as ;

1. Why is the current zipping method not effective ?
2. How to improve the method ?

### Practical information

The project will be facilitated RWS. Many interviews will be taken within and outside the organization (Traffic, control centre, TNO, Verkeerspolitie, VID, TUDelft ). Results from two previous research are available. A simulation model is tested and the principle of dynamic lanes is worked out extensively. The upcoming research is focused on completing the final design.



### Stakeholders

Main stakeholder is the Ministry of Infrastructure & Environment, Transport organizations.

### Field of required knowledge

Knowledge about workflow control, life cycle management, ICT-systems and simulation applications.



## Improving intercity direct connection to Schiphol

### Project description

The most vulnerable track of the network is the HSL connection between Rotterdam en Schiphol Airport. Almost daily delays are occurring or trains are completely cancelled. For most travellers it is seen as a bad experience. Special those, who has to catch a plane. There are many causes to be mentioned but a clear solution is not reached till now. An increasing complexity factor is caused by the hosting of two different voltages on the track

### Subject of research

Research questions might be formulated as ;

1. What is the main reason for the delays
2. What are the major complaints
3. How to improve the availability of the track and the rolling material ?
4. How to improve the training program of the traindrivers ?



### Practical information

The project will be conducted by the student self and executed under the responsibility of the RUG-supervisor in order to achieve objective and independent results. Many interviews will be taken within and outside the involved organizations (NS, Rover and other involved societies. It is expected that several surveys are to be organized.

### Stakeholders

Main stakeholder is NS, Dutch railways, Rover, VTV, Treinreizigersvereniging TreinTRamBus, Maatschappij voor beter OV The State of The Netherlands, Prorail, Nedtrain .

17:07	Lelystad Centrum	10 <sup>h</sup>	Intercity
	via Almere C		
17:08	Maastricht	4	Intercity
	via Breda, Zwolle, Utrecht C, Vught, Roosendaal		
17:09	Enkhuizen	11 <sup>h</sup>	Intercity
	via Sloterdijk, Hooft		
17:10	Zwolle	11 <sup>h</sup>	Sprinter
	via Weesp, Almere C, Lelystad C		
17:12	Den Helder	8 <sup>h</sup>	Intercity
	via Den Helder, Castricum, Castricum, Alkmaar		
17:12	Dordrecht	2 <sup>h</sup>	Intercity
	via Dordrecht, Rotterdam, Rotterdam, Rotterdam		



### Field of required knowledge

Knowledge about workflowcontrol, reliability engineering life cycle management, ICT-systems and simulation applications.



## Improving Aircraft Boarding:

### Project description

With the increasing number of airtravellers a reduction of the handling time on airports becomes more and more important. With in Delft University a project is started in order to optimize the handling time on airports with no cone considérations for safety issues. This project is incorporated within the European PASSME **What would you say if we told you air travel time in Europe will be reduced by up to one hour? Well this is exactly what the PASSME project aims to achieve. PASSME will reduce the time it takes passengers to get from the door of their departure airport to the exit of their destination airport in Europe.**

PASSME aims to make the airport experience less stressful and more enjoyable for the entire aviation community, from airports and airlines to passengers and baggage handlers. The project's twelve partners will combine their expertise to address this aviation challenge together. Funded by the EU's Horizon 2020 programme, PASSME brings together leaders in the fields of aviation, transport, academia, design, technology and communications.

PASSME researchers will investigate critical bottle necks in the airport experience, including luggage, security and mobility for those with disabilities and young children, boarding and overall passenger flow.



### Subject of research

1. What is the best design philosophy of boarding?
2. How to improve the current boarding procedures?

### Practical information

The project will be conducted by the student self and executed under the responsibility of the RUG in order to achieve objective and independent results. Many interviews will be taken within and outside the involved organization (TUD Aerospace, Industrial Engineering).

### Stakeholders

Main stakeholder KLM and many other airline company's TUD. PASSME The State of The Netherlands,



### Field of required knowledge

Knowledge about workflowcontrol, life cycle management, ICT-systems and simulation applications focused on queinglines.



## Improving Time Table Dutch Railways

### Project description

Twice a year Dutch railways NS is changing the timetable. Especially the recent 12<sup>th</sup> December change appeared not to be an overall improvement. The design principle was completely changed. It seems to much focused on the avoiding of delays instead of increasing the comfort and reducing waiting times for the travelers. Avoiding of delays is very important for NS Management because they have to take their responsibility about that to the Dutch Government and they have to pay penalties to the travelers. There is no overall performance calculation system available for the time table. The need for that is high. In a previous IP research a model is designed what calculation system. The benefits and advantage of the Time table in respect to the interest Of the traveller comparing with the Interests of the railway company. This model must be revalidated and Improved. The new timetable will Be used as case-study



### Subject of research

Research questions might be formulated as ;

1. What is the design philosophy of the new timetable?
2. How to improve the design method ?

### Practical information

The project will be conducted by the student self and executed under the responsibility of the RUG in order to achieve objective and independent results. Many interviews will be taken within and outside the involved organization (NS, Rijksoverheid and other involved societies. Results from previous research are available as a calculation model based on an excel spreadsheet.

### Stakeholders

Main stakeholder is NS, Dutch railways, Rijksoverheid, VTV, TeoZigersvereniging TreinTRamBus, Maatschappij voor beter OV The State of The Netherlands, ProRail .



### Field of required knowledge

Knowledge about workflow control, life cycle management, ICT-systems and simulation applications.







## How to appoint, calculate loadfactors ?



### Projectdescription

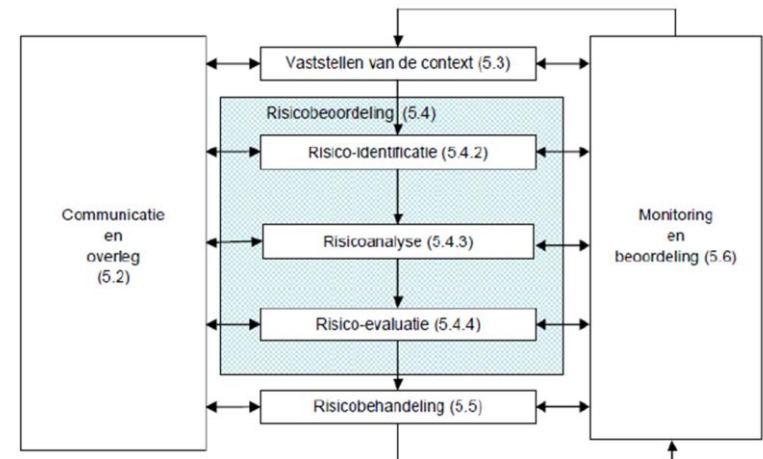
The availability of weapon systems owned by the Dutch Ministry of Defense (DMD) has, for the last couple of years, been too low. In 2015, the Dutch Ministry of Defense was not able to fully meet the objectives set for protection the Dutch and allied territory. This low availability is alarming, especially concerning the current state of the international security situation. One of the causes for the insufficient availability, is the lack of a long-term perspective on maintenance. Maintenance management has a large influence on the availability, reliability and cost effectiveness of systems.

To (partly) solve the availability problems of the weapon systems, the Dutch Ministry of Defense is collaborating with different parties, including the company AMC T&T. In collaboration, a simulation environment is developed, called DYNAM4MaDeSi (DYNAmic Asset Management, Maintenance Decision Support & Simulation). This simulation environment is aimed at optimizing Life Cycle Costs (LCC) of weapon systems of the Dutch Ministry of Defense and functions as a decision support tool for selecting maintenance strategies. To increase the accuracy of the simulation, so called Load Factors should be introduced. This thesis will focus on the implementation of those Load Factors in a simulation environment.

From literature research and consultation of experts, three types of Load Factors were distinguished. A proposal on how to incorporate

these Load Factors in the simulation environment is given, which is focused on the use of excel tables which should be filled in by experts.

### Knowledge area :



[ref.: ISO 31000]

### Stakeholders

Asset Management Control Centre,  
Den Helder [www.amcplaza.com](http://www.amcplaza.com) and t  
Dutch Defense Organization







## High-fidelity reconstruction of the Antikythera mechanism

### Project description

The Antikythera mechanism is a 2,000-year old astronomical computer found in a shipwreck off the island of Antikythera, Greece. It was a compact device used to calculate the positions of the planets known at the time and features complex gear trains similar to those found in clockwork.

### Subject of design

This project aims to produce high-fidelity reconstructions of the Antikythera mechanism using SolidWorks, based on existing high-resolution X-Ray scans of the artefacts. The resulting CAD model(s) will be visualized as virtual reality prototypes using zSpace.

### Field of knowledge

Computer Aided Design,  
Modelling

### Stakeholders

Advanced Production Engineering  
group-ENTEG, Department of  
Astronomy-Kapteyn Institute





## Virtual prototypes via zSpace for education

### Project description

The zSpace is a virtual prototyping system that uses CAD files within an interactive 3D virtual environment to simulate user interaction with various structures, ranging from mechanical assemblies to biological systems.

### Subject of design

This project aims to create virtual reconstructions of mechanical assemblies, e.g. subsystems of the Ocean Grazer or the hand press mechanism used in the CAD/CAM course, and biological systems, e.g. cell models. Educational aspects should be explicitly addressed within this project (contact person for education: Prof. Lucy Avraamidou).

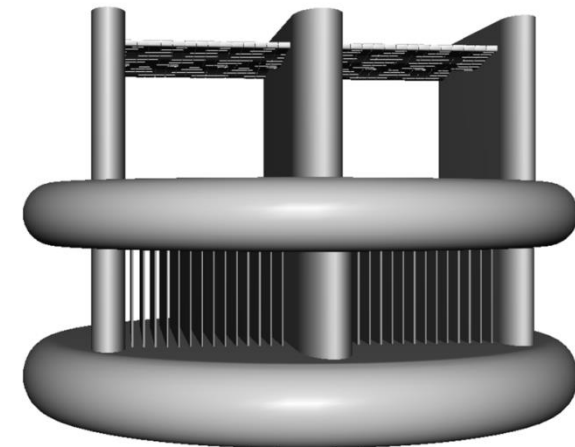
### Field of knowledge

Computer Aided Design,  
Modelling, Engineering  
education



### Stakeholders

Advanced Production Engineering  
group-ENTEG, Ocean Grazer  
group, Aquatic Biotechnology and  
Bioproduct Technology-ENTEG,  
Science Education and  
Communication-FMNS Research





## Structural FEA for metal-polymer interfaces

### Project description

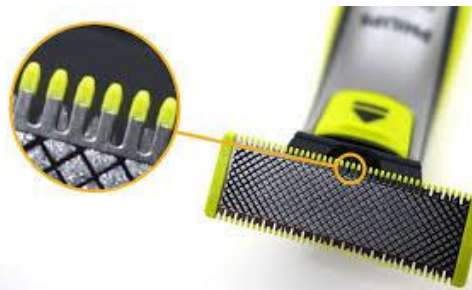
Metal-polymer interfaces are important for a number of applications, e.g. injection molding. The strength of the interface under different loading conditions will be dependent on the local bonding strength at the interface.

### Subject of design

This project aims to study the strength of metal-polymer interfaces in the presence of surface roughness and texturing. Research will be performed via the finite element method using software such as COMSOL. Aspects of bonding strength will be addressed within the scope of the general PhD project associated with this research (contact person: Ranko Toljaga).

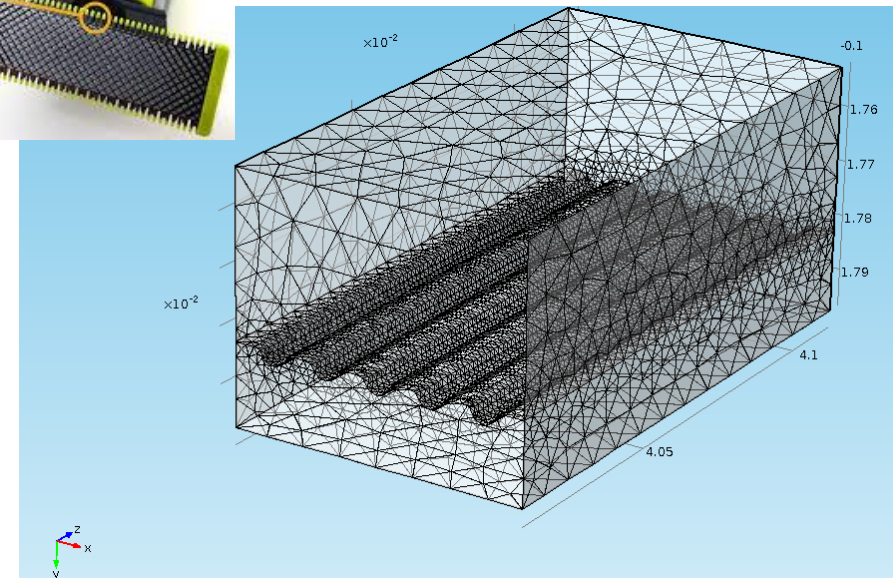
### Field of knowledge

Mechanics, Finite  
Element Analysis



### Stakeholders

Advanced Production Engineering  
group-ENTEG





## Ocean Grazer 1: external platform structure

### Project description

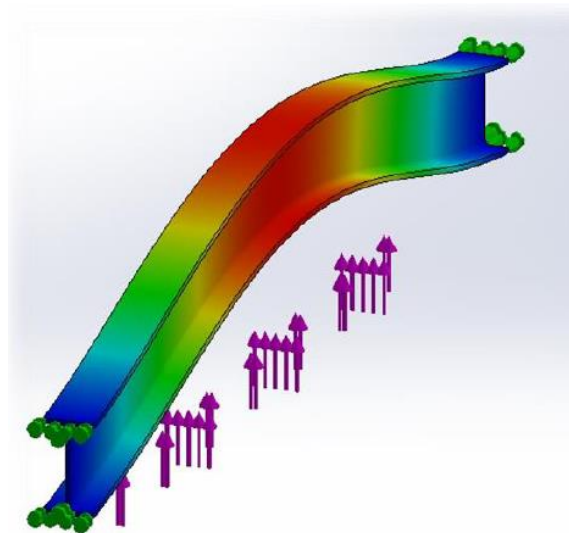
The Ocean Grazer is a novel wave energy collection and storage device, currently being developed by the University of Groningen. The platform houses various renewable energy generator modules based on wave, wind and solar energy.

### Subject of design

This goal of this project is to design the external structure of the Ocean Grazer platform under the effect of various loading conditions (information on these loads is already available). Cost estimations of the material and work necessary to build such a platform are expected by the end of the project.

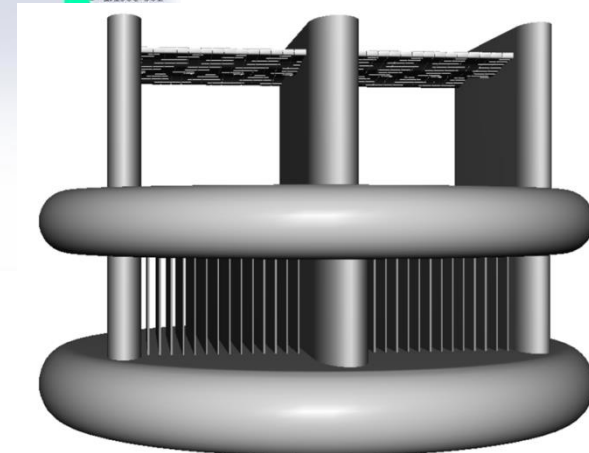
### Field of knowledge

Modelling, Mechanics,  
Finite Element Analysis



### Stakeholders

Advanced Production Engineering  
group-ENTEG, Ocean Grazer group







## Ocean Grazer 2: internal platform structure

### Project description

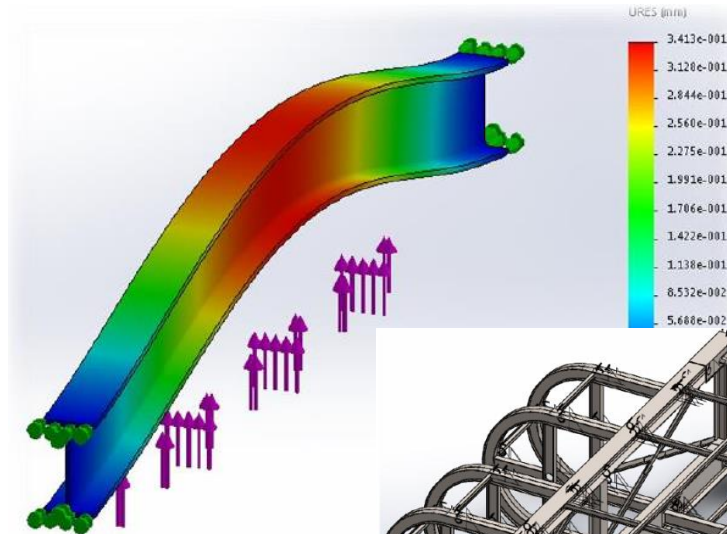
The Ocean Grazer is a novel wave energy collection and storage device, currently being developed by the University of Groningen. The platform houses various renewable energy generator modules based on wave, wind and solar energy.

### Subject of design

This goal of this project is to design the internal structure of the Ocean Grazer platform under the effect of various loading conditions (information on these loads is already available). Cost estimations of the material and work necessary to build such a platform are expected by the end of the project.

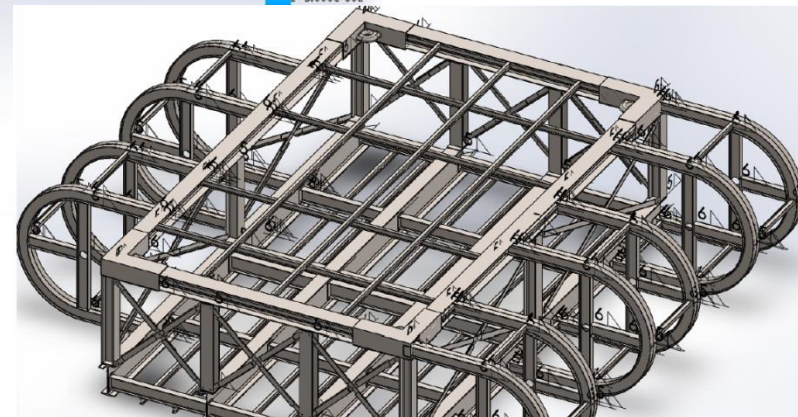
### Field of knowledge

Modelling, Mechanics,  
Finite Element Analysis



### Stakeholders

Advanced Production Engineering  
group-ENTEG, Ocean Grazer group







# Jamming Detection and Localization in Wireless Networks

Bachelor Thesis project

Supervisors: D. Senejohnny, Dr. P.Tesi, Prof. C. De Persis

Group: Smart Manufacturing Systems (SMS)

## Description

Because of the proliferation of wireless technologies, jamming in wireless networks has become a major research problem due to the ease in blocking communication in wireless networks. Jamming attacks are a subset of denial of service (DoS) attacks in which malicious nodes block legitimate communication by causing intentional interference in networks. To better understand this problem, we need to discuss and analyze various techniques for jamming detection and localization in wireless networks.



## Subject of design

The project aims at investigating the applicability of various jamming detection and localization mechanisms, analysing their strengths and weaknesses in the context of wireless networks.

## Prerequisites

Courses *Control Engineering* (Regeltechniek); working knowledge of Matlab/Simulink



## Identification of Complex Dynamical Networks

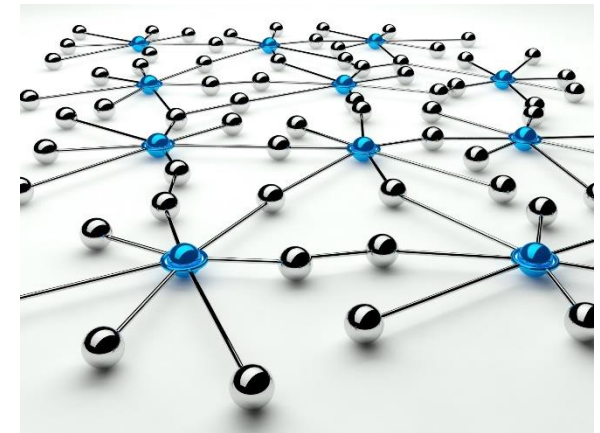
Bachelor Thesis project

Supervisors: H. van Waarde, Dr. P. Tesi, Prof. C. De Persis

Group: Smart Manufacturing Systems (SMS)

### Description

Often, the connection structure of a (large-scale) dynamical network is not known exactly. Therefore, a mainstream of research has focused on developing algorithms that are able to reconstruct the network's connection structure on the basis of observed data. However, in some cases we are not interested in identifying the *exact* network structure. Rather, we would like to determine certain network *properties*, such as connectedness and average vertex degree.



### Aim of the project

The aim of this project is to review the current methods used to infer properties of networked dynamical systems, and to analyse their strengths and weaknesses.

### Prerequisites

Courses *Control Engineering* (Regeltechniek); working knowledge of Matlab/Simulink



## Benchmarking power grid controls

Bachelor Thesis project

Supervisors: Erik Weitenberg, Prof. Claudio De Persis

Group: Smart Manufacturing Systems (SMS)

### Description

Today's power systems are rapidly evolving to become less dependent on fossil fuels, more secure, and more flexible. As a result, much research is underway to investigate how to build the so-called *smart grid*.

The new solutions resulting from this are usually only tested on academic (very small) versions of the power grid. You will investigate available benchmarks, and use one to measure the effectiveness of new control methods.



### Subject of design

You will investigate how various existing and theorized controllers perform on a benchmark model of the power network.

### Prerequisites

Courses *Control Engineering* (Regeltechniek); working knowledge of Matlab/Simulink



## Robustness of an optimal power dispatch controller

Bachelor Thesis project

Supervisors: Mr. T.W. Stegink, Prof. Claudio De Persis

Group: Smart Manufacturing Systems (SMS)

### Description

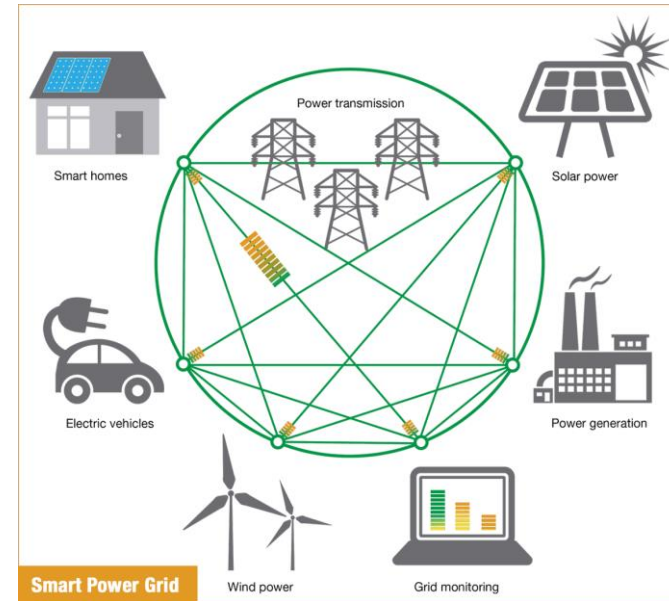
One of the approaches for achieving optimal power dispatch in power networks is using a gradient method based controller. However, this builds upon the assumption that the real-time power demand is known which hardly seems to be met in real power networks. One of the methods to overcome this issue is by modifying the controller so that it estimates the power demand. However, here it is assumed that perfect information about the (parameters) of physical power network is known.

### Subject of design

The project aims at analyzing the robustness of the proposed controller to uncertainty of the estimated system parameters.

### Prerequisites

Courses *Control Engineering* (Regeltechniek); working knowledge of Matlab/Simulink





## Distributed job scheduling in data centers

Bachelor Thesis project

Supervisors: Tobias Van Damme, Prof. Claudio De Persis

Group: Smart Manufacturing Systems (SMS)

### Description

Nowadays everything is online. Who can still remember the time when there was no such thing as Google, Facebook or Dropbox. Behind the screens of the online world hide big data centers which process massive quantities of data every second. The data centers are becoming so big that they are becoming hard to control from a central point. These systems can be better controlled in a distributed way where the total system is controlled by many smaller local controllers.



### Subject of design

The project aims at reviewing a distributed control algorithm to control data centers and studying how it works under different network conditions in the data center

### Prerequisites

Courses *Control Engineering* (Regeltechniek); working knowledge of Matlab





## Finding the equilibria of power consensus algorithms

Bachelor Thesis project

Supervisor: Prof. Claudio De Persis

Group: Smart Manufacturing Systems (SMS)

### Description

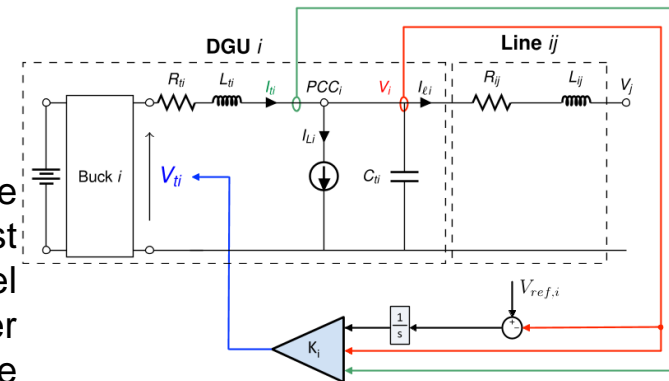
The proliferation of renewable energy sources and storage devices that are operating in the DC regime is stimulating interest in the design and operation of DC microgrids. Recently a novel power consensus algorithm has been proposed to achieve power sharing in DC microgrids. The aim of this project is to 1) evaluate numerically the solutions (equilibria) of the power flow equations that result from this new algorithm; 2) compare these equilibria with other resulting from existing algorithms.

### Subject of design

The subject of the design is the system of power flow equations arising from a novel power consensus algorithm for DC microgrids.

### Prerequisites

Courses *Control Engineering* (Regeltechniek); working knowledge of Matlab/Simulink





## Interface adhesion measurement of ZnMg PVD coatings on advanced high strength steels

Advanced high strength steels (AHSS) are widely used in car body frame. Recently, the demand for the improvement of corrosion resistance of car body frame has increased and magnesium-alloyed zinc coatings have proved to be the best choice. Technical limitations had made physical vapor deposition the most suitable method for continuous coating of AHSS rolled strips with ZnMg alloys. Nonetheless, Zn-Mg PVD coatings applied on AHSS suffer from relatively poor adhesion to the substrate. Efforts are underway to improve the adhesion properties of this novel coating to the steel substrate. In such coatings, interface adhesion strength is effected by the characteristics of the coating and also the process parameters. All these parameters should be optimized in such a way that yield the maximum adhesion between the coating and steel substrate. Therefore, a proper method to enable accurate measurement of interface adhesion must be utilized.

Common methods of measuring the adhesion strength of coatings are tear-off test, peel-off test shear test, bending, indentation and scratch test. Applicability of the prior three methods is limited by the strength of the glue used to bond the coat. Another problem with these methods is the non-uniformity of the stress distribution along the interface leading to large scattering in the results. The latter three methods are suitable to accurately measure the interface adhesion but only if the substrate and the coating have brittle nature which is not the case for ZnMg PVD coatings on steel substrate.

Therefore, in-situ tensile testing of coated samples is proposed to be the most suitable method to quantitatively measure the interface adhesion strength of ZnMg PVD coating on AHSS substrate giving the possibility to observe failure mechanism of coating in real-time. This technique can be performed using available the Kammrath & Weiss GmbH tensile-compression stage with 5000 N loading capacity installed inside TESCAN scanning electron microscope and observing the cracking behavior of ZnMg through the thickness and then along the interface (shown in Fig. 1). Later on, observations are linked to simple analytical solutions to quantify interface adhesion and conclusions can be drawn between the effect of coating parameters and interface strength.

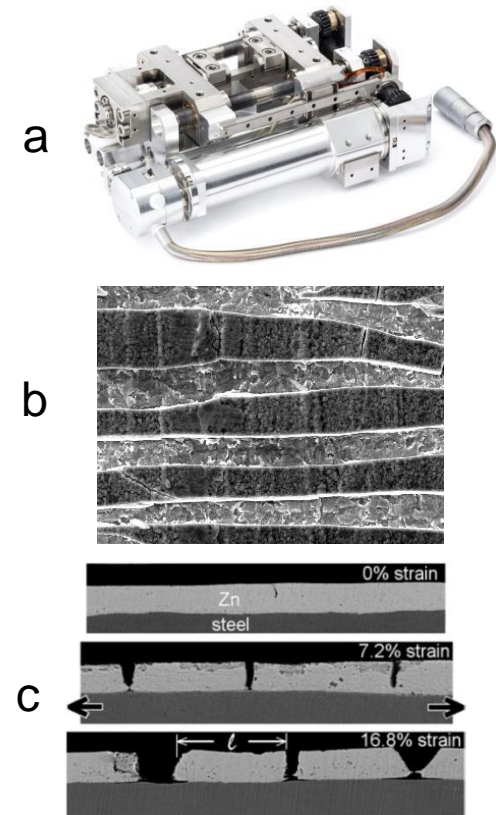


Fig. 1: (a) Tensile module, (b) and (c) cracking of coating from top and side view, respectively

## Investigating the morphology and microstructure of synthesized hydroxyapatite coatings

Titanium coated by hydroxyapatite is extensively used in orthopedic implants. This is attributed to the advantages of titanium which offers desirable mechanical properties and to the biocompatibility of hydroxyapatite. Synthetic hydroxyapatite has great structural and compositional similarity to natural bone and exhibits a surface chemistry that accelerates the growth of bone. In addition, being nontoxic in any quantity makes it a favorable coating for metallic implants.

Electrochemical deposition (ECD) is the most frequently used technique to produce hydroxyapatite coatings. The electrochemical deposited coatings depend on numerous parameters such as solution composition, pH, deposition temperature, applied potential or current density, and additives. These factors can affect the purity, phase composition, crystallinity, stoichiometry, morphology and mechanical strength of the deposited coating. The morphology of the deposited coatings is a critical issue and it is defined by crystallization rate. Deposition parameters influence the deposition rate which can cause different morphologies such as needle, ribbon, rod, plate, and flower like morphology.

The individual effect of these parameters on hydroxyapatite morphology is almost known. However, the influence of combined deposition parameters has not been clarified yet. Consequently, the key aspects of this project are synthesizing hydroxyapatite coatings via electrochemical deposition by changing different parameters (i.e, voltage, amount of additive, and temperature) and investigating the relationship of these parameters and crystallization rate and coatings' morphology.

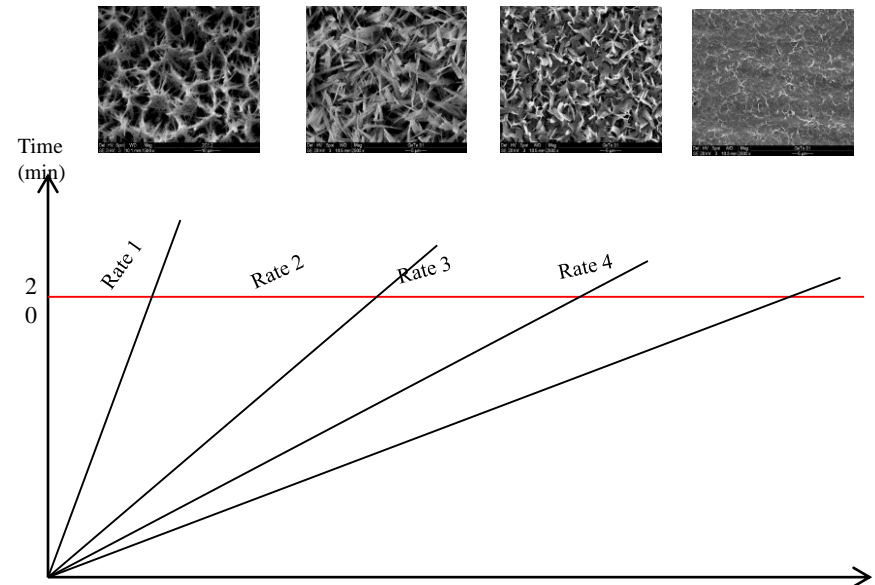


Fig. 1. Different morphologies of hydroxyapatite which are deposited by different crystallization rates.



# Mesoporous graphene for electrochemical energy storage

As the energy storage facilities, chemical power suppliers have wide applications in various fields including portable electronic devices, electric vehicles, aerospace etc. The current promising rechargeable chemical power suppliers such as high-energy-density lithium ion batteries or supercapacitors require high specific area, good electric conductivity for electrons transport, and rich pathways for ions transport. Mesoporous graphene materials (as shown in Fig. 1) are the most promising materials used for Li-ion batteries and supercapacitors owing to their low density, high specific area, good electric conductivity and many nanochannels. However, the preparation of mesoporous graphene is a big challenge. In this project, mesoporous graphene will be made by using template-directed method. The mesoporous graphene will be characterized by means of SEM, TEM, Raman, etc. The mesoporous graphene also will be integrated into cathodes for lithium ion batteries.

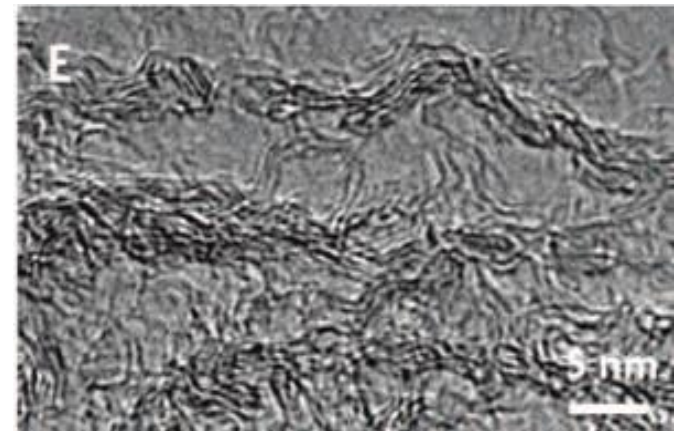


Figure 1. TEM images of mesoporous graphene (Science, 2015, 350, 1508-1513)



## Synthesis of nanoporous metals by thermal reduction

Nanoporous metals are new emerging materials used in the fields of energy storage, catalyst, environmental cleaning, sensors, conductors, bioengineering materials, and so forth. The current dominant method for synthesizing nanoporous metals is chemical etching or dealloying method (as shown in Fig.1). However, chemical dealloying method requires specially prepared starting alloys, and takes very long time in the etching processes, and it is better used for thin metal sheets as starting material because of the etching resistance in bulk. The etched away element should be less stable, and after etching, the post-utilization of these sacrificed elements is a complicated process and costly.

Another approach is by sintering of nanoparticles or nanosized powder, which is the process of aggregation and coalescence of metal nanoparticles. It requires metal nanoparticles as the precursors. Normally, the sintering process needs multiple steps that are complicated, and the additional cost of preparing nanoparticles leads to high total cost.

In this project, a new method, which is one step thermal reduction of metallic precursors, will be developed for the synthesis of nanoporous metals. The reduction conditions and mechanism will be scrutinized.

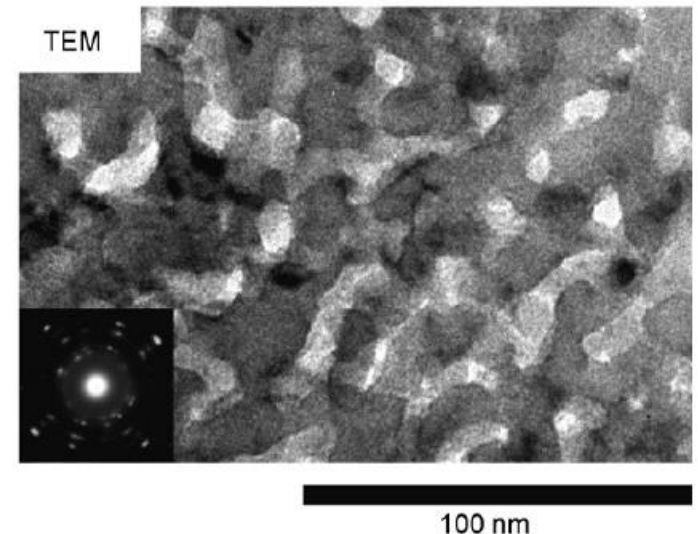


Fig. 1 TEM images of nanoporous Ni made by dealloying method (Journal of Alloys and Compounds 2009, 485, 583–587)





## Hardness distribution and microstructural evolution of resistance spot welded Boron steel

### Project description

Resistance spot welding (RSW) is currently the technology most widely used for welding car body components. Therefore, *the safety of vehicles is to a large extent determined by the property of resistance spot welds (RSW) that assemble all steel components together*. Boron steels are categorized as advanced high strength steels (AHSSs) and have been developed to improve hardenability during heat treatment by the deliberate addition of boron to a range of medium carbon steels. In spite of Boron steels application in automotive industries, information about the resistance spot weldability of these steels is limited compared to other AHSSs. The key aspect of this project is to investigate effect of welding current on the hardness distribution and microstructure of Boron steel

### Subject of design

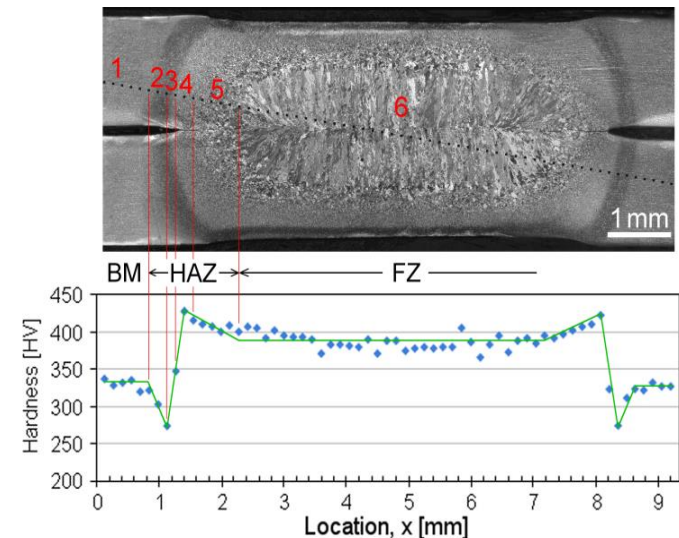
- Mapping microhardness using Vickers hardness measurements
- Mapping nanohardness
- Microstructural observations using scanning electron microscope

### Field of knowledge

materials science and engineering

### Stakeholder company

Tata steel, DAF trucks,  
University of Groningen



Cross section of a resistance spot weld and  
its corresponding hardness distribution

Supervisor: Prof. Yutao Pei, Drs. Ali Chabok



## Orientational optimization of the photovoltaic installation on Zonnewal Oostwold

Zonnewal Oostwold is a project plan by the local community of the village Oostwold, right north of the highway A7 between Groningen and Leek. The plan constitutes a 6 hectare area in which local solar electricity production, recreation, ecology, mobility, sustainable community, education, innovation, and other aspects are to be fully integrated.

Given (1): the photovoltaic (PV) installation (1,5 km long, 6 m high) is projected along the rim on the south side (i.e. at the highway side) of a 10m high sound wall; (2) the sale value of the produced electricity fluctuates during the day, determined by the market (APX). On a sunny day, the kWh value is at its minimum around noon due to massive solar electricity production elsewhere by installations oriented south.

Project goal: determine the tilt angle and percentage of east-west component of the panel orientation of the solar park at this position that yields the highest yearly economic outcome.



# Model and simulation of a welding process.

## Project description

Welding is a widely used connection process in industry. In particular, Gas Metal Arc Welding (GMAW) is attractive due to its speed and reliability. However, much efforts are still required to make the process efficient. This projects aims to create a suitable model of a GMAW process so that improvements that increase it efficiency can be proposed.

## Subject of design

Model and simulation of a GMAW process looking for its improvement.

## Field of knowledge

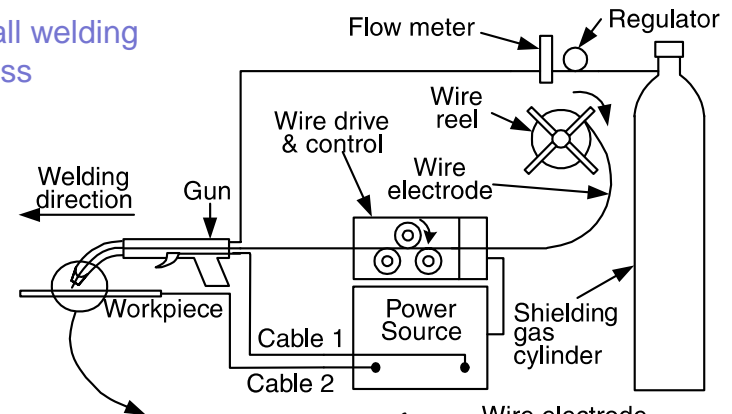
Mechatronics, Control Engineering

\*Basic Matlab and English required.

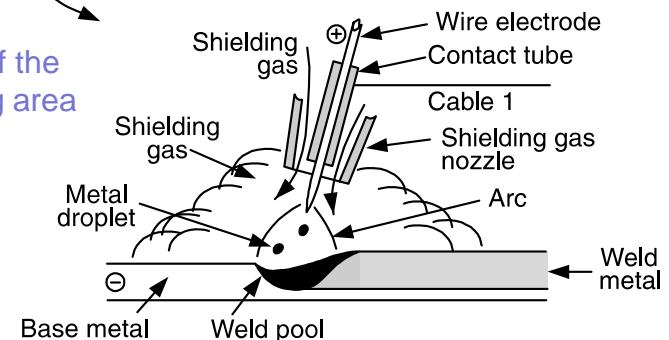
## Stakeholder company

University of Groningen  
Costa Rica Institute of Technology

Overall welding process



Detail of the Welding area





## Numerical methods for parametric resonance

### Project description

Parametric resonance is an internal effect that occurs in several mechanical systems under the actuation of a periodic external force.

Recently, parametric resonance is being investigated for its potential uses in energy harvesting. However, due to its difficult analysis, appropriate numerical methods must be developed in order to provide reliable simulations. This project aims to the development of parallel algorithms that compute graphs related to parametric resonance effects.

### Subject of design

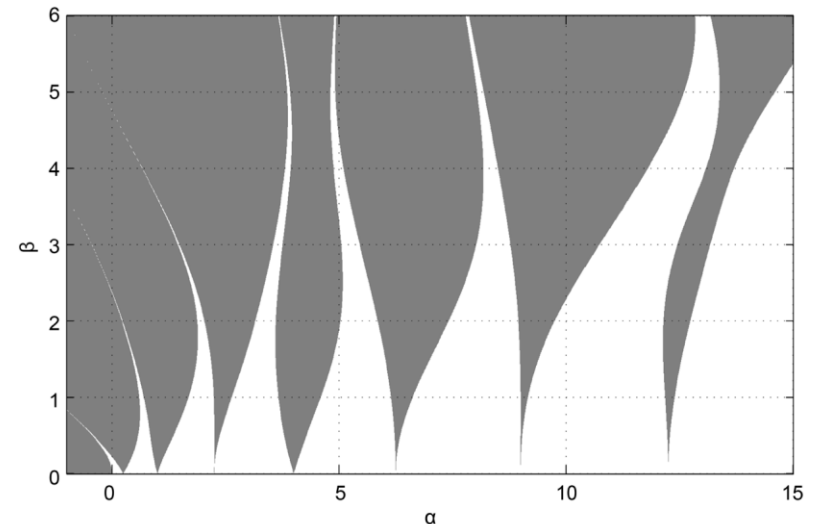
To develop efficient and well-suited numerical algorithms that allow scientists a better understanding of the parametric resonance effect.

### Field of knowledge

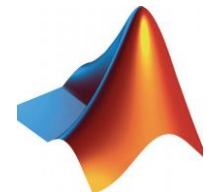
Control engineering, computer science.

### Stakeholder company

University of Groningen



\*English and Matlab required





## Modeling and simulation of a piezo-electric cantiliver

### Project description

Research in piezoelectric materials is nowadays fundamental for the development of new technologies. In particular, there is an increased interest on the potential applications of piezoelectric in Energy Harvesting. For some applications, a way to enhance the harvesting properties of a piezoelectric is to mount it on a cantiliver beam. This project aims to model and numerically simulate a cantiliver to be used in Energy Harvesting applications.

### Subject of design

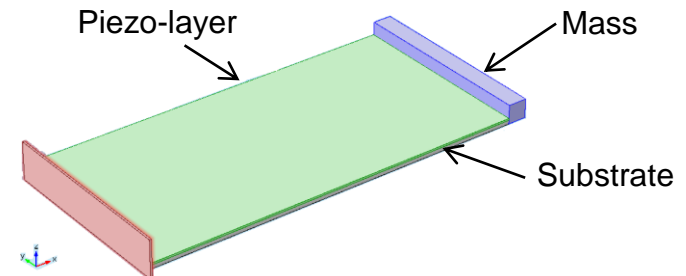
Model and simulation of a cantiliver beam.

### Field of knowledge

Mechatronics, control engineering.

### Stakeholder company

University of Groningen



\*English and Matlab required.





## FEA of a Piezoelectric cantilever for power generator

### Project description

Current advances in microtechnology and wireless communication bring an increasing demand for full sustainable systems. Thus, energy harvesting from ambient vibrations using piezoelectric materials have attached much attention. In this research project we will study the performance of a piezoelectric cantilever power generator using finite element analysis (FEA). Based on different design parameters and piezoelectric materials, we will decide the best energy harvester system.

### Subject of design

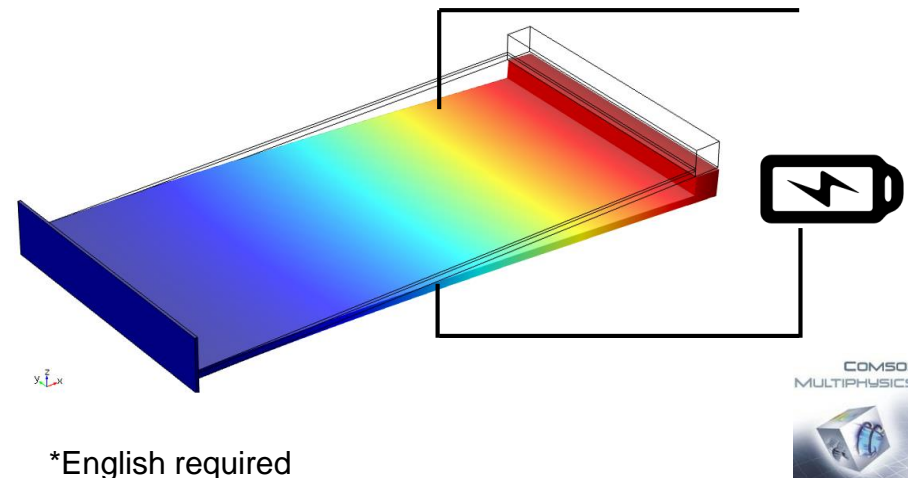
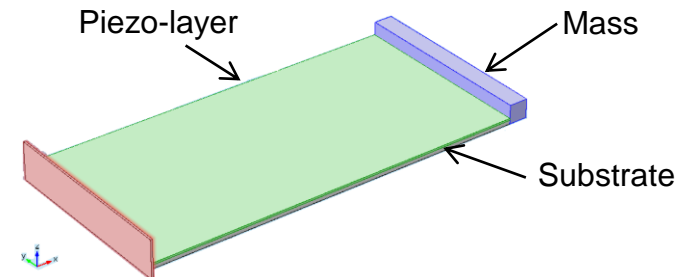
Design and FEA of a cantilever power generator based on piezoelectric materials for energy harvesting applications.

### Field of knowledge

Mechatronics, Material Science and  
Engineering

### Stakeholder company

University of Groningen



\*English required



## Solar Hydro-Pump System Modeling

### Project description

Renewable Energy sources have gained a lot of attention lately due to their low carbon footprint. However, they also introduce challenges in the operation of power grids. This Solar Hydro-pump system allows for energy storage that can help smooth energy fluctuations. The previous is achieved by activating a solar-driven pump that stores water in an upper reservoir, whose contents can be suitably released through a turbine system to produce electricity.

### Subject of design

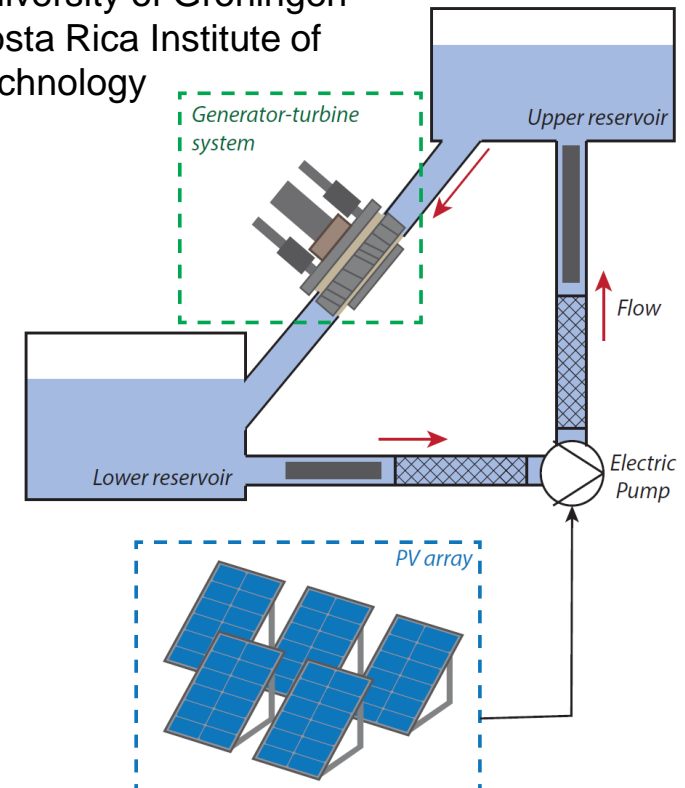
Modeling and simulation of the behavior of the solar hydro-pump system (possibly in the port-Hamiltonian framework)

### Field of knowledge

Energy Systems Engineering / Mechatronics  
English and (basic) Matlab required

### Stakeholder company

University of Groningen  
Costa Rica Institute of  
Technology





# Smart Manufacturing: assessing SME's

## Project description

The Northern Region of Smart Factories (RoSF) is a Industry 4.0 project to enhance smart-manufacturing in Groningen, Friesland and Drenthe. In order to detect opportunities for the SME's, a tool for assessing the level of smartness is in development. This project aims to improve and test the tool.

## Subject of design

A tool for Smart Factory Assessment


## Field of knowledge

Industry 4.0, Manufacturing

## Stakeholder company

RoSF

<http://rosf.nl/how-smart-is-your-factory/>



Fasen ►	Traditioneel maakbedrijf	Geavanceerd maakbedrijf	Vernieuwend maakbedrijf	Smart Factory nu	De Smart Factory in de toekomst
<b>Competenties</b>					
<b>Verdienmodel</b>	Verkoop product voor vaste prijs	Verkoop van product obv. total cost of ownership	Verkoop van customized product voor vaste prijs	Verkoop customized product obv. total cost of ownership	Verkoop van dienst/ probleemoplossing
<b>Product Strategie</b>	One size fits all	Product instelbaar op gebruikers/situatie	Vraaggestuurd, maar offline	Vraaggestuurd via IoT	Lerend ('smart') product
<b>Product-ontwikkeling</b>	Learning by doing, trial & error	Op basis van experimenten, alles gedocumenteerd	Design of experiments (DOE) & statistical design and analysis	Modelbased system engineering (MSSE), "First time right"	Modelbased, modellen gekoppeld en geoptimaliseerd
<b>Connectivity</b>	Alleen (delen van) indirecte processen gekoppeld	Kantoor met sleutelprocessen in productie aangesloten. Eilandautomatisering	100% interne connectivity, geautomatiseerd, iedereen connected en papierloos	Alle spelers (suppliers, producten in het veld gekoppeld onder regie kernbedrijf)	Alle spelers gekoppeld via cyber physical system en decentraal aangestuurd
<b>Adaptievermogen</b>	Ad hoc, relatief en afhankelijk van vakmanschap	Geautomatiseerd, maar star. Aanpassingen zijn complex. Externe specialisten vereist	Aanpassingen eenvoudig uit te voeren door eigen operators	Aanpassingen autonoom doorgevoerd. Fout is kans, wordt maar één keer gemaakt	Lerend, organisch ecosysteem. No limits
<b>Productie Management</b>	"Shoot & Forget", Grote afwijkingen praktijk van alle dag	Obv. planning, Dus geen extreme afwijkingen	Obv. realtime informatie. Quick Respons, maar mensafhankelijk	Obv. inline/realtime geautomatiseerd aangestuurd	Autonoom/adaptief, op nivo ecosysteem
<b>Kwaliteits-Management</b>	Controle achteraf	Inline controle obv. steekproef	100% inline controle, correctie bij opvolgend product/batch	Inline controle, correctie onderweg, bij hetzelfde product/batch	Feed forward control modelbased
<b>Maintenance</b>	Repareren in plaats van onderhouden	Onderhoud obv. vaste intervallen	Vraaggestuurd onderhoud	Preventief onderhoud	Predictive onderhoud



## A PV Emulator for a Micro Grid Test Facility

### Project description

A Photo Voltaic (PV) panel is a non-linear DC source. A solar micro inverter feeds current into the grid and must maximize the power from the panel with a maximum power point tracking (MPPT) algorithm.

In the DTPA group, research is done on control strategies in PV-inverters to regulate the active and reactive power delivered to the grid, thereby maximizing the extracted power from the PV panel.

### Subject of design

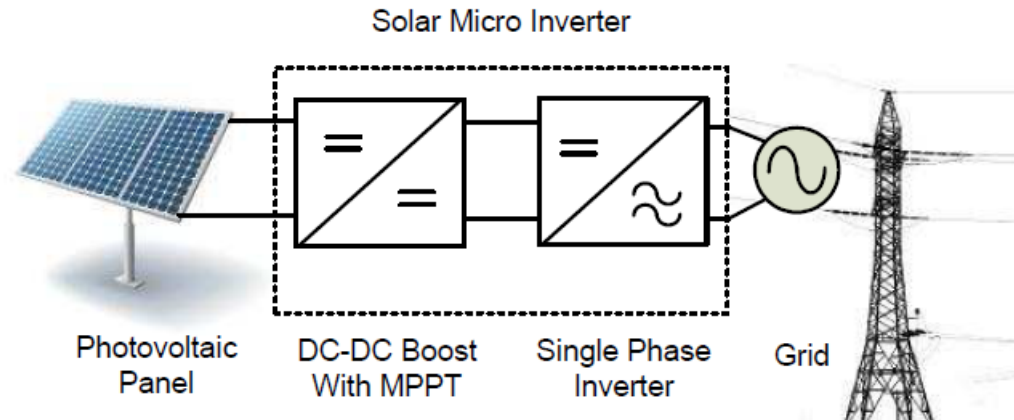
To test PV-inverters and control algorithms of inverters in the lab, there is need for a PV panel hardware emulator. The emulator input is the profile of the solar radiation and the output is from a current and voltage regulated source.

### Field of knowledge

System modeling, computer simulation techniques, electronic circuits and building an experimental setup.

### Stakeholder company

The Discrete Technology & Production Automation (DTPA) research group from the RUG.



Source: TIDU405A.pdf, Texas Instruments 2016





## Navigating the Nexus robot

### Project description

The Nexus robot has special mecanum wheels that can drive the robot in any direction, even sideways.

The project consists of making this available in the navigation system that is used.

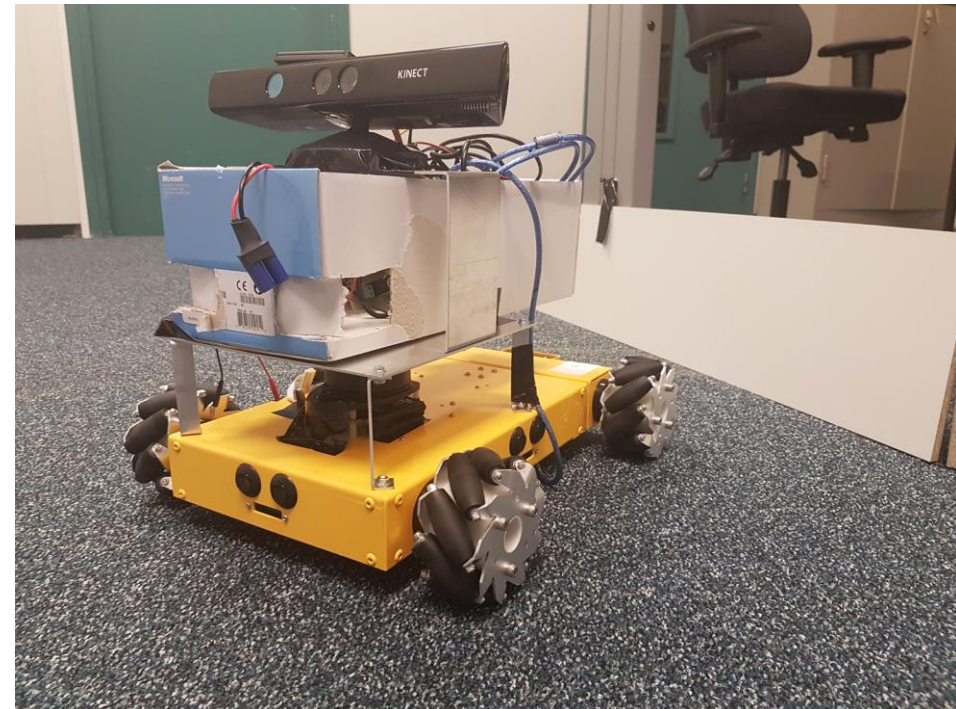
Also the navigation system has to be optimized to make maximum use of this functionality.

Finally a flexible “world” has to be created in which the robots can live.

### Field of knowledge

Robotics, Python programming with ROS

A nexus robot in our DTPA lab





## Design of a space simulator cooling system

### Project description

PLATO is an ESA space mission that will be launched in 2025. The mission goal is the detection of earth like planets at other stars. This will be done with long observations with 30 optical cameras. SRON will validate the performance of 8 of these camera's in a dedicated space simulator.

### Subject of design

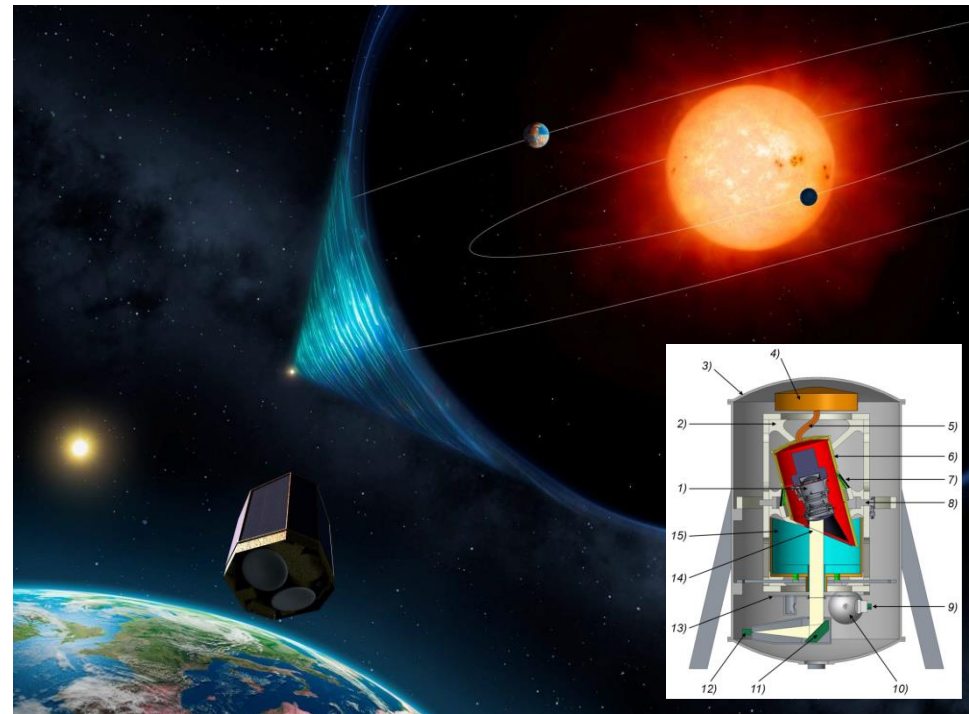
Investigate different design options for the cooling system of the space simulator. Make a trade-off between costs, reliability and design efforts. What is the best way to cool a CCD to  $-90^{\circ}\text{C}$  ?

### Field of knowledge

Process technology, thermodynamics, heat transport



Netherlands Institute for Space Research





## Cost estimation of a space simulator

### Project description

PLATO is an ESA space mission that will be launched in 2025. The mission goal is the detection of earth like planets at other stars. This will be done with long observations with 30 optical cameras. SRON will validate the performance of 8 of these camera's in a dedicated space simulator.

### Subject of design

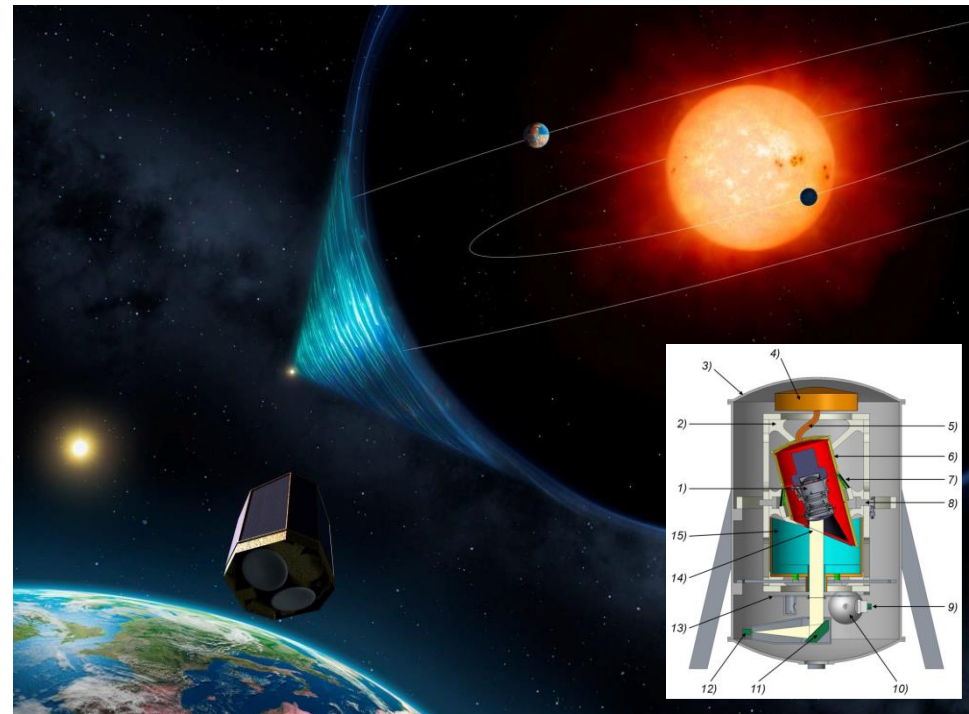
Make a trade-off study between the costs and efforts of building the space simulator with commercial components as compared to an in-house custom made design and manufacturing. What components could be purchased, which design efforts can be outsourced to (local) engineering companies, at which costs (approximately)

### Field of knowledge

Cost estimation, production technology



Netherlands Institute for Space Research





## Key to the future of the RDW

### Project description

In the field of mobility, many complex technical problems pop up, related to the authenticity domain at RDW (Rijksdienst Voor het Wegverkeer), like:

- Chip and applet technology
- Personalisation technology
- Use of license for DIGID
- Law

### Subject of design

The project is about the development of a technology roadmap for the RDW.

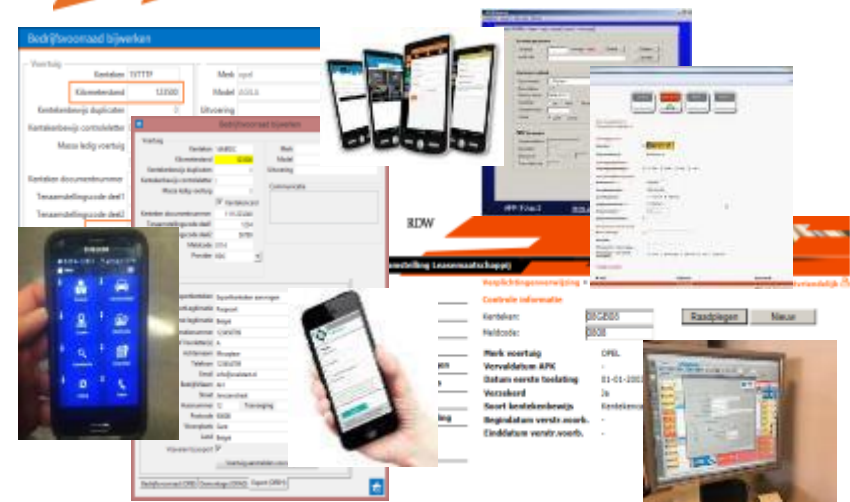
### Field of knowledge

Production Technology, road mapping

### Stakeholder company

Rijksdienst Voor het Wegverkeer  
(RDW)

# RDW







## Design a data management system

### Project description:

Resato requires an efficient and effective data management system for their R&D and production related environment. Consultants noticed that control and management of Resato's data access is hardly manageable. The company requires advice on how this is best managed in the form of a system or framework for the production and R&D departments.

### Subject of design

Data management system

### Field of knowledge

Digital technology, Information management, production technology

(There are IT experts available, no prior IT experience required, but affinity with the subject is convenient)

### Stakeholder company

Resato is a leading high-pressure machinery manufacturer located in Assen, with our 84 employees we serve our customers in over 81 countries (including China, Russia and Iran). It is our mission to meet and exceed the expectations of our customers. With more than 25 years of experience in high pressure technology, we are equipped with the knowledge to provide reliable and safe solutions.

Main stakeholder: R&D and production

### Picture of the project





## Multichannel LED stimulator for vision research

### Project description

Vision research on insects with compound eyes requires an automatic mapping of its visible spectrum responses. Modern LEDs cover the whole visible spectrum and can be conveniently used for fast visual stimulation. A microcontroller will be used to drive LED flashing and concurrently record the response from the “eye” (a photodiode). After the basic design is tested, signal extraction will be enhanced with stimulus-response cross-correlation techniques.

### Subject of design

Firmware for a multichannel stimulator based on an ARM microcontroller and PWM LED driver modules.

### Field of knowledge

Signal analysis, Control systems  
design, Hardware programming

### Stakeholder

University of Groningen

