

W.S.G. Isaac Newton Internship Booklet

2022

W.S.G. Isaac Newton

17th of May

Introduction

Dear reader,

In your student life there eventually is a point where your study comes to an end. To prepare yourself for what comes next and to already get a taste of what it is like to be a real Mechanical Engineer, an internship is done. In a three to four month period you learn what it is like to work fulltime and to be a part of interesting projects. This is a great opportunity to find out what you like and to work at companies all over the world. To help you pick a suitable internship, we have gathered a lot of information! This booklet contains the experiences of students who did their internships assignments at a range of different companies. In case you want to know more about a certain company after your internship, we set up the Shadowing Days. During such a day you can tag along with an alumnus Mechanical Engineering to see what it is like to work in a certain kind of field. Please take a look on the website, or contact me.

Kind regards,

Roel Schoorlemmer

Commissioner of Educational Affairs of W.S.G. Isaac Newton

Nil satis nisi optimum

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7th edition

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Aeronamic

This particular internship took place at Aeronamic, Almelo. Aeronamic manufactures high speed rotating parts and subsystems for the aerospace industry.

Aeronamic has been working on improving their workflow in their shopfloor and in the offices. In the past Aeronamic used different CAD (computer aided design), CAM (computer aided manufacturing) and TDM (tool data management) programs. Some of these programs can interact with one another, but some cannot. This results in people having to update files in multiple libraries when something is changed. This gives a lot of unnecessary work and room for human error.

Aeronamic has made changes the past few years to streamline all these programs which are used for production. Siemens NX is the basic package they use nowadays. Some things are still done using different CAD and CAM programs, but this is being phased out. Siemens NX is used as CAD and CAM program. Aeronamic also has a new Tool Data Management program (TDM), called Zoller TMS. The final step is to integrate the TDM with Siemens NX. This way the tool database is always up to date and it is not necessary to keep multiple tool libraries. A clear 'master-slave' relationship is necessary. The CAD and CAM programs can find the necessary tools in the tool library from TMS, and setup sheets can be exported back to Zoller TMS. This decreases the amount of work, chance of errors and lead times.

The goal of the internship was to investigate the roadblocks of making a new product in this new way of modelling, using a dummy product. In the second part of the internship it was reviewed what happened if an existing product was altered, what gets updated automatically? What does not? And how is that fixed?



AmperaPark

AmperaPark is a company which focusses on the energy and mobility transition by creating a solar carport, a comfortable and aesthetic charging place for EVs. Circularity is a recurring topic in these transitions. Madaster, founded by Thomas Rau in 2016, developed a product called the materials passport. The core principle of this passport is to give materials additional value. When a material goes to waste, most of the time the value is reduced to zero. However, not all used materials should be considered directly as waste. Steel for instance has a much longer lifetime than for how long it might be used in a construction. The material passport captures these materials and gives additional value. Together with Primum, a subsidiary company of VolkerWessels, a materials passport for the solar carport of AmperaPark, the AmperaSol, is created.

Furthermore, research and simulations have been carried out on hydrogen storage. There is a considerable amount of surplus in PV generated power. Storing this energy could match the demand when PV production is low (winter and morning or evening). The simulation comprised of a 232 kWp system. This resulted in showing a clear advantage of smart charging compared to normal charging. It also pointed out the potential of energy storage and quantified the hydrogen storage to scale. It resulted in 20 weeks where a surplus of energy was generated, a total shortage of 28 MWh, but a surplus of 77 MWh and 72 MWh for respectively the weekdays and the weekend.

AmperaPark

The internship at Amperapark was performed for 3 months. During this time, multiple projects were performed concerning a variety of subjects within the field of energy infrastructure and photovoltaics. These projects concerned the following subjects

- Developing a social scenario for the ends user of smart charging concepts that are currently being developed (Smooth EMS & Gridshield)
- Setting up a technical scenario concerning an Amperaport project in Bergen
- Developing an overview of different payment methods that are considered in the development of the new back office of the company.

During this internship, both social and technical prowess on sustainability concepts were tested as well as my adaptiveness on processing data using new programming languages. Working from open assignments during this internship proved to be one of the more challenging facets of this internship. Improvising or adapting to a dynamic process never seemed to trouble me in previous academic projects, but a certain pressure is felt when the knowledge is present that the deliverables you produce will be used further beyond the extent of your assessment. It made me approach the open projects with more care than usual and got me to request and look for more clarity within some of the abstract facets of the working process. The internship has allowed for testing my adaptiveness in a working environment in a dynamic and diverse way with supervisors that were consistently available and helpful in helping me to further develop my abilities. Overall, the experience has been considered as extremely insightful and educational in orienting my capabilities on adaptiveness and application of knowledge in a working environment.

Apollo Tyres Global R&D

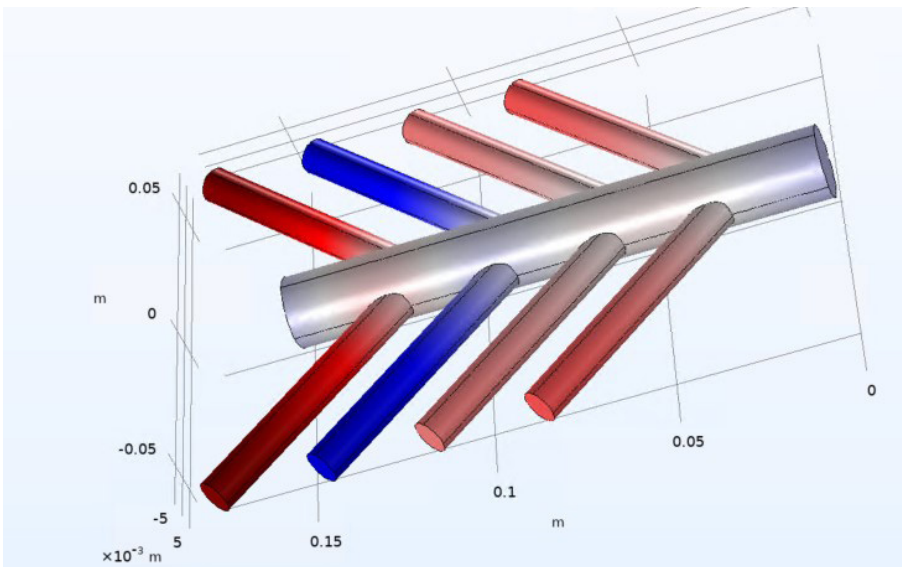
Static loaded radius of agricultural tires

During the internship, the student had to develop a tool that is able to predict the static loaded radius of a tire. The static loaded radius is the radius of a tire after a load is applied and it vertically deforms. This static loaded radius is influenced by different parameters including; the vertical load, inflation pressure and the stiffness of the tire. The tool had to have general tyre characteristics as input, such as; outer diameter and rim diameter. As a references test data was available from a test machine at the location of the plant. So, a lot of comparing and analysing of data was part of this internship. Next to this assignment, there were so side activities, in which the student was involved in different teams and worked together with a few people on solutions. This also included some practical work at the plant and testing location. There were some innovative and challenges within the assignments. Results were presented in front of a team and they provided feedback and criticism, which was very useful. After all a very educational and good location for the internship.



Apollo Tyres

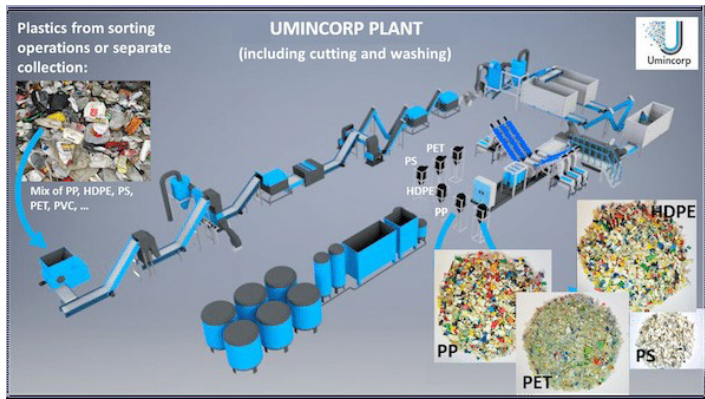
A major noise source that affects many people is road traffic noise. The tyres of a car have a huge influence on the road traffic noise produced. Apollo is a car tyre manufacturer that tries to reduce the omitted sound from tyres through smart design. In the internship assignment a study was done about the relationship of tyre tread patterns and noise. Since testing everything experimentally is very expensive a lot of resources are invested in ways to numerically simulate such problems in an efficient manner. In this internship the student performed several simulations, first with Matlab and later with COMSOL to try to predict the noise level of several tyre tread designs. In the internship you can see how a company approaches such problems. Also the student learned lots about the basics of acoustics and performing simulations efficiently.



Belfinger Tebodin

Bilfinger Tebodin is an engineering consultancy company with multiple locations throughout the Netherlands. The internship assignment has been fulfilled at the energy department in the Schiedam office. Generally, the energy department works on various projects at the same time, giving the possibility for engineers, and interns, to work on multiple topics. The main project during the internship was the optimization of a part of plastic recycling plant of the company Umincorp, which uses the disruptive magnetic density separation technique to separate plastics at different densities. At the moment, there is a pilot plant already operating continuously in the Netherlands, but the company wants to extend their reach by developing a blueprint for future plastic recycling plants which can be built anywhere in the world.

During the process, plastics are washed and this wash water needs to be treated before it can be reused in the process or discharged to the sewer. This part of the process was studied and relevant documents (e.g., calculations and drawings) for the basic engineering phase of the project were made. Additionally, optimizations compared with the current pilot plant were suggested and implemented. This project included several site visits and a lot of direct contact with the client, which not only gave the possibility for broadening of technical knowledge, but also improving communication skills.



Bond3D

Bond3D is a 3D printing company located close to the University of Twente where they use a patented technique to print engineering parts with PEEK. PEEK is an engineering polymer which is mainly known for its high strength and because it is chemically inert which means that it is in high demand in the medical and oil industry. Due to its properties it is very hard to 3D print with PEEK, but Bond3D has developed a printing technique which can produce 3D printed parts with properties similar to injection molded PEEK parts. One of the problems their design team faces is that most of their projects are subject to an NDA, and they cannot use these designs to show and explain to a layman what their printers are capable of. The aim of the internship was to redesign a component of their 3D printer such that it could be printed by their own printers and benefit from the printing process and the material properties of PEEK to serve as an indicator of possibilities towards customers.



Boretech Holland B.V.

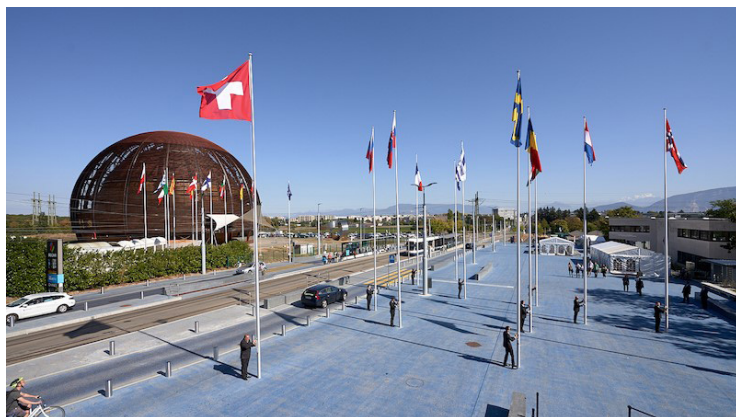
Boretech Holland B.V. is part of Hydraulic Systems Engineering (HSE) located in Vaassen (Netherlands). Boretech Holland is a supplier of high-end horizontal directional drilling (HDD) machines and mixing installations. In short, Boretech Holland specializes in the service of equipment and development of swivels, reamers and cutting equipment needed for horizontal directional drilling (HDD). To successfully perform HDD activities, the mud system is equally important. The mud lubricates the drilling head and pipes as well as structurally support the hole through which a reamer will be pulled. The quality and debit of this drilling mud need to be controlled during the mixing and drilling process. A unit called a skid had to be designed with the primary purpose of mixing and storing the drilling mud. If you want to work with heavy equipment, focus on practical implementation of your design, gain experience in talking to suppliers and on top of that be responsible for a significant part of a project, Boretech Holland B.V. is highly recommended! Example; The frame is something the trainee designed during his internship and was made at ROBEX in Poland!



CERN Switzerland

Design of an experimental setup for a remote dry cavity cooling test stand.

At the CERN central cryogenic laboratory, research is conducted on the development and application of cryogenic systems. Cryogenic systems are systems operating below 120 K. Depending on the application and required temperatures, different types of cryogenes are applied. One of the new technologies currently under research and development at the laboratory is the application of remote cooling systems. In these systems, cooling power is supplied by a cryocooler in combination with a closed loop circuit. This allows a cooling object to be mechanically and magnetically decoupled from the cryocooler. In this internship, a test setup was designed for a conceptual remote cooling system. First a thermodynamic model was made of the system. Several configurations and heat loads were simulated after which they were analysed and evaluated. After the system was confirmed, several heat exchangers were modelled, designed and commissioned. Next to the project work, several courses on cryogenic design and safety were provided. Furthermore, the international environment, the organisation and the environment itself gives a great enriching experience in many fields.

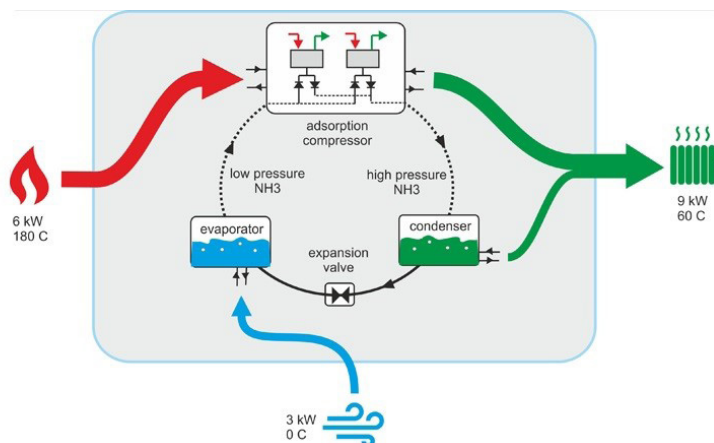


Cooll

Cooll is a start-up from the University of Twente developing a heat pump with a gas adsorption compressor as opposed to an electrical compressor, located close to the UT in Enschede. Through heating or cooling of the compressor, the refrigerant is either adsorbed or desorbed by the carbon contained inside. This generates the pressures required to drive the cycle. Because heat is primarily required to drive the heat pump, many different sources of energy can be used, e.g. natural gas, biogas or hydrogen. Cooll's heat pump has 30% to 50% reduction in natural gas usage and CO₂ emissions compared to condensing boilers.

The aim of the internship was to assess the pressure losses in the refrigerant (ammonia) circuit of Cooll's heat pump. To do this, a model was created in Python based on analytical and empirical relations. The model would determine pressure losses at given operating conditions, mainly the heat demand, outside temperature and the central heating water temperature.

Cooll is a dynamic company with a great atmosphere and helpful colleagues. The assignment was interesting and fun to work on. It provided a good opportunity to get familiar with a large part of Cooll's heat pump and technology.



Demcon Medical Systems

DEMCON develops and produces high-end systems in various fields like medical and aerospace. Currently, DEMCON is developing a steerable guidewire. Guidewires are commonly used for various medical procedures. Typically, guidewires are long flexible wires with diameters of less than 1 mm. These guidewires can be pushed to specific locations inside the body of patients. They guide for instance a catheter or feeding tube. Because of the small incision needed, the surgery is considered minimal invasive.

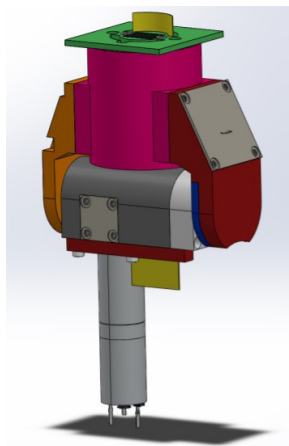
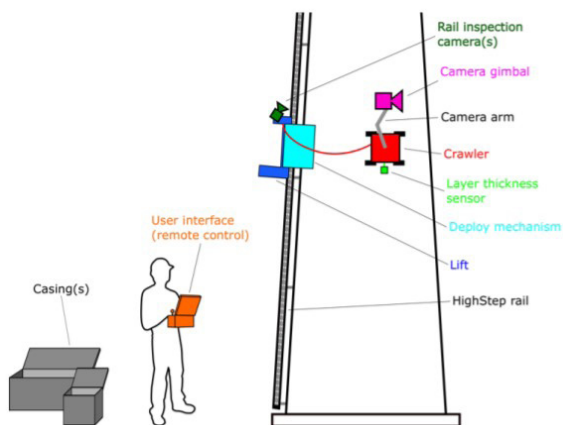
The focus of the internship was on the technical feasibility of a steerable medical guidewire. When needed, experiments were done to verify the feasibility. Furthermore, production companies were contacted to discuss production methods.

Doing the internship at DEMCON was a nice experience. The student could peruse his own interests and was able to develop himself. In addition, it was useful to look at other projects at DEMCON to get a better overview of possible projects within the company.



Demcon Advanced Mechatronics

Student did the Internship at Demcon Advanced Mechatronics in Enschede, Netherlands. The assignment was about designing a gimbal prototype. The gimbal is used for the camera gimbal of a Wintrack Pylon inspection robot as shown in the figure below. The current Win-track inspection method has limitations which led to the request for a new automated inspection method.



The gimbal needs to perform rotations over two axes, shall be weather resistant and needs to be as light and compact as possible to exclude significant design risks for the inspection robot. The prototype satisfied all requirements and can be applied in future projects.

Demcon

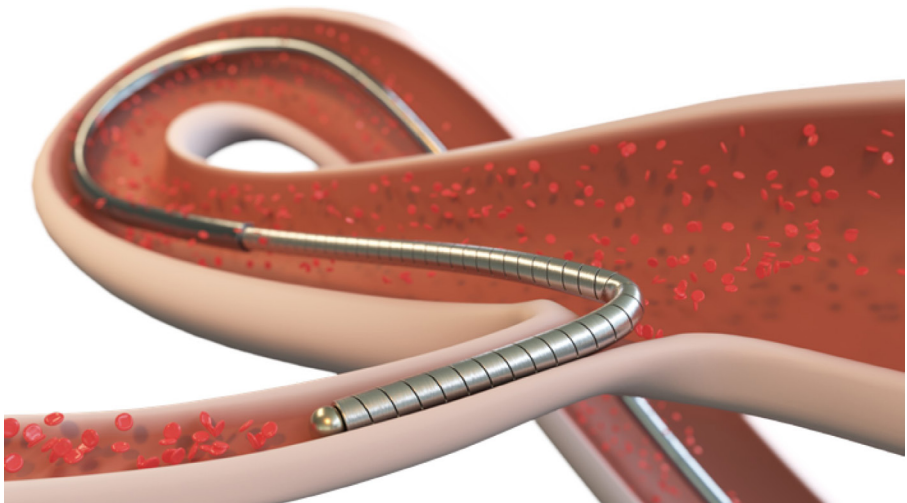
The student did the internship at Demcon. During the internship the student competed with a team of 2 other interns in an ESA (European Space Agency) challenge. The challenge was to design a robot that can (autonomously) navigate and map a moon like landscape and overcome different obstacles. Demcon provided the team with a robot called Dora. Dora is a skid-steering 4 wheeled robot which uses LiDAR, IMU, camera and sonar sensors to navigate and map its surroundings. As a team they were responsible for the software of Dora. In order to connect all the information from the different sensors and actuators, ROS2 (Robotic Operating System) was used. To check whether the ROS2 nodes were working correctly a virtual moon like world was created. Furthermore Demcon supported the student during the internship with a team of engineers from different disciplines and therefore the student gained in a fast way a lot of new knowledge. For the challenge itself the student stayed 3 days in Noordwijk, where ESA turned a hangar into a moon like landscape. During these 3 days the student was able to meet other teams from Europe and see their creations, which was a really cool experience. Overall the student's experiences with Demcon and ESA were very positive, and the student thinks it is a good place to learn and grow.



Demcon Medical Systems

In the steerable guidewire project, the goal is to develop a steerable guidewire for endovascular applications in the smallest category. Currently, guidewires are used for navigation purposes for all kinds of endovascular procedures like placing stents, coils or doing embolizations. However, these guidewires are not steerable in situ at the tip for such small diameters. Together with Memory Metal Holland, DEMCON developed a new concept for a small and steerable guidewire.

The internship consisted of the investigation of friction and hysteresis problems in the new guidewire design. During the internship, the student designed a test setup, made analytical models and linked it to literature. Overall, the guidance during the internship was very good. Besides the external supervisor always being available for help, there were also weekly project meetings to discuss progress and results. Therefore the student had a very positive experience at DEMCON. Everyone is very collegial, friendly and always happy to help when needed.



Demcon Energy Systems

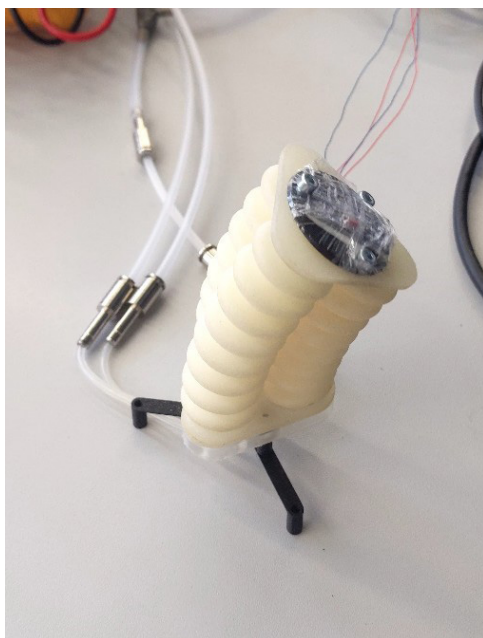
DEMCON is a multidisciplinary company established in Enschede. For the internship the student participated in the project team of DEMCON Energy Systems (DES). This young department was founded in 2021 and is constructing an electrolyzer. A machine that generates hydrogen and oxygen using electrolyte and electricity according to the electrolysis process. The assignment during the internship was to design the core part of the electrolyzer using CAD software. Cells that perform the electrolysis process.

DEMCON has an open door policy what results in colleagues that are eager to help, even if they are not from the same department. It also helped to work in a team with employees of DEMCON to get to know the rest of the company: colleagues, culture. Instead of working alone at an assignment.



Eindhoven University

The internship was done at the soft robotics group at the Eindhoven University of Technology. Soft robotics is one of the fascinating fields that has drawn much attention in recent years due to its high performance and capabilities. The soft robotics group at TU/e is one of the best groups in soft robotics, and works on different aspects of soft robotics, from control and modeling to haptic exploration and teleoperation systems. This internship work was on inverse kinematics solution for soft extensible actuators, one of the challenging problems in this field due to intricate dynamics of these robots. The result of this work was later used to control the robot shown in the picture for multiple solutions. The supervisor and other members of the team were really friendly and helpful, and the student learned a lot about soft robots and their applications in this group. In general, this was a humbling experience in which both the student's technical knowledge and communication skills evolved.



Enerpac

Improving the supply chain of stress wedges for strand jacks by altering the design, coating and material choice

Strand jacks are lifting devices that use a hollow hydraulic cylinder where strands, rigid steel cables, are fed through by clamping the strands at the top and extending the cylinder. The strands can then be clamped at the bottom, allowing the cylinder to retract without lowering the load. These strokes can then be repeated to lift the load higher and higher. Strand jacks can also be placed horizontally for pulling applications. A section view of a strand jack can be seen in Figure 0.1.

The clamping of the strands is done by wedges. These conical threaded wedges are made out of an exotic and difficult to machine material.

Furthermore, the wedges are hardened, glass beaded, plated with 2 different layers, assembled and lubricated before sending to the customer.

Almost all steps are done by different suppliers, resulting in a long and expensive supply chain. Therefore an alternative should be investigated.

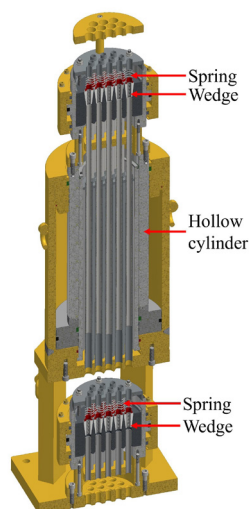
The research is started by mapping the current supply chain and costs.

From here it could be seen that the interest of the material, hardening and assembly are inexpensive and the machining and coating added significant costs. With this knowledge, a new material, hardening

process and coating are chosen. Furthermore,

the influence of the small design differences between the different wedge types was evaluated. This led to a combination of multiple designs which offered the best results in the FEM simulation and the field according to experienced service mechanics. These new wedges can offer similar performance but possibly result in a 47% cost reduction.

Failure of the wedges would mean failure of the strand jack. This can have catastrophic and dangerous results for both loads as operators. Therefore the wedges should be tested properly. For this, a series of tests are developed which will ensure the wedge performs as desired on corrosion, ease in manufacturing, durability and strength.



Feadship DVNA

The First Export Association of Dutch Shipbuilders (Feadship) is a cooperative venture between the shipyards Royal Van Lent Shipyard and Koninklijke De Vries Scheepsbouw. The internship position was at the Knowledge & Innovation (K&I) department of Feadship's engineering division De Voogt Naval Architects (DVNA) in Hoofddorp. The K&I department focuses on identifying and integrate new technologies to create the next generation of superyachts. There is open culture within De Voogt Naval Architects where everybody respects each other and can be their self. The objective of the project was to identify a practical case of predictive maintenance solution for a Feadship. Some interesting cases were revealed by conducting Failure Mode, Effects and Criticality Analysis (FMECA) with service personnel.

Fokker Aerostructures

Fokker Aerostructures Hoogeveen is a company that produces aerospace parts in both the civil and defense industries. Examples are parts of the Gulfstream G650 empennage and empennages and aft-sections of NH-90, Chinook and AW169 helicopters. The company innovates in the usage of thermoplastic composite solutions. Fokker Aerostructures produces non-pressure floorboards for the Gulfstream G650. The floor of a G650 consists of a jig puzzle of smaller boards. These boards are made by folding a thermoplastic flange against the product, with the use of a folding bench, creating a closed box. The question posed for the internship was to investigate the folding process as it is not stable in time and has not been for a couple of years. The machine itself is an old (~40 years) R&D project that was converted to a production machine. The process of finding solutions required a very broad spectrum of knowledge. For the determination of focus points and possible causes, Lean Six Sigma techniques were very useful. Possible causes even included original design flaws in the choice of material for bolts used, which required Material Science and statistics as proof. Electrical and control systems knowledge was also needed for investigation.

Fokker Aerostructures Hoogeveen is a great place to have your internship, the people are very open and honest. As with all companies in the aerospace sector processes are very conventional, so significant process changes are not common. Possibilities for internships can be found in both the R&D and manufacturing areas.



Fokker Aerostructures R&D

During a four-month period, the internship at Fokker Aerostructures R&D department in Hoogeveen included an optimization of a unidirectional (UD) composite tape-slitting machine. Research in production methods using UD tapes is conducted at the R&D department. Originally, these tapes are bought as 12-inch wide tapes and slit by an external company to widths of 6.35, 10 or 48.5 mm. A new machine has been bought to be able to slit in-house in order to reduce costs.

The machine is not yet operational, and the internship included various aspects of improving the efficiency and productivity of the machine. Examples of optimizations are the improvement of splicing strength by means of ultrasonic welding, setting up the correct slitting programs, and redesigning components to fit the needs of the process at Fokker.

Overall, many aspects within engineering were addressed during the internship. Most of all, finding problems and thinking of, creating, and testing possible solutions to overcome these problems.

Theoretical aspects within the internship were mechanical testing of the tape splices and designing new components. Practical aspects were assembling and testing the components or process solutions found, as well as making sure the designed components were actually manufactured. This final aspect also made sure experience was gained with working within a large company across other departments and working together with other companies.



Fokker Aerostructures

Stamp forming of demonstrators for process qualification

GKN Fokker Aerostructures B.V., Hoogeveen is a supplier for aerospace companies, specialized in composite products, machining and assembly of (sub-) assemblies. GKN Aerospace has recently opened a new facility, the Global Technology Center at the Fokker Aerostructures plant, which focusses on developing processes for TPCs. In ongoing research to develop processes to manufacture parts from TPC, the student worked on a project for process qualification of an out of autoclave stamp forming process according to external specifications of a major aerospace manufacturer, such that Fokker Technologies B.V. can process laminates with matched metal die forming for this customer.

During the internship, the student worked in close collaboration with the press operator to manufacture demonstrators. The demonstrators were analyzed on compliance to the external requirements. These results were used to analyze and improve process capability of the stamp forming process to the external requirements.



Groku Kampen B.V.

Groku Kampen is the producer of many stainless steel custom countertops for the professional kitchen industry. The intern was tasked with finding an solution to the heavy workload for employees. Either by decreasing the weight of worktops of by changing the production process. Different materials and production processes where investigated for feasibility. Combinations of different materials and production processes where investigated until a viable concept was designed. A prototype of a undergluing with a selfmade sandwich-panel was made, tested and attached to a worktop. A prototype of a new arrangement and production method in the gluary of the factory was designed. This implemented gluing clamps in combination with moveable carts and a sandwichpanel undergluing. However, this was not tested or produced as time ran short. The selfmade sandwichpanel is the best alternative material to wood, as all other sandwichpanels are too expensive. While the sandwichpanel is also more expensive, this can be made with materials already available at Groku, which made testing such a panel a relatively efficient process. This experiment yielded that sandwichpanels can reduce the weight of the undergluing by 70% and the overall weight by 30%. In some specific cases the sandwichpanel turned out to be even cheaper than current undergluings.

This internship was relatively practical and therefore different from the theoretical approach learned at the UT. However, it is a nice assignment to see those differences and learn about your interest.



H2Trac B.V.

The EOX is a tractor with an electric powertrain developed by the company H2Trac BV. The current prototype makes use of a battery which powers the electric motors. To increase the tractor's range, a range extender in the form of a diesel engine is used. This diesel engine drives a generator which is connected to the battery to charge it. However, as H2Trac wants to make the tractor hydrogen driven, the diesel engine needs to be replaced by a hydrogen fuel cell. During the first part of the internship a conceptual layout to fit all the needed fuel cell system components within the existing frame was made. This is done by first looking into which components are needed and how these components need to be connected to each other. After this the available space for component placing was determined and conceptual layouts were made.

During the second part of the internship a new cab suspension design was made. This as the cab suspension on the current prototype has some design flaws and does not result in a good comfort. To come up with a good suspension design, first a literature study on existing cab suspension systems has been done. After this a conceptual and a detailed design were made. This design was tested using a mathematical model made in Simulink. To validate the Simulink model, test were done with the real prototype and compared with the model. Next to this, a strength analysis on the new suspension design is performed using FEM.



Heves Engineering

Heves Engineering is an engineering firm located in Duiven, Netherlands. The company develops products for the manufacturing industry. The firm operated with weekly follow-up meetings where the progress was discussed between the student and the external supervisor. The communication was professional and friendly and the student was given the opportunity to freely execute the assignment within the boundaries of the project.

During the internship, an upgrading system for biogas has been developed. Biogas produced by a biogas digester contains all kinds of particles that require filtration to achieve high quality biogas. Biogas upgrading systems already exist in the biogas industry, but, only in large size. Therefore, the internship focused on the feasibility of a size reduced upgrading system. For the duration of the internship the biogas itself and the filtration methods were analysed. The obtained information led to the development of a complete scalable 3D-model that is able to deal with small biogas flows. The final model was equipped with the required gas measuring and safety devices.

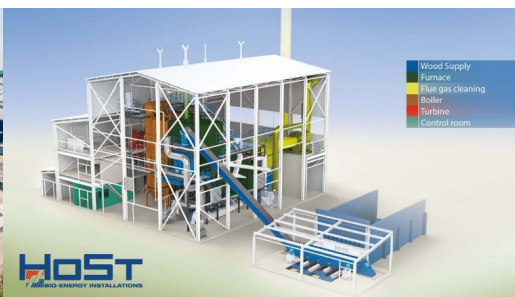


HEVES ENGINEERING

HoSt

HoSt is a company which is been specialized in Bio Energy Installations, based on creating energy from waste streams. HoSt builds installations for two main sectors; biomass fuelled power plants and bio gas production plants. HoSt is located in Enschede and sells their installations internationally. HoSt is the market leader in the Netherlands and a major global actor, in their area of operation.

HoSt is nowadays also working on the development of power plants fueled by Refuse-Derived Fuel(RDF) and waste from the paper industry. These fuels have different combustion and pollution properties than biomass fuels. During the internship the student had to work on the cooled furnace, more specific he had to come up with solution for the heat utilization for the heat subtracted from the cooled RDF fired furnace by the cooling water. To do so installations were visited to look at the fouling in the furnace. Calculations had to be done to design heat exchangers, and based on that simulations had to be made.



HoSt

HoSt is an independent company whose activities are focused on the technological development of waste-to-energy systems. These systems process biomass and other waste streams to supply sustainable energy and help contribute in the energy transition. HoSt has grown into a global organization with more than 200 engineers and bioenergy projects around the world.

This internship was based on the Waalwijk Biomass Combination (Wabico). The Wabico purification plant has been expanded with a third purification reactor with a new design for biological nitrification and-denitrification. The internship associated with this new purification reactor, was to draft a model that calculates the process parameters and predicts/compares the performance of the complete purification process.



HoSt

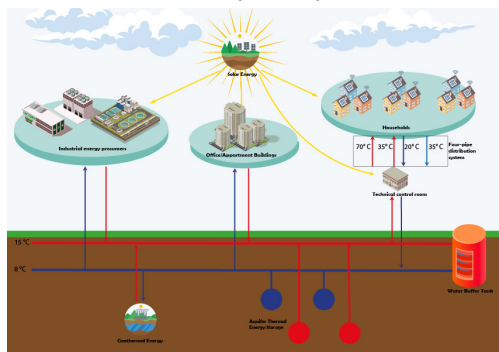
HoSt is a company which designs, constructs, and operating biogas installations. Their main office is located in Enschede, and they have additional offices within Europe and North America. The principal internship task was to model and assess the heat efficiency of a novel manure heat exchanger design being considered for use in new dairy projects. Analytical and empirical techniques were used to validate and assess an offer provided by an external company. Other tasks included site visits in Friesland, lab work, and modelling the profitability of the new heat exchanger designs. HoSt made a strong effort to include the intern, including external company outings. Additionally, the employees were friendly and very helpful.

Huis Voor Energie B.V.

Thermal Grid Development in a Pleasant Company

During the internship at Huis Voor Energie B.V. in Apeldoorn, the student got to work on an assignment in which the student was going to research which components should be present in a smart thermal grid. To answer these questions a literature research and two expert interviews were conducted. This resulted in a clear overview of which components were required for the creation of a smart thermal grid. After the generic smart thermal grid was outlined, the following chapters described every component present in more detail. This description mainly focused on the relevant technologies for different components and how these could contribute to a smart thermal grid. For that, the working principle of every technology was described. Besides the technological aspects of a smart thermal grid, one chapter was dedicated to the legal aspects that are involved in the development and exploitation of a smart thermal grid with a sole focus on Warmtewet (2.0).

The student has enjoyed the stay at Huis Voor Energie B.V. (HVE) in Apeldoorn very much. The company is currently working in multiple regimes in the energy sector; however, they are trying to focus more and more on (smart) thermal grids. In the process of internship, the student has been able to contribute to the company by helping them in their daily business and parallel to that with the assignment. The student has been in close collaboration with really everyone within the company and from the beginning the student felt appreciated, which is a very good thing in an internship, the student thinks. The company and the student actually liked each other so much that the student has continued to work at HVE ever since the internship ended.



Koninklijke de Vries Scheepsbouw

Koninklijke de Vries Scheepsbouw builds ships under the name Feadship. Feadship is recognized as the world leader in the field of pure custom superyachts. At de Vries Aalsmeer the student researched the implementation of methanol in superyacht newbuilds. Designing a system and solving actual technical problems were motivating. This was done at the shipyard at the engineering department. This internship allowed the student to learn more about the marine industry.



Lightyear

Lightyear's main work is focused on bringing a long-range solar electric vehicle with a strong emphasis on efficiency to market called Lightyear One. The company was founded in 2016 and will release Lightyear One



in the latter half of 2022. It currently employs over 350 employees with a large share being young, talented, high performing people. Part of what makes Lightyear a great company to do the internship with is that there are many students doing their internship or graduation and other young people that are working there, so there are many like-minded people that can help with any challenges regarding work, but there is also ample opportunity to get to know other people better during the Friday-afternoon drinks and many other activities organised either for the whole company or for all the students at Lightyear. As an intern, you are welcomed into the company and are given meaningful work and responsibility. Seeing your work is directly useful for the car or other people is highly motivating. To help you grow and learn during the internship you will be guided by your direct supervisor who helps with the project you are working on. Next to this, you get guidance from a general intern supervisor who focuses more on personal development and the challenges of working as an intern instead of a student and other personal related topics.

Working with such driven people as in Lightyear and getting to work on meaningful projects makes Lightyear a great company for an internship, graduation thesis or a full-time job.

For more information on available internships see:

<https://lightyear.one/careers#current-openings>

Luchtverkeersleiding NL

During this internship, the objective was to give advice on how to bring several technical teams together within a department. The internship took place at the department Air Traffic Management Systems (ATMS) of Luchtverkeersleiding Nederland (LVNL). The management team of ATMS wanted to research the possibilities of bringing several teams of ATMS together.

The first task lay in understanding how the teams and departments within LVNL are structured and how they are connected. When the basics were understood interviews with all levels of employees within ATMS were taken and the strengths, weaknesses and differences were inventoried. The results were bundled and processed into an advice for the management team of ATMS. The results were discussed in an interactive workshop where the advice was presented and discussed with the management team.

Marin

Marine Research Institute Netherlands (MARIN) is a top institute for hydrodynamic and nautical research. The internship performed at MARIN was part of a project on the improvement of the blade design of a tidal turbine. A simple semi-analytical model to predict the performance characteristics was previously developed in Python. The goal of the internship was to extend this model for predictions of cavitation inception and for the corresponding performance decay. In a later study, the model could be extended for computations on passively adaptive blades which are expected to improve the cavitation response of the tidal turbine. During the internship, use was made of XFOil and Python. Due to the COVID-19 regulations, a part of the internship had to be done from home. Nonetheless, supervisors were always happily to help with questions and discuss results.

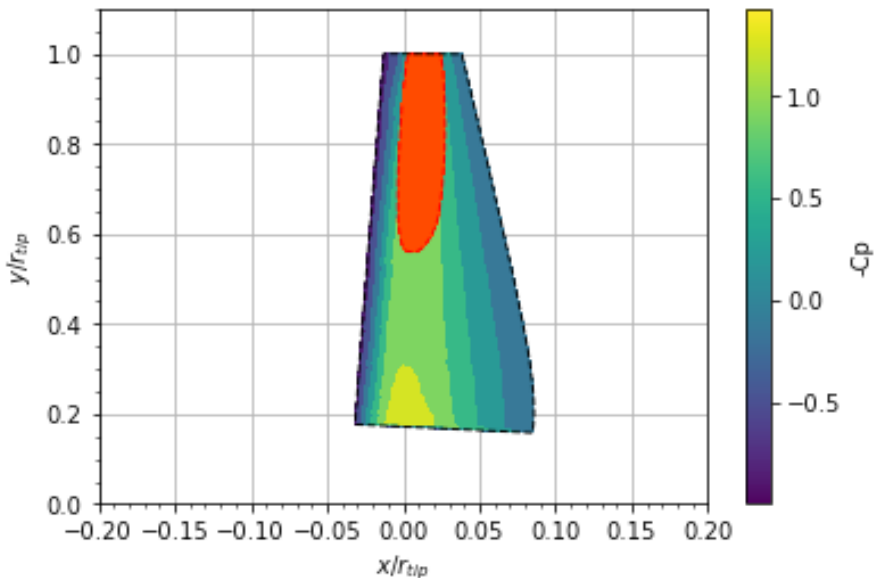


Figure 1. Pressure distribution and cavitation position (red) on the suction side of the blade of a tidal turbine.

Masévon Technology

The internship was performed at Masévon Technology which is located in Hardenberg. Masévon develops and builds modules, machines and full systems for high tech markets. Masévon Technology is part of Masévon Group which consists out of 5 companies with expertise in different areas such as advanced welding constructions, vacuum engineering, precision parts and cleanroom assembly.

At the time of the internship, Masévon was developing a force measuring cartesian stage. The goal of the internship was to investigate and work out how the force sensor of the stage could be used to increase the accuracy of the set-up up to micron range while the stage was subjected to forces in the kilo-Newton range.

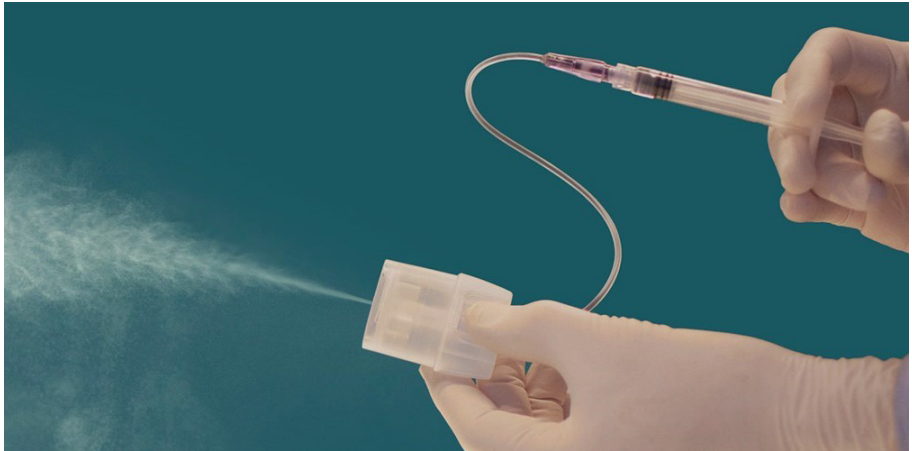
During the internship, a literature study was performed to learn from already existing systems. After that, a control strategy was developed which uses the force sensor measurements and stiffness of the system to reach the desired accuracy. Also, the stiffness and backlash of different components were evaluated to see if these would prevent the desired accuracy from being reached.

At Masévon, colleagues treat interns as equals. Questions about anything can be asked to anyone. The work environment is pleasantly informal.



Medspray

The internship at Medspray focused on the analysis and improvement of the Pulmospray. This device is a nebulizer of liquid, which can for example be used to transport medicine to the lungs. The intern performed a theoretical analysis of the turbulent airflow-droplet interactions and performed measurements in order to validate the theories. Also, measurements have been performed with different mixing chamber designs and a self-developed Pulmospray in order to check the influence of different variables on the efficiency of the Pulmospray. Based on these measurements, possible correlations have been found, which have been used to design a new, possibly more efficient mixing chamber. The intern experienced Medspray as a warm company with lovely people, and would definitely recommend it. On top of that, you get free lunch every day!



Medspray

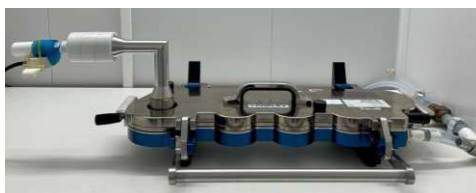
Medspray specializes in creating innovative spray nozzles that are for example used to administer medicine to a patient through inhalation. The concept of Rayleigh breakup is used to produce droplets of which the size can be determined very precisely. However, due to aerodynamic drag forces the droplets collide with each other right after ejecting, causing the droplets to coalesce. During this internship the effect of an added air flow is investigated with the help of a 2D CFD model and experiments. The goal of this air flow is to guide the droplets after ejecting, and to control the droplet coalescence. The student enjoyed working at Medspray a lot. The company gave him the opportunity to set a goal and to reach it by combining CFD simulations with performing measurements. Medspray provided a great working environment with colleagues always willing to help.



Medspray

Medspray is a nanotechnology company that specializes in the development of spray nozzles using the Rayleigh breakup principle to create a fine stream of droplets. Their spray nozzles have different applications such as inhalers, nasal spray devices, eyesprays, perfumes and deodorants. The goal of this assignment was to measure and characterize the performance of a nasal spray device that uses Medspray's nozzle technology to deliver aerosol to both the nasal cavity and lungs simultaneously.

The performance of this device is related to the droplet size it produces as



this determines where the aerosol ends up inside the respiratory system as well as the losses inside the device. Since medical aerosols are usually polydisperse, the average particle size is expressed with a measure of its central tendency, the mean average aerodynamic diameter (MMAD). The device consists of 3 main parts, the pump, the main body, and the nasal adapter. The nasal adapter is a small part that fits on top of the device and acts as the interface between the patient's nose and the device to allow proper fitting and drug delivery. To minimize the losses inside the device, several nasal adapters were developed and tested based on the use of multiple conical shapes and angles in order to manipulate the flow characteristics inside the adapter so that the particle depositions are limited. Several measurement methods were used to evaluate the MMAD as well as losses such as aerodynamic particle sizer (APS), laser diffraction, impaction and the invitro nasal cast assessment. The test setup for the next generation impaction (NGI) can be seen in figure 1.

This internship was a valuable learning experience as it not only helped put existing practical research skills and knowledge to use but also helped in learning more about the practical applications of fluid mechanics in the industry, experiencing how to work in a laboratory and conduct measurements using pharmaceutical testing equipment and of course gaining a working experience in a company environment and making connections that help boost one's career.

Ministerie van Defensie

To advance the energy transition in the Dutch armed forces, the military's department for Concept Development and Experimentation launched a project with TNO and the UT aimed at researching novel energy systems for military base camps. The military committed itself to make base camps fully self-sufficient in terms of energy by 2050 and so the three-month internship conducted within this project dealt with the development of a hybrid energy system relying on diesel generators in combination with PV panels and battery energy storage. The energy system was designed for the UN base camp in Mali and real measured energy data of the camp has been used for dimensioning the PV and battery systems. Using a simulation framework for decentralized energy management developed at the UT, the system has been optimized with respect to a certain generator base load and subsequently evaluated regarding the reduction of diesel fuel consumption.



Oostendorp Apparatenbouw

The internship host company, Oostendorp Apparatenbouw B.V., is known for manufacturing and repairing high pressure and vacuum equipment. The student worked on reducing the company's high yearly energy consumption costs. The student did an energy scan on the facilities that involved taking equipment inventory, analyzing energy consumption data, and interviewing employees. The student focused on reducing the heating related consumption by gas fired heaters and boilers while a fellow intern covered the electricity consumption.

Based on the identified problems in the energy scan, the student looked for solutions by consulting government websites and experts from external companies. The student devised optimum solutions after considering their financial implications and fitness to company conditions. Finally, the student recommended purchase and installation of energy efficiency improvement products, adjustments on daily operations, and establishment of a company wide energy management system.

In addition to improving technical knowledge, the student learnt about the company business from the lively discussions the student had with the Oostendorp family. The student had to use Google Translate frequently to understand company documents written in Dutch, but verbal communication was not difficult for the student as the student enjoyed learning a bit more of the language.



Oostendorp Apparatenbouw

Oostendorp Apparatenbouw (OAB) is a Dutch manufacturing company that was established more than 100 years ago in Tiel. It is specialized in the fabrication and repair of custom-made static (pressure) equipment, and it was well known amongst the petrochemical industries. The internship main assignment is to identify the company's main electricity consumption during the production activities, reduce electricity consumption during peak and off-peak hours and create the implementation plan of the proposed solutions. The market research for sustainable energy technology products was also conducted, such as hydrogen storage and biomass reactors, which may suit for OAB to contribute for Energy Transition. Overall, the assignment is very interesting and related for SET students, since the final solution of the problems should be both scientific, simple, and financially feasible for the company.



PVC Group

The PCV group is a small engineering firm located in the a beautiful mansion near the centre of Enschede. Even though it only has around 40 engineers, they work on diverse projects. Due to confidentiality, the student cannot say anything about the multiple projects the student worked on. The student was free to choose which projects to join and what spiked the student's interest. This way the student was able to focus on control theory, software project, and SolidWorks since the student wanted to improve in these areas. In addition to hard skills, the PCV group teaches an intern about their way of documentation (using PowerPoint) and way of working. During an internship you are also allowed to join their internal course which, during this internship, was about quality control.



Pertamina Power

Computational simulation of output enhancement due to bifacial modules and light management strategies

Bifacial PV modules allow the light to be absorbed both from the front and rear surface which makes the energy production becomes higher than monofacial PV modules. This becomes the interest of the research to find the effect of replacing Monofacial PVs in Badak



Solar Power Plant in Indonesia with Bifacial PV Modules. The simulation method using PVSyst software is demonstrated in the research because it is impossible to do the study physically in the location in this time period due to Covid-19 restrictions in Indonesia. PVSyst is the most widely used solar simulation software for the energy yield estimation and the optimal design of solar power plants. The simulations use Meteonorm data for the irradiation data because it provides reliable meteorological data in any place around the world. The simulations are demonstrated 3 times. Firstly, simulation of monofacial power plant with aim to compare the results of simulation and actual data which shows a 1 MWh difference. Secondly, the simulation of Bifacial Modules Solar power plant which shows an energy improvement of 9% higher than monofacial power plant. Thirdly, to find the optimal values, pitch, elevation, and the tilt angle are varied. It's found that with the pitch of 6 m, tilt angle of 5°, albedo of 0.3, and elevation of 2 m, the energy gain 11% more than monofacial modules. In addition, the variation of albedo is done to see the difference in energy production and performance ratio. To enhance the energy production, 2 light management strategies are explained and analyzed. Afterwards, the most suitable light management strategy for the power plant is proposed by the writer. Finally, the Levelized cost of electricity (LCOE) and CO₂ emission produced by the solar power plant are calculated.

Reden B.V.

Reden provides consultancy for engineering problems located in Hengelo. They primarily focus on modeling and simulations. With these models and simulations they can provide extensive information about systems to their clients. Since they perform so many simulations the internship assignment was part of an effort to reduce computational time for certain simulations. Most flows can be described as a continuum. Flows that cannot be accurately described as a continuum are rarefied flows. Flows in the continuum or rarefied domain can be accurately simulated using CFD and DSMC respectively. The CFD method is far less computationally heavy compared to the DSMC method, so it is preferred to use the CFD method whenever possible. However, a problem arises when a flow is partly rarefied, while the other part is well into the continuum regime. This would mean CFD would not be accurate, because of the rarefied part, and the more expensive DSMC must be used for the entire flow, but that would be very computationally heavy due to the continuum part. The optimal solution would be to use DSMC only for the rarefied part of the flow and the rest of the flow with CFD. This would create a boundary between DSMC and CFD results, which would require mapping the DSMC data to values usable for CFD.

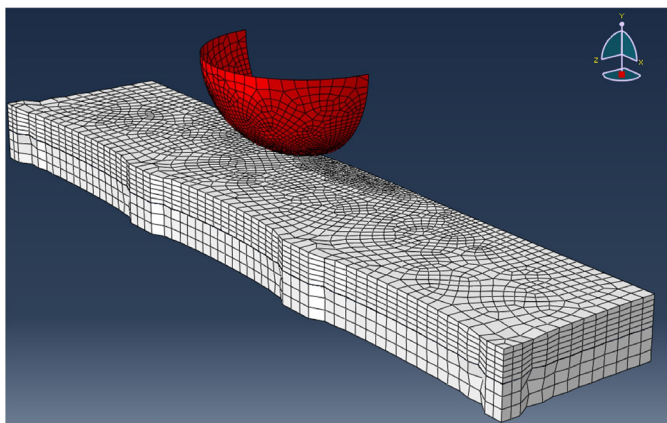


Reden B.V.

During the internship at Reden b.v. (Hengelo, Overijssel), a transition from an old version of Abaqus to the newest version of Abaqus was made. This was done by converting and rebuilding a bunch of existing models to ensure compatibility with the latest version of Abaqus. After this conversion, the parametrised models were validated extensively using a developed validation tool. This validation tool can be used in other projects in the future as well. Moreover, simulations using these aforementioned models were used as a measure of successful conversion as well. In this way it was ensured that the transition to the new version of Abaqus regarding those models went smoothly and the outcome was reliable. Overall an exciting internship in a very welcoming team with always someone willing to help when needed.

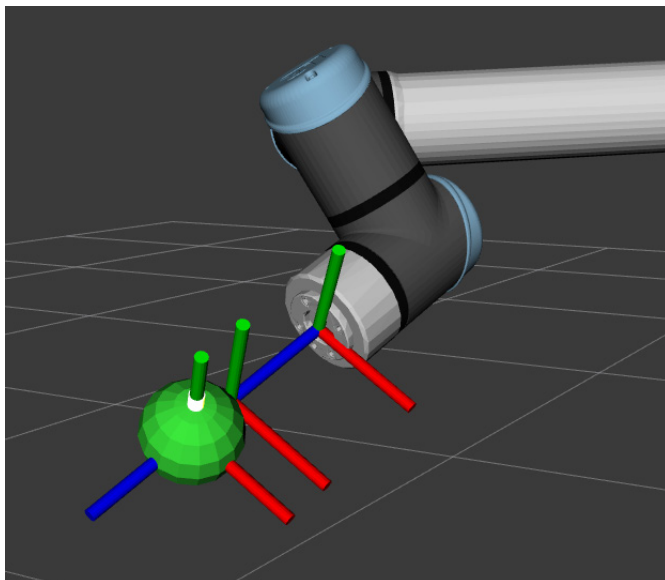
Reden B.V.

Cardiac Catheterisation is a common procedure to diagnose or treat a variety of heart problems. The UPSIM project wants to produce a 'Digital Twin', a real time virtual representation of the device-human interaction. Then, provided that the results are credible, the complete product life-cycle is known and a better quality assurance can be given, to deliver better products with less development time. This report focuses on a segment of the problem: the device-tissue interaction of the catheter and the aorta. Literature research on a variety of experiments has been done to understand the underlying mechanisms. From these experiments can be concluded that the coating applied on the catheter has a significant impact on the interaction. Polymer brushes exist on the surface of the coating, which results in hydrophilic behaviour and as a consequence gives it its low frictional properties. It is also seen that the aorta damages rapidly after the coating is completely deteriorated. This could be a significant threat to the patient. A wear model of the coating has been made to quantify this deterioration based on Archard's law. A predictor/corrector scheme is implemented to increase the stability and the model is successfully validated by various use-cases. Finally to demonstrate the capabilities of the model the wear behaviour of an experiment where a coated PU-sphere slides over an aorta is made visible.



Riwo Engineering B.V.

Riwo is a company located in Oldenzaal, and operates in the field of industrial automation and machine and process control. Besides, there are multiple robotics and vision projects ongoing in their R&D department. One of those projects aims to develop an autonomous apple picking robot. The goal of the internship assignment was to investigate how the current apple picking movement could be improved, and integrate the findings in a simulated environment using the open source software frameworks ROS2 and MoveIt2. The assignment required to study the apple picking motion and describe it in a systematic way, taking into account multiple factors of the apple, the environment and the robot itself, such as apple orientation, surrounding obstacles and robot positioning. In addition, those findings needed to be translated to a program to control the robot, which was tested in simulation. The assignment was challenging and multifaceted, which gave opportunities to learn more about robotics and to develop myself.

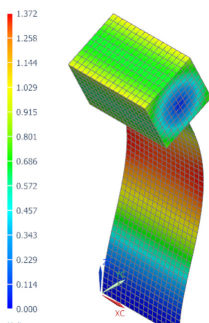


Sioux Technologies

Sioux Technologies in Eindhoven is a global technology partner that supports or acts as the R&D department of high-tech companies. Their activities span a broad range, from software development to mechatronic system design.

Clients of Sioux Technologies ask for more and more predictability of their machines and therefore predicted (FEA) natural frequencies and mode shapes must be verified. The activities conducted in the internship period focused on validation of a new modal analysis software package. The workflow this software offers was applied to simple and more complex systems. The ultimate objective was to verify the numerical model of a system by correlating experimentally observed modes shapes with their predictions.

Although the assignment was an independent research, as an intern you are placed in a team and therefore you are surrounded by experienced engineers who are always eager to help. While the internship was carried out in the Mechatronics department, sometimes help from the Mechanics or Realisation & Test department was required. The open culture made it easy to ask questions to people in those departments. It also made it possible to get exposure to the different kinds of projects a high-tech company like Sioux Technologies is working on.



Solar Team Twente

In edition 2019 of Solar Team Twente, extra care was taken to improve the aerodynamic design process. This was done in three ways: by developing a CFD-based simulation that takes into account rotating wheels, by designing a test set-up to be able to do experiments on rotating wheels and surrounding aerodynamic bodies, and by designing aerodynamic bodies, both internal and external parts of the solarcar, that reduce its total drag.

The rotating wheel simulation was set up successfully, showing good agreement with data from the windtunnel and testdrives. The aerodynamic fairing bodies, referred to as 'shoes', that were designed showed a small reduction in total drag as well. Sadly, the practical implementation of the shoes on Red E had to be discontinued due to time constraints.

The mentioned experimental test set-up was designed with help of engineers of the company Demcon, a partner of Solar Team Twente. The design was finished and reviewed, but has not been build yet due to time and budget constraints for both Solar Team Twente and Demcon. As the current car, Red Horizon, does not fit the design anymore, it is put on hold until a smaller solarcar is designed in the future.

To improve the aerodynamic resistance of the car, inner wheel covers were tested and designed. The experimental results on the single wheel configuration show an decrease in induced drag.

Overall, a significant improvement was made in understanding the influence of rotating wheels on the vehicle drag and the approaches to mitigate the effects.

Technological University Cyprus

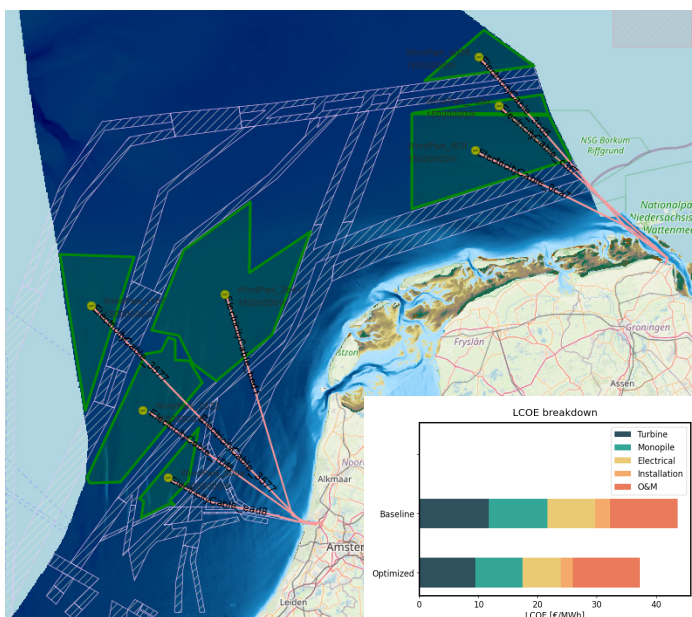
The goal of this internship project was to create a dynamic model of a quad rotor having small scale helicopters instead of common dc motors to provide thrust. This major difference gives high maneuverability to the user and allows the quad rotor to perform difficult trajectories easier as compared with traditional UAVs. Despite the increased maneuverability that the helicopters provide the dynamic model is way more complex than typical UAVs. Due to that a dynamic model was obtained, where many physical and aerodynamic phenomena were considered to have a model that is as accurate as possible. Additionally a kinematic model for the swashplate mechanism is proposed to reduce the computational power in real flight conditions. Finally, the dynamic model is evaluated using some reference inputs. Throughout this internship project the student explored many different aspects regarding the Unmanned aerial vehicles but the student also realised the several difficulties that occur in the development and control procedure.



TNO

Offshore Wind Energy

TNO is a research institute which performs studies on a variety of topics. The offshore wind department is concerned with everything regarding wind energy: fluid mechanics, structural mechanics, electrical, control, system integration and techno-economics. In this project a software tool was developed to assess the levelized cost of electricity (LCOE) of new offshore wind projects in the Dutch North Sea. For this purpose, a python based cost model was developed and integrated with a GIS application. The user of the software can draw a wind farm on the map and provide key design parameters such as rotor diameter and power, the software then calculates cost components for every part of the project and gives LCOE estimates per component. This can be used to identify favourable locations for new offshore wind projects.



TPRC

The internship took place at the ThermoPlastic composites Research Center (TPRC). TPRC is a research center for thermoplastic composites where experts work together on increasing knowledge of materials, their behavior, product design and processing technologies. Their primary aim is to enable a more widespread use of thermoplastic composites by joint research and development. Companies can sign up as partners of the research center and have access to all the research generated in the field of thermoplastic composites. Some of the partners of TPRC include Boeing, GKN Aerospace, Toray Advanced composites and the University of Twente.



The internship involved the repair of impact damage on laminates consisting of carbon/low-melting PAEK composite material. With thermoset composites, the only way of repairing a laminate is through patching the damaged area. However, with thermoplastic material it is possible to repair damaged laminates by melting the matrix material and pressing it in its original shape. A lot of research still has to be performed to make this a viable and reliable repair method. The internship project involved reducing the heat and time input in the process and the effect of pre-reconsolidation heat treatments on the quality of the repaired laminates.

Since thermoplastic composites are promising, versatile materials that have not yet reached the maturity to be widely used in the industry, there is a variety of research performed at TPRC. TPRC offers a great work environment with friendly and supportive staff.

Trioliet

Trioliet is a leading family-owned company that specialises in the development, production and marketing of feeding machines

and systems for livestock farms and is based in Oldenzaal. Trioliet is the market leader in the Netherlands, thanks to more than 70 years of experience in the field of feeding technology. The products range from silage cutters to fully automated feeding systems and stationary mixers for biogas plants.

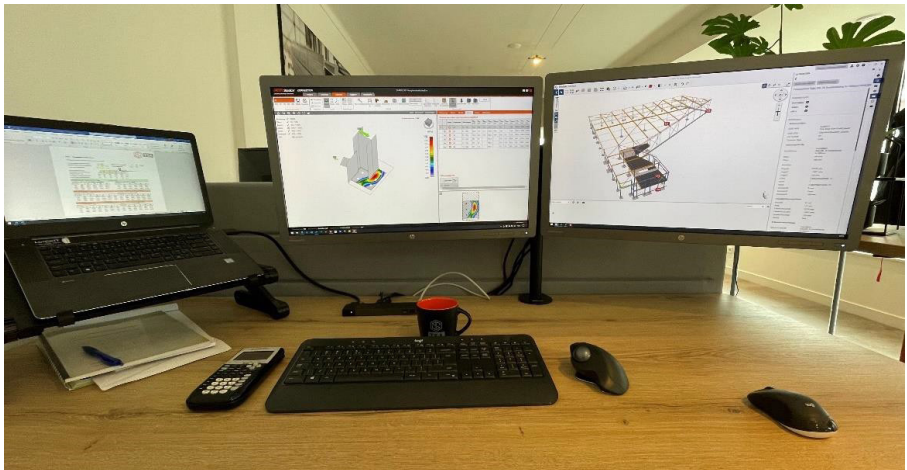
During the internship a redesign of the onboard hydraulic system for the trailed feed mixers was considered, from setting up the requirement to building and testing the first prototype. The internship was started with a week of working and looking around in the factory, to get to know the company and the machines. After that the work at the R&D department started. The Solomix R&D department is a young and enthusiastic team, with whom humour and enjoying your time at work is important. The colleagues throughout the whole company were very open and helpful with any questions.



TSA Engineering

TSA Engineering in Albergen is a consultancy firm that specializes in all aspects of steel structures. Mainly aimed at industrial buildings such as big offices and distribution centers. For these buildings multiple tasks are done at TSA, consisting mainly out of main- and detail calculations on structures or components, optimization of steel structures, second opinions and welding advice. The main customers consist out of Van den Brink, Tasche and Bincx, which are all companies that are of great importance in the construction industry. The activities conducted during the internship period were focused on optimizing connections for multiple construction designs.

After optimizing these connections, a library was made within the software that is used for the design of the structure details such that they are available within the program for everyone within the company. Next to that, customer assignments were also done in collaboration with colleagues, during these assignments the other engineers treated the intern as their equal, resulting in a serious, and most importantly, pleasant work environment where an intern can feel like a normal and respected employee within the company.



Valstar Simonis

Valstar Simonis is an engineering consultant in the field of sustainability, circularity, comfort and safety in buildings. There are various challenges regarding technical installations in buildings. The sustainability demands in buildings become stricter and stricter, so it requires development.

The development that was focused on during the internship, is the optimal use of PV panels. PV panels are a promising source of sustainable energy, but also bring challenges. Especially in high buildings with a relatively small rooftop area, providing enough electricity with only PV panels is difficult. Energy calculations were done during the internship and the possibilities of coupling electric vehicle charging were investigated. Data from current and previous projects was used to perform the calculations and draw conclusions.



VDL ETG

At VDL ETG in Almelo, complex parts are manufactured and assembled into complex (sub)assemblies for high tech industries like the semiconductor, medical and aerospace industry. As the technology progresses, so does the complexity of the manufactured parts. Currently the dimensions are kept track of, both automatically by Coordinate Measuring Machines (CMM) and operators who fill in the results manually on an Inspection Management Sheet (IMS).

To ensure a repeatable and precise manufacturing process of parts in the future, VDL wants to make use of Statistical Process Control (SPC). If all measurement results are saved digitally, it is possible to monitor the production process in real-time and intervene if that is required. This leads to less scrapping and therefore reduces the costs of manufacturing.

The research done during the internship is the first step into implementation of a digital IMS. It contains a broad exploration into the employees and the software at VDL. The current existing IMS and a digital prototype from another department were analysed as well. This knowledge is combined and converted into system requirements. Similarly, the system workflow and data flow are mapped. The existing prototype at VDL was modified to fit the finishing and milling department. Additionally work instructions were written to support it. This mock-up was tested with operators to find out how improvements could be made. Finally, a research into the features of commercial applications like Sylcom and Inspection Manager has been performed.

Recommendations were written for an improved version of the existing prototype IMS, such that the IMS could be used in other manufacturing departments of VDL too.

Also step-by-step plan is written towards implementation of this existing IMS. However, it could also be that VDL chooses to buy a commercial solution. That is for VDL to decide.

