Connecthor 41

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Magazine of e.t.s.v. Thor and the department of Electrical Engineering at Eindhoven University of Technology

March 2018

LAN party | **Blue Jay** | Internship abroad | Thor **Lustrum** | Cooking club | **PhD** Research

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In front of you lays, hot off the press, a brand new Connecthor magazine. It is filled with different articles written by personnel and students.

We started this year with a New Year's gathering together with our colleagues of Applied Physics. Our dean Bart Smolders gave a short speech about the high- and the minor lowlights of the year 2017. This New Year's speech is printed in the magazine along with the pictures taken during this merry event.

We are very proud of the achievements of the people in our department and their work. We have an article written by Roeland Dilz about his PhD research on optical gratings for wafer metrology. Student team Blue Jay explains about their challenge for building a drone to be used indoors for health care purposes. One of our layout editors, Birgit van Huijgevoort, went to New Zealand for her internship. Her experiences can be read on page 28 and 29.

Master Student Thomas Brok, also known as Luminite, shares his double life story with us. We also look back at some of Thor's festivities during their 60th anniversary.

We have added a new fun item to our magazine, the Cooking Club. Since we have many different nationalities within our department and we all need to eat, we thought it to be a good idea to write a story behind a certain dish and add the recipe. We start off with a typical Dutch dish. Please feel free to hand in your story and recipe about a regional dish from your country.

We hope you enjoy reading this March edition.

The Connecthor editorial board

P.S.: The Connecthor editorial board has positions open for creative and enthusiastic employees of the Department of Electrical Engineering interested in joining us to make the Connecthor magazine. Up for a new challenge? Please contact us!! As always, we will be glad to receive your suggestions and nominations for the 'vlaai' and ideas for upcoming editions. You can contact us via connecthor@tue.nl. ■

Blue Jay
Read about Blue Jays new drone on page 10.

Charles Proteus Steinmetz
You can find out about Charles Proteus Steinmetz on page 27

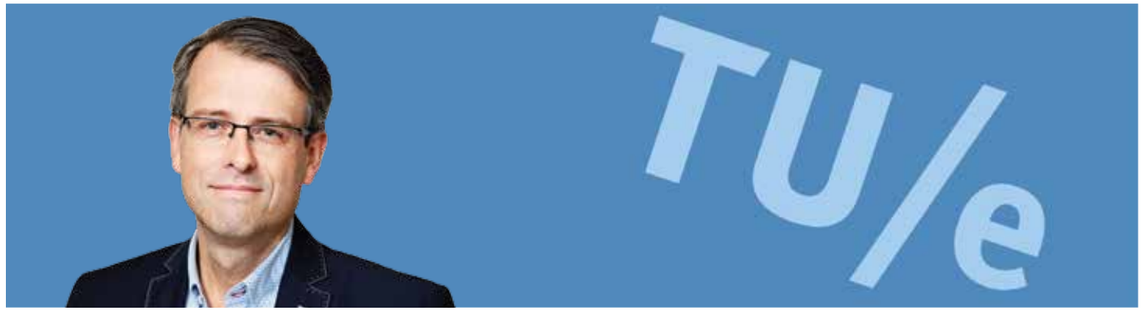
Luminite
Read about Thomas Brok his career as a master student and DJ on page 18

Lustrum Thor
Read about the XII lustrum of Thor on page 14

Internship Abroad
What is it like on the other side of the world? Read more about Birgit van Huijgevoort her intership in New Zealand on page 28.

New Year's Speech 2018

By: Prof. dr. ir. Bart Smolders



Dear colleagues and students of Electrical Engineering,

First of all, I would like to wish you and your loved ones a Happy New Year and good health. Despite the growing work load in our department, I hope that you will all continue to enjoy working in our nice Flux building. If not, please let me know.

2017 low- and highlights

Let us first look back towards the year 2017. Fortunately, we did not have major lowlights in the department as compared to previous years when our respected colleagues Harm Dorren, Wil Kling, Ralph Otten and Barbara Cornelissen passed away. A minor lowlight in 2017 was the fact that Twente University took over our first position as best Bachelor in Electrical Engineering in the national student enquiry (NSE). Of course, we will do our best to get back on top of this ranking this year.

We did have several highlights in 2017. First of all, the intake of first-year Bachelor students remains high, stabilizing at a level between 250 and 300 freshmen in the past three years. We are very happy to attract a lot of new talented students, but we need to manage the increasing workload properly in the upcoming years. We agreed with the board of the university to have a maximum capacity of 350 first-year students. Another highlight is the introduction of the BEP and Master market places to organize the large number of students and projects and to obtain a better distribution of students over our research groups.

In December 2017, the research assessment of our department took place. This happens in a cycle of six years. Based on our self-assessment report and a one-day visit of the international committee, the committee provided us with first feedback. The committee was very positive, ranking the quality and quantity of our research between very good and excellent. Especially, the visits to the research groups have been appreciated a lot. The full report including all recommendations will become available in March 2018. Another highlight was our success in acquiring new research funding, including several personal grants, European projects and "NWO-perspectief" programs. Next to this, we were able to appoint the Director of our Center for Electrical Energy Technology and Systems (CEESTe). We are very happy to have professor Korneel Wijnands on board to take the lead in making a success out of this center. The last highlight of 2017 was the 60th birthday of Thor for which our students organized several activities, including a special Thor lustrum radio station.

2018 Outlook

Our financial situation for the upcoming years looks very promising. Therefore, we were able to reserve additional budget to accommodate the growth of our department. Several new assistant professor (UD) positions are available in the upcoming years. Next to this, we have funding to hire additional teaching assistants (student-assistants) and "PhD-plus" candidates who will get a 5-year contract with an education load of about 25%. Next to this, we expect the Master market place to help us to distribute our graduate students more uniformly over the research groups.

At university level, the new strategy towards 2030 will be defined this year. This new strategy will have serious implications for our educational model. Strategy 2030 will also stimulate cross-departmental multi-disciplinary research topics. I would like to invite you all to contribute to the strategy 2030 discussions in the upcoming months. It is important for our and your future!

Bart Smolders ■

From the President

By: Laurens Kok

There is something hanging on our door: 'Bestuursinteresselijst'. It feels weird, but we have started the process to find our successors. The people on the list right now are the kandi-kandi-kandi-kandies, or in short the kandi^4's. These are the people who might be interested in becoming involved in becoming the possible candidates to become the next candidate Board. Let me talk you through the process of becoming a Thor Board member.

The process starts with the kandi^4's showing up to the Board information lunch. There the Board members explain how it is to be a Board member, what everyone does and what you can expect as a Board member. After this meeting, the kandi^4's decide if they want to continue. The people who do are now the kandi-kandi-kandies (kandi^3's).

The kandi^3's need to form the group with which they want to become the next Board. They have to decide on the number of Board members and the tasks they are going to perform. To decide they write a plan on what they want to do during their year. The plan determines the number of Board members, not the other way around. It has to be prevented that there is one Board member who has nothing to do, or a Board member too little to make all those amazing plans a reality. When they have determined the amount of Board members and the functions are divided, they are now the kandi-kandies (kandi^2's).

The kandi^2's present themselves during the active members day. During this day the kandi^2's have to try getting into contact with all of the active members, to show them that they are capable of convincing the freshman that Thor is indeed, the 'gaafste' association of them all. After the active members day the kandi^2's get back to their policy for next year. After being sort of confident in their plans, they present them on the kandi-ALV (general members meeting). If the members of the GMM are convinced that the plans the kandi^2's have presented might be, after 'some' modifications, something that could work, they take a vote. If successful, the kandi-kandies are now the official kandies of Thor.

The fresh kandies go into the infamous 'kandi-periode' where they need to get themselves known, convince members of their ideas and prepare themselves for their functions as Board members. The most important moment in this period is the introduction week. Whereas other study associations choose to make their kandies intro-parents, within Thor the kandies have absolutely no responsibilities, except for one: making sure the kiddos (freshmen) have the time of their lives. By doing this, they need to convince the kiddos that they will be a Board to look up to, that will do anything to make their studies as fun and interesting as possible.

After convincing the freshman, the kandies need to convince the older-year students. Their challenge is the kandi-drink, on which you can read the article written by Thomas van der Werff in the previous Connecthor. After this drink the former kandies are now officially the candidate Board members of e.t.s.v. Thor.

The candidate Board members are now ready to present their final plans on the wissel-ALV. The members give them their last feedback and advice on their plans. After that, the current Board continues to the part where the kandies have been working to all this time. One by one the Board is discharged, ending with the President. With one scale of Mjölnir (our association hammer) the current President is discharged and the candidate-President is installed as the new President of Thor. The President then installs the rest of his Board members. The new Board is now ready.

Veel gedonder!
Laurens Kok
President of Thor ■

Fons van der Sommen Cum Laude

On November 15, 2017, Fons van der Sommen (VCA) gained his PhD with distinction. He defended his thesis, titled 'Computer-aided detection of early Barrett's cancer'. His promotor was professor Peter de With.

New driptrays 'Het Walhalla"

During the Christmas break Het Walhalla got new drip trays. It took a whole week to take out the taps, remove the old drip trays, renew the wood, install the new drip trays and to install the taps again. All efforts paid off, as from now on all the bartenders of Het Walhalla can enjoy the new and shiny drip trays.
The reason the old drip trays were renewed was because the wood started to rot and the silicone mastic between the different compartments started to fade away. Now, there is waterproof wood and less gaps with silicone mastic. Now, there is also much more space for glasses.

Dr. Nikolaos Paterakis (EES) was listed as one of the Best Reviewers of IEEE Transactions on Smart Grids in 2017.

In recognition of the commitment and active participation in the peer review process for the Transactions, dr. Paterakis was also recognized as one of the Best Reviewers of IEEE Transactions on Smart Grid in 2015 and IEEE Transactions on Sustainable Energy in 2016.

Kick off Spring Semester Electrical Engineering (BSc & MSc) and Automotive (BSc)

On February 6, 2018, all bachelor and master students were invited for the kick-off meeting in the large lecture hall of Flux for presentations by Sjoerd Hulshof and Huug de Waardt on our education system of the past six months and what to expect in the near future. Daan Daverveld gave an update on Student Body Eindhoven. Arjo van der Ham, co-founder and research and development, from Lightyear talked about the Lightyear Mission. TU/e Electrical Engineering alumni Hans Crijns, product line manager at Genexis, talked about his career after graduation. The visiting students were invited for an informal gathering in Het Walhalla, in the late afternoon, for free drinks and to have a chance to fill out the National Student Survey Questionnaire (NSE).

Appointment Prof.dr. Guid Oei

Prof.dr. Guid Oei has been appointed Officer in the Order of Orange-Nassau on Thursday November 16, 2017.
He received this royal distinction for his outstanding work in the field of Obstetrics and Gynaecology. Guid Oei devoted himself to make pregnancy and childbirth safer.

Scoop for EE: first doctorate awarded without a professor

On November 22, 2017, an associate professor conferred a doctoral degree. Roeland Dilz had associate professor Martijn van Beurden as his principal supervisor.
Roeland Dilz's promotion research had the title 'A spatial spectral domain integral equation solver for electromagnetic scattering in dielectric layered media'.

Nico Baars Cum Laude

On November 6, 2017, Nico Baars (EPE) gained his PhD Cum Laude. He defended his PhD thesis, titled 'Three-Phase Dual Active Bridge Converters; a multi-level approach for wide voltage-range isolated dc-dc conversion in high-power applications'.

Storm Damage

During the storm on Thursday January 15, 2018, a roof cap of approximately 4 meters at the north side of Flux came loose and fell on the parking area. Fortunately, no one was hurt and no vehicles were damaged.
The Emergency Response Officers of Flux and later also the officers of Gemini, acted fast and effectively by closing the building and by blocking the immediate surrounding. As soon as the storm settled, the roof cap was well secured to the adjacent 30 meters. The whole rooftop of Flux will be checked and if necessary repaired. The guarantee with BAM will be called upon.

Orientation days January 12 and 13, 2018

25th promotion Ton Koonen

In celebration of his 25th promotion, the Executive Board awarded Ton Koonen with a special art piece. Ton Koonen was first promotor of all these promotions. The 25th PhD student is Netsanet Tessema.

Graduates December 2017

Photo by Photodette

Graduates December 19, 2017

Arjan Johannes Petrus Maria de Meijer
Iulian Dobrovolschi
Dimitrios Barakos
Paulus Martinus Hubertus Vissers
Safee Hussain
Martijn Franciscus Johannes Lunenburg
Khodr Hammoud
Remco Wilhelmus Theodorus Bonten
Yan Lu
Raja Bhattacharjee
Gijs Derk van der Wal
Xiaoding Zhu
Pedro Dos Reis Petrucci
Luuk Anton Eli Maria van Knippenberg
Peiran Chen

IPI event

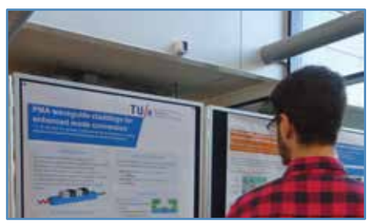
By: Jan Vleeshouwers

On a regular basis, the Institute for Photonic Integration (IPI) organizes networking events where research results are presented in a couple of presentations and about twenty posters.

In the IPI, several groups from EE and AP cooperate. From EE, the Photonic Integration group and the Electro-Optical Communication group are involved. From Physics, four groups particiate: Physics of Nanostructure (FNA), Plasma and Materials Processing (PMP), Photonics and Semiconductor Nanophysics (PSN) and Advanced Nanomaterials and Devices (AND).

In the last session (of November 10th), Mark Lalieu presented the advances made in the research of specific nanostructures which change magnetization when hit by femtosecond laser pulses. These changes are permanent and reversible: a next pulse returns the magnetization to the original state. This mechanism might open up possibilities to create a dearly missed optical building block, the optical memory.

In the following poster session, PhDs from the groups presented their work for an audience of IPI staff and others.The next IPI event will be on Friday April 26th. ■



TesLAN

By: Kars van Kessel

The TesLAN, which found its roots as a small LAN-party first organized by the freshmen committee Ivaldi 2014-2015 and then the ACCI 2015-2016 in the GasLab, has grown to a big event in a fully packed sports hall. The first edition of the TesLAN in the Student Sports Centre missed some of the coziness that the GasLab provided, but the new location gave room for expansion. The potential of the new location was made use of in this second edition, with over two hundred participants. Those participants did not only come from the sixth floor of Flux, as the TesLAN is starting to become a prominent event recognized at the entire TU/e. But even the campus didn't span the entire range of participants; from all over the country people came to the LAN because of the good atmosphere, amazing facilities, and the great prizes. There was even someone who flew over from England to participate.

There was a stark contrast between the fanatic gamers with their multiple monitor setups or a forty-inch screen, and the more casual gamer with a laptop. Some took the casual gaming to the next level and gathered around a table to play some tabletop games, the old school analog way. Meanwhile the fanatics were testing their skills in League of Legends or Counter-Strike, with high quality matches and close finals. The gamers who were not playing in the finals were able to watch the matches with a small delay on the large screen, almost like a professional E-sports match. Later in the evening the games would get a bit less competitive, probably due to the beers that got consumed. Despite all these beers, at the beer pong tournament the players were still focused and the suspense was killing. Luckily,

the beer pong participants were supplied with enough crunchy deep-fried bitterballen to accompany the drinks. After the beer pong tournament the TesLAN came to a climax with a spectacular show from Ivicii. 'Kratje Pils' (Beer Crate) from Ivicii's new album was an instant hit. The spectators even went on the stage to sing alongside the singer. Some tournament winners were so fortunate to receive a CD with the new Ivicii Album: 'Als de pilskes zijn geschonken' ('When the beers are served') at the awarding of prizes.

Only gaming at your spot can get a bit repetitive. For more diversity you could trigger your inner Max Verstappen in the Racing-Simulator from Roel de Meulder. Most people did not need alcohol to become a road hog and crash in every other wall. Another option was to emerge yourself in a horror game on a Virtual Reality station or battle some friends in Mario Kart on a big screen, following the success of our Mario Kart event from last October.

Because the TesLAN is organized by Electrical Engineering students, it had to have a state of the art internet network. The network was realized in collaboration with Juniper, to which the crew also made a small excursion. If you brought your own 10 Gbit network card you were able to get the fastest speed test you have ever seen, with those speeds you could make the Netflix servers sweat. It is almost unnecessary to say, but the power grid of the TesLAN worked excellent too, not a single group has failed.

And so a tradition emerged: gaming for more than 48 hours in the last week of the Christmas break. With just enough time afterwards to get some sleep back for the lectures on Monday.

Even though facilities to sleep at the SSC were provided, every year a few diehards get through the whole event with close to no sleep, dozing off at their computers. ■

Blue Jay

By: Yasmine Bartelds

Can you imagine a world where drones serve in indoor environments as intelligent companions, capable of empowering and assisting people in daily life? Well, this imagination has already become a reality, named Blue Jay.

You might know us from the 60th anniversary of the Eindhoven University of Technology. In 2015, Blue Jay was founded to organize the world's first Drone Café. The increasing popularity of drones and the innovation possibilities with this technology sparked the effort to begin our student team. During the launch of the café in 2016, drones took guests' orders and served drinks. The concept was playful, but with a strong message: drones can be safe, helpful, autonomous, and interactive.

A drone in healthcare

Today, drones are part of a public debate where they are often portrayed in a negative perspective, such as the fear of war drones and violations of privacy. At Blue Jay Eindhoven, we believe technology should serve as a tool for positive change and should help people improve their quality of life. Thus, we strive to show the great opportunities and benefits drones can bring to society. Our drone sets itself apart from other drones in the market, which are mainly deployed for outdoor applications (e.g. photography, crowd management, surveillance) and engage in limited user interaction. Blue Jay will be the first drone to function autonomously indoors, in the healthcare sector.

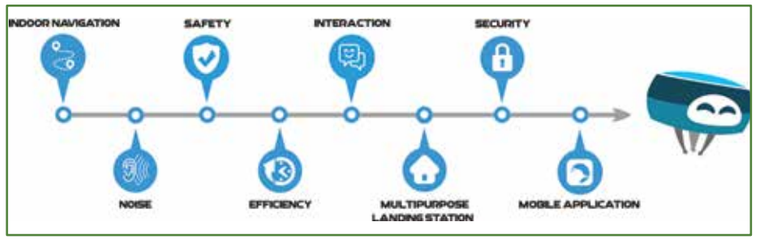
Our goal is to develop a drone that can assist both medical professionals and patients. Blue Jay can help reduce the workload of nurses and caregivers, allowing them to fully focus on the wellbeing of their patients; and at the same time, it can make the life of patients easier and more comfortable by helping them with daily tasks. Our development process is based on user-centered design, where we aim to understand the needs of users, their goals, and the environments they form part of. This iterative, collaborative process will allow us to build a drone that actually matches user needs and can be implemented seamlessly in hospitals and healthcare facilities.

We believe that indoor drones will be part of our daily lives in the future. Not only in healthcare but in all kind of scenarios. Worldwide natural disasters destroy entire areas. Often people get trapped under the rubble and are unfindable. Blue Jay could help searching for the exact location of people in buildings where it is too dangerous for rescuers to enter. Because Blue Jay is able to fly over objects, it won't create any more damage. Another example is guiding people in overcrowded areas, like airports. Since people are walking in all directions without knowing where they need to be, Blue Jay can help out. Another example of crowded areas are concert halls. Indoor drones can hover and observe where and when things go wrong, and guide people in the right direction.

Last year, our student team managed to build a drone that flew indoors and was able to play Tic Tac Toe with children in the Maxima Medisch Centrum. The children loved it! This year, we will build new drones with improvements and we hope to show the world in a few months what we have accomplished.

Challenges along the way

With currently eighteen students from all different faculties, we have challenged ourselves to build an indoor drone that is autonomous, safe, helpful and interactive. This brings some challenges along the way.



Indoor navigation: GPS, which is used for outdoor drones, is not detailed enough for our indoor drones. Over the past two years, we have been using Visual Lighting Communication. Multiple lamps transmit light at a different frequency. The drone knows the exact frequency of every lamp and uses that information to determine its own position. However, if you need to implement lamps anywhere the drone needs to fly, its application will be limited. Therefore, alternatives need to be considered. A new, emerging technology is ultra-wideband. The basic principle is that anchor points are placed in a room. These anchors send out a wide band frequency to which the drone connects. The drone can determine its location, based on the distances between the drone and the anchors. Ultra-wideband has the advantage that it can pass through walls.

Noise: The amount of noise produced by our prototype is above the acceptable for use in a healthcare setting. There are several ideas how to reduce the noise. For instance, having propellers with a smaller or even reversed tip. Also, the frame should be made out of sound absorbing material and more propellers can be added to lower the rotations per second.

Safety: The drone needs to interact and fly near people, therefore it is of high priority that the drone can fly safely through houses, hospitals and other healthcare facilities. Therefore, the propellers are covered well by means of a 'shell' around it, and covered on top so no hands can easily touch the rotating propellers. Also, ultrasonic sonars are added in the frame such that they can prevent the drone from collapsing in walls, objects and people.

Efficiency: Nowadays the topic is all about efficiency of products. Drones have a large battery consumption. The most obvious solutions are size and weight reduction. But if you want batteries that last longer, the batteries will be bigger and heavier. Currently, we use two 2-cell LiPo-batteries that supply our drones for a few minutes of fly time.

Interaction: People tend to interact with things around them. When we give a drone eyes, people are more likely to look at it as it is part of their environment and they will more easily interact with the drone. A LED-strip is also added to show emotions by means of light and also to give certain warnings, for instance when the batteries are low. You can give tasks to it by speaking to it and the drone will recognize your face, movements and objects.

These are just a few of the challenges we meet within Blue Jay. There is even more going on in Blue Jay! We are looking into a landing station for our drone, the drone also needs security such that it cannot be hacked by third parties and preferable the drone could be controlled by a mobile application.

Electronics

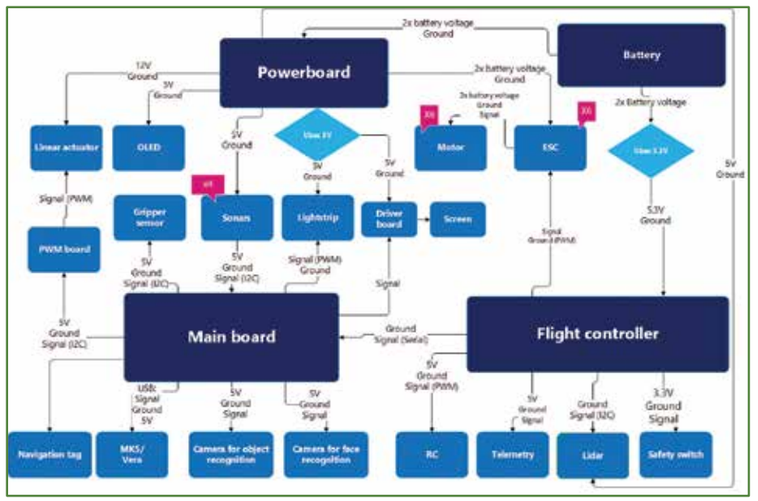
Regarding all the electronics that are part of our drone (there are more than you might think!), it is not all plug-in and play. Our drone operates at 14.8-16.8V with a nominal current of around 40A which can be 80A at peak due to the six motors. To manage such a high current, we have to design a power distribution board that can handle that amount of current and convert voltages to a reliable 5V for all other components. And, for all Electrical Engineers among us: What happens with your signals over a small wire when there is a large wire along with a high amount of current? Well, a magnetic field is generated that disturbs your signal. This can be dangerous because some components won't work anymore, like your sensors. To face this, we use shielded cables that prevent electromagnetic interference.

All components need to be controlled, but all in a different way. Blue Jay uses communication protocols such as I2C, PWM, Serial. To communicate from outside with the drone, it isn't reliable to use WiFi since this gives too many distortion. Currently, the drones use an MK5 module and this will be upgraded to a Vera module. These modules communicate at another frequency channel. All these communication channels are processed by a main board in the drone that can handle this.

This is just a small bit of all challenges we face as Electrical Engineers within Blue Jay. We meet many more challenges within electronics regarding our drone. Maybe in the future we can charge our drones by wireless charging. Or we can integrate most of our electronics into only one printed circuit board.

Interested?

We are always searching for enthusiastic students who want to challenge themselves. Do you want to contribute to society? Do you want to hone your professional skills? Do you want a big professional network? Blue Jay is the extracurricular activity you are looking for! Don't hesitate to walk by our office in the Momentum building on the TU/e campus or mail us at info@bluejayeindhoven.nl! ■



Graduating on an innovative control method for EV chargers

By: Remco Bonten

"My graduation project extended the bidirectional isolated DC/DC converter to an innovative and modern conversion stage that combines most advantages of the state-of-the art solutions currently in use". Remco Bonten (27) is a fresh master graduate of the TU/e that performed his graduation project at Applied Micro Electronics "AME" B.V, where he performed his research on control of series resonant converters with bidirectional power-flow capability. With the research results, a prototype converter was build. The main contribution of Remco's work was extending an existing unidirectional modulation method for resonant converters to allow bidirectional power flow.

"Although I already worked on some smaller DC/DC converters, the medium-power application did certainly arouse my interest. Along with the challenge that the converter should be able to operate in a bidirectional fashion made the graduation project challenging.

"

would be able to transfer power between the storage battery of an electrical vehicle (400V) and the lower voltage used by the vehicle's peripherals (48V).

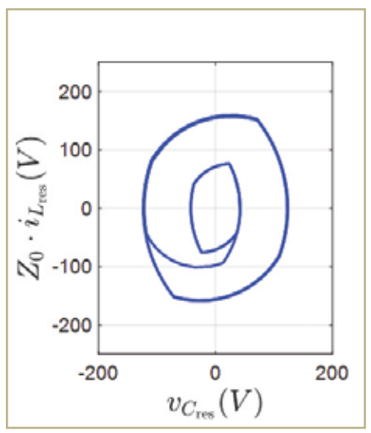
"Initially I had some problems grasping the core of the problem. Many converters that operate in a similar fashion were already developed and I did not want to copy someone else's work, but really contribute to the field of power conversion. As such, my research covered a large scope and I came into contact with resonant converters. Series resonant converters are often dismissed due to its complex operating nature, however, I was fascinated with the possibilities of these converters. Although resonant converters are not new, they generally use a control algorithm that operates under the assumption that the converter is in steady-state, i.e. there is no change in the load or the voltages applied. This assumption really limits the dynamic performance of resonant converters".

Remco started to work on optimal control (OTC). OTC is a control method that regulates

At this moment, Remco is working at AME as a System Engineer, where he is working on various projects. However, within some

AME is a company that is always searching for opportunities to develop new, innovative, and high-tech products.

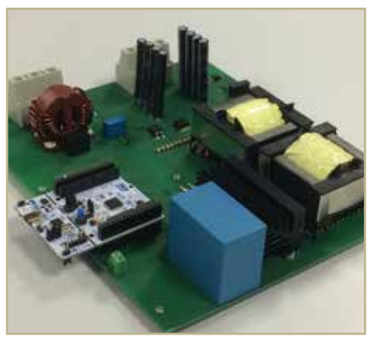
AME is a company that is always searching for opportunities to develop new, innovative, and high-tech products. The design goal was to achieve a large-step down ratio (400V to 48V) for electric vehicle applications. With the chosen specifications the converter



the amount of charge that is transferred to the output during each resonant cycle. To do this, it calculates the exact moment of switching required for the set amount of charge that should be transferred. OTC is not yet used in industrial and commercial products, but is an actively research topic at universities. Solutions for unidirectional power flow were already developed at the EPE group. In order to realize bidirectional power flow, he had to extend the OTC algorithm to take the bidirectional power flow into account. Through calculations and simulations, the design became conclusive and a prototype was built.

"I still remember the moment when the converter first operated as designed. The first seven months of the graduation lead to this moment and the struggles were all worth it! Without the tools provided by AME and the knowledge of my colleagues I'm not sure whether such a prototype would have been possible."

months he will start with his PhD. Due to his innovative design and the doors that the design opened, he was offered to continue his graduation project in order to expand the research done on bidirectional optimal trajectory control. AME offered to provide the resources and possibilities for Remco to reach his doctorate. "I cannot thank AME enough for the options and the possibilities they have provided and are still providing me!" ■



Introducing...

Hi everybody,

My name is Femke Witteveen. Just before the summer of 2017 I read about the vacancy of Project Assistant within EE. When I read about the new position I was immediately enthusiastic. For the past 3.5 years I have worked with great pleasure as a secretary for the HRM department. Previously, I worked for the EPC (TUe Equipment & Prototype Center). I was on the lookout for a new challenge in the form of a

new job or study. This new job seemed to be in line with my experience and ambition, but there is still a lot to learn for me. I love working in a dynamic and technical setting, working on a team, making the move to a department, and sharing knowledge and experience so I am very happy in this new job and glad they gave me this chance.

Besides my work I am married with Mark, we have a son Miel (15) and a daughter Tess (18). We live in the beautiful village Waalre. Usually, I come to work by bike, it's about thirty minutes one-way. In the weekend I am active at the sport fields. I am a fanatic supporter for my son's soccer team on Saturday and team manager of my daughter's hockey team on Sunday. I hockey myself for DAF (I used to work there a long time ago) in a business competition against all kind of other organizations in the region. In the winter we love to go skiing, I have just come back from Val Thorens in France, the snow was perfect! In the summer I like to cycle on my racing bike through 'De Kempen', but the best and most beautiful is cycling in the mountains. At home we like to invite friends and family for delicious food (my husband loves cooking), good

drinks and nice talks. And I like to spend time, go out and meet with my family and friends. I work four days a week. Friday is my day off, then I try to spend time on my study 'HBO Office Management'. If you want to know more about me, just stop by at room FLUX 0.155. I am looking forward to meet you! I started my job about three months ago and I am really enjoying it and still learning every day.

See you! ■

Hello everyone! My name is Michalis Chatzimichailidis and I am 28 years old. I come from Thessaloniki, the second largest city in Greece and I have lived and worked in the Eindhoven area for the last four years. In 2013 I graduated with a MSc degree from the Electrical Engineering Department of Aristotle University of Thessaloniki. My last semester was combined with my military service in the Greek army, which is obligatory in Greece.

Shortly after finishing my military service, as a gunner in a mobile artillery unit, I moved to The Netherlands. I worked for one and a half years at ASML as a test engineer, qualifying

subsystems for state of the art lithography machines. Then I moved to the world of development and worked as an electronics engineer for Prodrive Technologies for the next two and a half years, designing electronics for commercial and industrial applications. Recently, I had the opportunity to move from corporate to academic environment, hoping this way to combine the best from both worlds. Since last December I am working in the PhI group, in the Electrical Engineering department of TU/e, developing an automated measurement system for photonic ICs.

In my spare time I like to hang out with friends, watch movies and go on small weekend trips. I also enjoy flying drones (either purchased preassembled or self-built) and nice DIY projects. Recently, I started backyard gardening and after a first miserable failure with some tomatoes that never turned red (!), I managed to harvest my first backyard grown organic potatoes. Sure they were just a handful of small potatoes, barely enough for two portions for me and my flatmate, but they tasted heavenly!

I'm thrilled with this new world that lies ahead of me and I'm looking forward to meet and work with a lot of new and amazing people at TU/e! ■

Lustrum Thor

By: Elwin Hameleers

On November 28, 2017, the study association for Electrical Engineering Thor turned 60 years old. With a committee consisting of 31 members we organized a month full of activities and festivities. It was an awesome period to celebrate Thor's birthday.

Lustrum stunt!

After a few months of preparation, it was finally there, the lustrum stunt. We based this stunt on a few principles, the first one was that it should be interactive, the second one was that it should be related to both electrical engineering and automotive. Thus we came with the idea to create a VR Mario kart race. During the stunt participants could race against five others to claim one of the many prices, of course related to Mario kart. During this race participants were driving around with an RC car on a track. On top of the car we mounted a camera so that participants were "inside the car whilst driving around". During this race the lap times where tracked so we could decide who the fastest contestant was. The stunt lasted for three days, starting on Monday and ending on Wednesday evening with a winner announcement drink. During this drink we announced the results in Het Walhalla and over the radio.

Radio

This Lustrum, we wanted to produce something cool, something that is unique or has not been done many times. Radio was the perfect solution for this. At first, we were worried if this would make it. Do people want to produce a radio show? Is it not too expensive? Will people listen to the radio?

These questions were no problem at all! Already at the start of the Lustrum, people were enthusiastic to make their own radio show, and on the first day we already had many listeners. With all different kind of shows, made by for example first year students or old board members, there was something different to listen to every hour! It really became an enormous success with humor and Thor-related programs. Even the Dean of Electrical Engineering has hosted a radio show for an hour. Originally, the radio was supposed to last one week of the Lustrum. But as we didn't foresee this success, we decided to add another week of our own Thor Lustrum radio, and a success that was! People were enthusiastic again to produce radio, and the people who did not have the chance to make radio the week before took this change with open hands. But as with most things you must quit while you're ahead. We really want to encourage the next Lustrum committee, or even the dies committee, to set up such a radio station again. Try to make it such a success as it was this year, and even try to do it via FM signal!

Lustrum Gala

Friday December 22, 2017, the day before the Christmas break, it was finally time for the 12th Lustrum Gala of e.t.s.v. Thor. This evening started with the 'Oude Bokkenborrel', around 18:15 the first bus full of hungry guests departed from the TU/e to have a fancy dinner at Kasteel Maurick. At the entry we started the evening at Kasteel Maurick with Prosseco as welcome drink and soon after that we were invited to the dinner table. During this dinner we listened to a few speeches given by honorary members, Oude Bokken and Board members. We watched the current Board handing over the gifts to the old Board and - of course - we enjoyed the fancy meal.

Around 20:45 the second bus left the TU/e with guests who only went to the Gala. The Gala started with an 'opening dance' played by the 'Weet Je Moeder Wel Dat Je Hier Band', the band of our Gala. Also a DJ from Dance Street played at the Gala. As a surprise we had a guest singer in the band, this was Rosemarie van den Bongard who is also part of 'La Tuniña'.

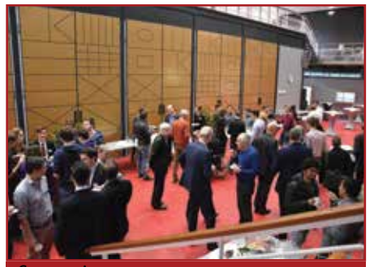
After a long evening of dancing and a lot of liters of alcoholic drinks the last bus departed at 3 am, and that was the end of an amazing Lustrum Gala. ■


Thor Ragnarok X


Opening Lustrum


Ellips Pub Lecture


Cantus


Symposium


Sinthorklaas


Gouden Carolus Party


Pubquiz


Arcadis Lunch Lecture


Lustrumfeest

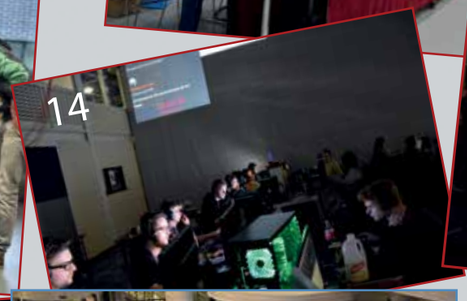

AME Tesla Coil Workshop

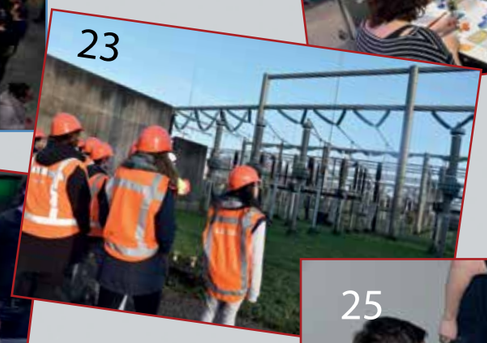

Thor goes to the Efteling

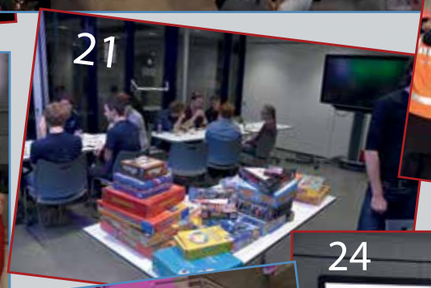

Cisco Lunch Lecture

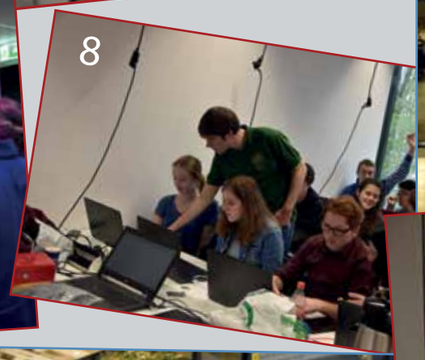

Christmas Party


Oude Bokkenborrel









1. Volundr KiCad workshop
2&3. Sioux lunch lecture
4. Computation exam training
5. Clrcuits exam training
6&7. First- and secondyear drink
8&9. Volundr IoT workshop
10&11. ACCI TV deco
12&13. GMM 234
14 till 16. TesLan
17 till 19. New year's reception
20&21. ACCI board games
22&23. Alliander excursion
24&25. ACCI bingo
26&27. Information days

Luminite

By: Thomas Brok

My name is Thomas Brok, aged 22, and during weekdays I am a master student in Electrical Engineering (Electronic Systems department). In the weekends, I fly around the globe by the name of 'Luminite', to perform at parties and festivals, playing music (hardstyle), which I created myself!

What started as an innocent hobby, resulted in a life-changing way of life. I have been messing around with music production since approximately 2007-2008, after my father introduced me to music production software. I already owned a piano and a drumkit, but the curiosity for more resulted in getting into the creation of digital audio.

In the second year of my Bachelor Degree (2013-2014), things started to get way more serious, very quickly. The Scottish label 'Gearbox Digital' saw potential in my productions, and signed me to release on the label. A corresponding signing to their own booking agency 'Pure Bookings' followed, providing me with more and more bookings, further and further away, with larger payments every time.

With this career getting more and more intensive, my results at the university definitely suffered. The fact that it started as a hobby, means that I highly enjoy spending time in the studio, developing my skills further as a producer and creating music. Around this time, the total amount of hours in the studio added up to approximately a normal workweek (40 hours). With an increasing fanbase, an increasing demand to perform followed, meaning that the payments I received for performing also increased (nearly) exponentially. There have been points in my academic career where I was in doubt whether I should finish my education or not. Imagine having to choose between doing something you have a sincere passion for all day long and getting paid relatively bizarre amounts, or to persist in trying to get my degree, which meant (for the time being) that the studio time decreased as the difficulty of courses increased, all without getting paid at all. Luckily, my parents brought some sense into me, and to this day I am still very convinced of the fact that I want to have a Master's degree in Electrical Engineering, no matter how long it will take me. I know it will be hard, but I am not a risk-taker when it comes to big life decisions.

In the end, I did have some delay in getting my degree. A mere 0.1 point at one exam prevented me from having 60 ECTS in the first year. On the other hand, in the second year of my Bachelor Study, I managed to get a miraculous amount of 10 ECTS in one year, of which 5 ECTS belonged to that last first year course. Contrarily, I did manage to increase my amount of Facebook likes on my artist page from 2.000 to almost 20.000 that year. The next two years of the Bachelor education I managed to pass all courses and receive my Bachelor's degree. In the first year of my Master education, I basically had the same issue as in the second year of my Bachelor's degree; I passed a mere three courses, although this also had personal reasons. Currently I am in the second year of my Master education, and I expect to finish in the end of 2019. I do not yet know if I will choose the path of an engineer or the path of a DJ, but for this judgement I will trust my instinct when I have my Master's degree in my hands. Being a DJ is a dream come true, but it is also a (very!) high-risk business, which can crumble to bits by making the slightest mistake.

At the moment, I spend a rough twenty hours per week in my bedroom studio. A social life at the university is hard to maintain, since the small group of friends I had since the first year of the Bachelor education split up due to different learning directions. I do have a group of friends at home that I do see often. I made an agreement with myself before all the big stuff happened, to never let myself lose touch with what is real, such as real friends, family and general social life.

I have performed at big festivals and parties (Defqon.1, Intents Festival, Decibel Outdoor, Rebirth Festival, Q-Base, Loudness), mostly in my own country, with a monthly average of two international bookings in Europe (mostly in France, Germany, Scotland), with two finished performances in Australia. You can follow me on my social media by simply searching for 'Luminite' on Facebook, Twitter, Spotify, iTunes, YouTube etc.

As a conclusion, it still feels weird to me to see people actually viewing me as some kind of legend or god, since I still see myself as a basic guy from Brabant, doing what I love, of which the results from doing that somehow brings joy to people. ■

Cooking traditional Dutch snert

By: Stijn van Himste

Snert, also known as 'erwtensoep', is the dutch name for split pea soup. Snert is mostly eaten during autumn and winter combined with a 'broodje Unox' (bread with sausage). Snert is called a soup, but in reality, it looks more like a porridge, this is due to the peas and potatoes which gives it its thick texture. The name itself comes from an old Dutch verb "snorren", which means "to simmer", due to the fact that the soup was mostly boiled for a long period in which ingredients would fall apart.

There is not much known about the exact origin of split pea soup, which originates from Asia. Later on, around the year 500BC, the Greek found the recipe for the soup and started eating it. You could find a lot of street vendors selling this hot nutritious soup. During this time peas were mostly dried before using it in the soup. Fresh peas had a short shelf life, but after drying them they could last the entire winter. Using potatoes and onions, they could make a nutritious and delicious soup out of it. Due to the soup its nutritious contents, the soup was used a lot in the military, because they could simply cook everything in a pan and give it to the soldiers without much preparation, which is still done today.

With the spread of the Greek and Roman Empire the soup eventually found its way into the rest of the world. The use of fresh peas was still seen as a luxury, so not many peasants could afford it. This changed in the late 1600s, when fresh ingredients were more available than before. France was one of the first countries in which fresh peas were used inside of the pottage, also known as the Potage Saint-Germain. This was refined and served to Louis XIV of France, who named his court after the pottage. Due to France its influence in several fields, such as the cuisine, pottage finally became popular in the Netherlands. We even adopted the dish and recreated it to suit the Dutch style.

As of a few years, we as the cooking committee have made this typical Dutch dish during the Christmas drink. To suit everyone's need, we had to make over 100 liters of snert. With almost two days of preparation of the ingredients we succeeded in making in enough snert. We used two beer kegs to prepare the snert in. This was done by cutting a hole inside of the kegs and cleaning them thoroughly. The snert was in the end served with warm glühwein.

How grandmother used to make snert:

Get a big pan and fill it up with 4 liters of boiling water, boil the bacon for 45 minutes. While the bacon is boiling, clean the split peas with cold water. Add the split peas after 45 minutes and boil both the bacon and the split peas for another 45 minutes. While the splits peas and bacon are boiling, cut the onions, carrot, leek, potatoes and the 2 slices celeriac into small cubes, cut the smoked sausage into slices. When the bacon and splits peas are done boiling, get the bacon out of the pan and cut it into slices. Add all the ingredients into the boiling pan and let it simmer for a few hours. Be cautious, don't use a high fire so it does not burn and don't forget to stir the snert. You can either eat the snert after you are done cooking or let it stay for a day and heat it up again, which makes it thicker. You can eat snert together with bread with cheese or just alone.

Ingredients:

300 grams bacon (one piece)
400 grams split peas
1 smoked sausage
2 big onions
1 big winter carrot
1 big leek
2 potatoes
2 slices celeriac ■

The Question concerning technology

By: Jan Vleeshouwers

I stumbled upon 'The Question concerning Technology', an essay by Martin Heidegger and I first thought I'd skip it. My experience with philosophical texts is that they are often difficult to read and rather disappointing if you take up the effort to study them. But the last sentence intrigued me: 'For questioning is the piety of thought.'

So I read it, and it confirmed my experience, so I'm not advising you to read it also. But the German original and the Heidegger Wikipedia page helped me get at least a basic level of understanding, and that leads to a couple of observations which are food for thought.

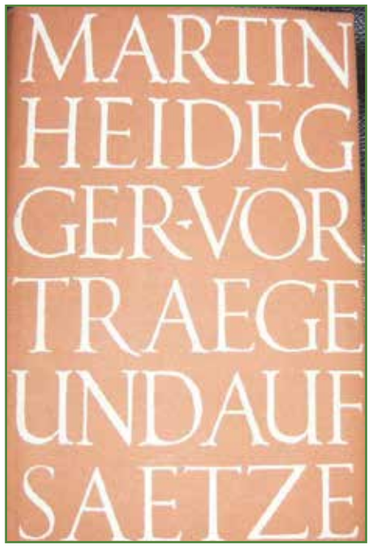
Heidegger wrote the first version of this essay in 1949 as one of a 4-part cycle on 'Insight into that which is', which covered elementary philosophical topics in his view: the Thing, the Change, the Danger and the Enframing. In this last essay he tries to uncover the essence of technology. In 1954 it obtained its final title, which reflects Heidegger's prime way of working, namely questioning. Questioning is the way to explore the world and to obtain knowledge.

Without going into detail, and without going into the intricacies of Heidegger's language, the essence of technology, according to Heidegger, is creation: to bring something into the light of existence. He traces this essence back to Greek thought, and notices explicitly that to the Greek, τέχνη did not only refer to craft but also to art. Modern technology has lost this connection, and instead has become obsessed with extracting from nature every possible resource for the benefit of mankind. Even man himself becomes subordinated to this obsession, which for Heidegger is the ultimate danger for man: to lose humanity. Notably, this endangers the proponents of technology equally seriously as those who deny it.

In this danger, however, he also observes the seed of a power to save mankind. In an almost poetic plea, he associates the creative power of men, which is at the root of technology, with ways to find truth and continuity. (He suggests that might be art, but he admits he doesn't know.) Exploring truth will free man from his narrow-minded focus on exploiting nature. How to do that? Heidegger's suggestion is to keep questioning, in the service of truth. And that, for him, is a form of piety.

Confronting grave danger by questioning? Do you share my slight disappointment regarding this suggestion? For that reason I will leave it as it is, and instead point out a couple of other remarkable topics from the essay.

There is the unexpected religious association attributed to the scientific way of working. For us it is more or less routine, but is there really a kind of moral, or perhaps religious, obligation to work this way?

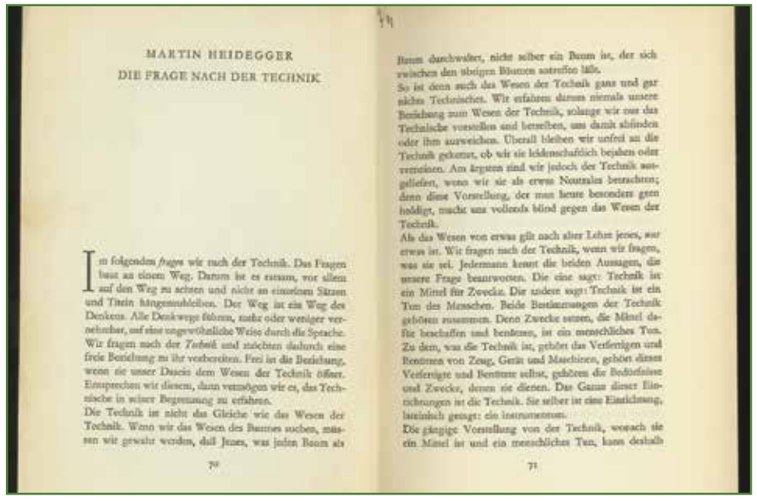


And then there is Heidegger's statement that technology is danger and rescue in one. Not just in the sense that e.g. fire can be both, but also for what technology does to humanity. Do you recognize this in daily life?

Third, there is the kinship of technology and art. Are we sufficiently aware of the fact that what we do and make is related to art, and has some of its properties and goals?

Finally I'd like to add the observation that here again technology is considered as an actor. As I have argued before, that hides the motives of the people using technology. These motives may not determine the essence of technology, but they certainly determine the development of technology into the danger Heidegger describes. The tendency to exploit everything to the utmost, is not a property of technology, it is human. You can also see it at work in capitalistic trade, for example.

None of these themes are particularly new, but if you as an engineer need reflection, these topics will probably serve you very well. ■



MARTIN HEIDEGGER
DIE FRAGE NACH DER TECHNIK

Im folgenden *fragen* wir nach der Technik. Das Fragen baut an einem Weg. Darum ist es ratsam, vor allem auf den Weg zu achten und nicht an einzelnen Sätzen und Titeln hängenzubleiben. Der Weg ist ein Weg des Denkens. Alle Denkwege führen, mehr oder weniger vernehmbar, auf eine ungewöhnliche Weise durch die Sprache. Wir fragen nach der *Technik* und zeichnen dadurch eine freie Beziehung zu ihr vorbereiten. Frei ist die Beziehung, wenn sie unser Dasein dem Wesen der Technik öffnet. Entsprechen wir diesem, dann vermögen wir es, das Technische in seiner Begrenzung zu erfahren.
Die Technik ist nicht das Gleiche wie das Wesen der Technik. Wenn wir das Wesen des Baumes suchen, müssen wir gewahr werden, daß Jenes, was jeden Baum als

Baum durchwaltet, nicht selber ein Baum ist, der sich zwischen den übrigen Bäumen antreffen läßt.
So ist denn auch das Wesen der Technik ganz und gar nichts Technisches. Wir erfahren darum niemals unsere Beziehung zum Wesen der Technik, solange wir nur das Technische vorstellen und betreiben, uns damit abfinden oder ihm ausweichen. Überall bleiben wir unfrei an die Technik gekettet, ob wir sie leidenschaftlich bejahen oder verneinen. Am ärgsten sind wir jedoch der Technik ausgeliefert, wenn wir sie als etwas Neutrales betrachten; denn diese Vorstellung, der man heute besonders gern huldigt, macht uns vollends blind gegen das Wesen der Technik.
Als das Wesen von etwas gilt nach alter Lehre jenes, *was* etwas ist. Wir fragen nach der Technik, wenn wir fragen, was sie sei. Jedermann kennt die beiden Aussagen, die unsere Frage beantworten. Die eine sagt: Technik ist ein Mittel für Zwecke. Die andere sagt: Technik ist ein Tun des Menschen. Beide Bestimmungen der Technik gehören zusammen. Denn Zwecke setzen, die Mittel dafür beschaffen und benützen, ist ein menschliches Tun. Zu dem, was die Technik ist, gehört das Verfertigen und Benützen von Zeug, Gerät und Maschinen, gehört dieses Verfertigte und Benützte selbst, gehören die Bedürfnisse und Zwecke, denen sie dienen. Das Ganze dieser Einrichtungen ist die Technik. Sie selber ist eine Einrichtung, lateinisch gesagt: ein instrumentum.
Die gängige Vorstellung von der Technik, wonach sie ein Mittel ist und ein menschliches Tun, kann deshalb

70 71

[1] The Question concerning Technology, Martin Heidegger. In Readings on the Philosophy of Technology, David M. Kaplan (ed.), 2nd edition, Rowman & Littlefield, 2009.

Excursion Alliander

By: Luc Spooren and Niels Dirks

On January 11th we went to Alliander. After a journey by train, we finally arrived at the headquarters in Arnhem. First we got some coffee and tea and we were introduced to employees of Alliander, followed by a presentation that showed the ins and outs of Alliander. They hold two main companies, Liander and Liandon, and some smaller start-ups. Liander is holding both the electricity and gas network, and keeps track of the customers who want a connection to the grid. Liandon does the maintenance and construction of the grid.

A new challenge for Alliander is the uprising generation of electricity at home. More houses are becoming 'nul-op-de-meter', which means that on average no electricity is taken from Alliander. Such houses consume energy from the grid at night and deliver energy by day for instance. However, the major problem is that the current electricity grid is not designed for the increasing number of such houses. We also tried to solve this problem ourselves in small groups and shared our solutions afterwards.

After the lunch, we were taken to a substation in Elst. This substation transforms 150kV to 10kV. The 150kV part of the substation

is owned by Tennet and the 10kV part by Liandon. From this substation, the 10kV lines are distributed to different towns. Everything is 'copy-pasted' in order to ensure there is no blackout when one system fails. It was the first time we visited such a substation, which was impressive to see up close. Fun fact: instead of using wires for power transport, hollow pipes are used, because, as you should know, the skin effect occurs.

Although this sounds quite nice, a substation is very dangerous as one of Liandon's employees was killed while doing his job in Elst last year. Despite this warning, it does not stop thieves stealing copper. After all, it was a very interesting day. ■

"Working at TNO allows me to prove the potential of new ideas and technologies"

TNO innovates with impact by bringing together a wide range of disciplines and thereby tackling societal challenges. At TNO electrical engineers work on a wide range of themes, with a focus on signal processing, control technology, automation software development and systems engineering. The know-how developed by TNO is used in practical applications up to the level of demonstrators or prototypes.

Projects our electrical engineers work on are, among other things, a sonar that detects mines, a self-driving car, a simulation tool for smart mobility, semiconductor equipment to improve chip production, smart grids for far-reaching integration of energy sources and the development of 5G for mobile telephony.

Spectrum Intelligence

Vincent Voogt studied Electrical Engineering at the TU Delft. He is Scientist Integrator at the research group Electronic Defence and works on Spectrum Intelligence, monitoring and analysis of signals in the electromagnetic spectrum. "Detection and classification algorithms are used to create a real-time picture of who is transmitting, what is being transmitted and what the content is of the transmitted message. The application of Software Defined Radio enables the design of flexible receivers to carry out this task autonomously."

Creative and dynamic environment

Vincent tells "Working at TNO allows me to prove the potential of new ideas and technologies by demonstrating their benefits in proof of concept designs and how they fit within the customer needs. I like that this requires a lot of interaction with different kinds of customers and their work process in order to create a good understanding of these needs. TNO has provided me a creative and dynamic environment in which I can grow and develop new skills. Within my department there is a good balance between experienced senior co-workers and enthusiastic juniors, as well as a good balance between serious work and social interaction."

Manage your own career

When you start at TNO, from day one, your work at TNO will involve active participation in projects and you can directly apply your knowledge of signal processing, measurement and control technology, cyber physical systems, chip design and much more to societally relevant themes. You will work together with other experts within and outside TNO and with clients.

At TNO you are given a lot of freedom to manage your own career. This ranges from choosing your own projects to determining the direction in which you want to develop. You always have the option of taking part in projects at other departments, too. What's more, the projects involve plenty of variety. Each project you work on is different and so your own creativity and expertise are always required.

The people of TNO

TNO employs around 3000 people with all kinds of backgrounds, qualities and interests. This multidisciplinary aspect is essential to be able to innovate. We combine the right, existing and newly acquired expertise from different disciplines to get the optimum results. Together with universities and top technology institutes we develop knowledge that is closely aligned with the latest international trends and developments.

Ambitious starter?

Are you interested in getting a flying start at TNO? There are many different options within our organisation. Whether you want to be a top researcher, consultant, project leader or business developer. Once you join us, you will have the freedom and responsibility for shaping your own career path.

Discover your possibilities at: www.tno.nl/career.

Twitter: @tno_talent
Facebook: TNOresearch
LinkedIn: company/tno
Instagram: @tno_research ■

Whose desk is this?

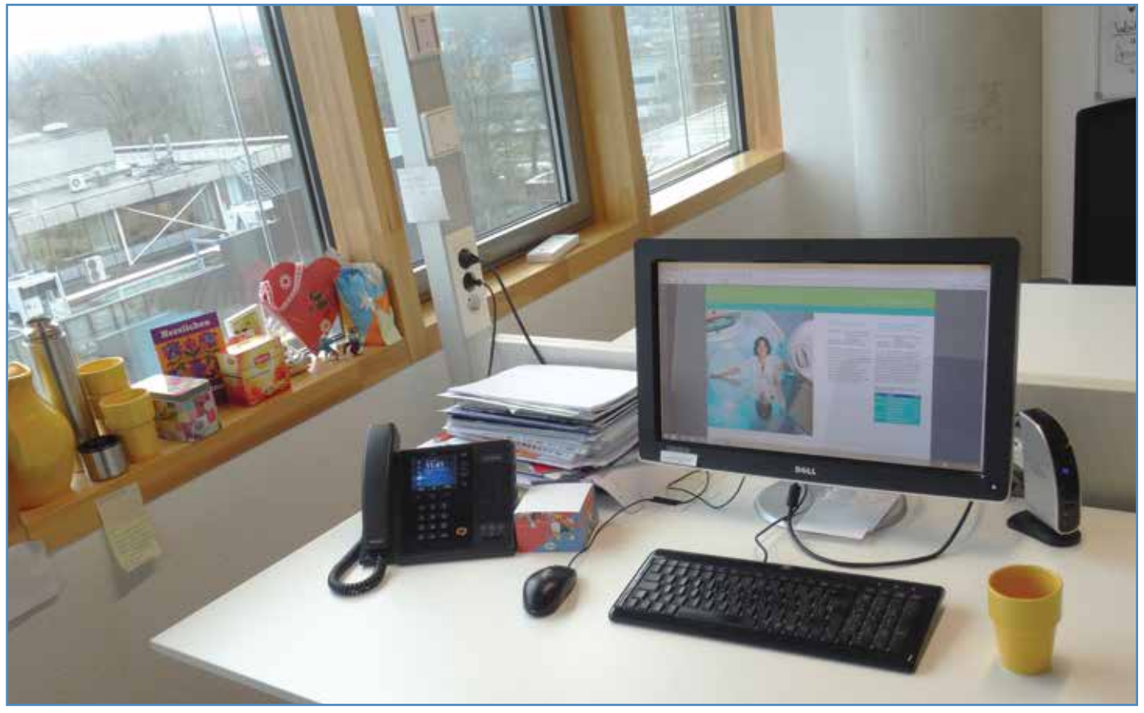
By: Jan Vleeshouwerss

There are several remarkable aspects about this desk. One is that it is looks well sorted – although the owner informs me that the pile of papers behind the phone still needs work. The other is the pen to the right of the keyboard and the mouse to the left: does this indicate a right-handed or a left-handed person?

The other eye-catcher on the desk is the notepad-block with Donald Duck imprint. The imprint is accidental, the desk owner does not have any specific affinity with Disney characters. But the small pieces of paper characterize her: she uses them to structure daily tasks, and if you look carefully, you will see several of them: below the display and attached to the light pillar and the window frame.

The tea-cup on the desk is used frequently. As you can see in the windowsill, tea is the owner's favorite drink: three spare cups, a matching can and a thermos bottle. The windowsill also shows a couple of presents: two smurfs her brother gave her at her graduation, a paper heart for mother's day and a gift card saying "Hertzlichen …"

But the most remarkable aspect of this desk is not on it but behind it. On the wall there is a painting she got from her students in Aachen, which is an artist's impression of a Smith chart. ■



A glimpse at the invisible

By: Roeland Dilz

Integrated circuits ("chips") are vital parts in modern electronics. They are applied in a wide range of products, ranging from phones and computers to price tags, airplanes, and cars. An integrated circuit can contain billions of electronic components and connections. To cram that many components in the space of a few millimeter squared, requires manufacturing with great precision. A constant monitoring of the production process is required to achieve this precision.

Nowadays, the smallest detail size in integrated circuit technology (about 10nm) is less than a hundredth of an atom. This is way smaller than the wavelength of visible light. Therefore, simple microscopy is not a feasible method of measurement for monitoring the production of integrated circuits. A microscope image only produces a vague "blob" that does not bear resemblance to the integrated circuit that is looked at. However, important information can still be extracted from this "blob".

Inverse imaging

Let us start with an example. Suppose you look at the traffic sign in Figure 1, which is situated close to the town of Tuil. From a large distance, you might not be able to read the individual letters, but you might still be able to discern in which direction to go for "Tuil", just from the length of the text. This is of course only useful when we already know for sure that Tuil is on the sign and that it is the only short-named town. This shows how important information can sometimes be recovered when we have some prior knowledge.

This example with recovering some information from traffic signs is a basic example of the technique of "inverse imaging". With inverse imaging we mean the art of recovering some details about an object, details that are too small to be seen directly. In general it is impossible to recover all details from a vague image.

The important step in successful reverse imaging is to have prior knowledge about the structure that we look at. Although it might be impossible to recover the exact structure of the integrated circuit from an imaging apparatus, it is possible to discern how well some parts of the integrated circuit are aligned. The prior information we use is that we know how the structure looks, except for the alignment parameter.

Special target structures are located on an integrated circuit. The shape of these target structures is known, except for some key parameter(s) that we wish to measure. It is possible to compute how the image that is recorded by the camera depends on these parameters. When we compare several of these computations to the actual measurement, the misalignment can be recovered.

Figure 1: Although the image is blurry, you can probably still discern that Tuil must be to the right, just because the name is much shorter than the rest.

The need for fast electromagnetic solvers

In practice, several parameters are recovered from a single measurement. Therefore, a large number of computations is required to fit all those parameters simultaneously to the measured image. The computation time for such an amount of simulations becomes a serious concern. The state-of-the-art in semiconductor industry is to make approximations that ease the computational burden.

When a measurement is carried out on a grating, or other structure that periodically repeats itself, such as in Figure 2, the electromagnetic fields that make up the light can also be assumed to periodically repeat themselves. When the fields are assumed to periodically repeat themselves, they can just as well be computed within one single period, instead of the whole target. Because this greatly reduces the size of the scattering problem, this also greatly reduces the computational burden.

From the mathematical point of view, this approach is very advantageous. The periodicity of the problem can be exploited in the so-called spectral domain. In the spectral domain the electric field is decomposed into a set of waves, where each wave fits in the periodicity of the target. The electric field can be represented as a set of waves each with its amplitude.

Integrated circuits consist of several layers, some of them containing components and others containing the connections between components. Each of these layers will reflect or transmit light to some degree. The computation of these reflections and transmissions can also be done very efficiently by using this decomposition of the electric field into a set of waves. The reason is that the amplitude of the reflection can be accounted for by all waves simultaneously. In the past, several methods have been developed to efficiently exploit this effect. This has led to fast solvers for periodically repeating scattering objects.

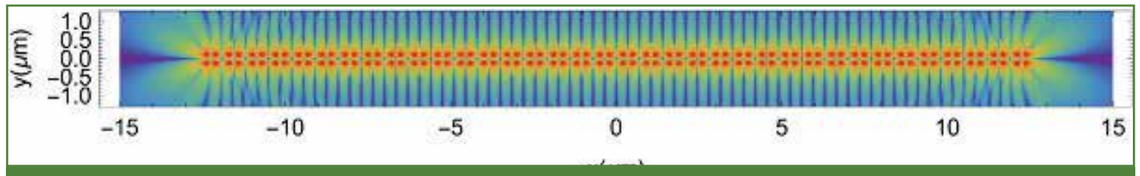


Figure 2: The electric field around 36 square objects. In the middle, the electric field around each of the objects is clearly the same. However, at the endpoints a difference is observed, compared to the middle.

Extension to Aperiodic scatterers

In practice these reference targets, on which measurements are carried out, are only of finite size. This means that the repeating nature of these targets ends at some point. To improve the accuracy and reliability of measurements it is beneficial to be able to model the whole structure, without the assumption of periodicity. Of course, this problem is much larger and hence much harder to solve. But a few computations for complete targets can already give a good estimate of the accuracy of the simpler periodic computations.

The goal of our project was to build a computational method to solve scattering from finitely-sized structures. Although such methods are already available, they are mostly not very optimized for the layered media that are encountered in integrated circuit production. Especially the layered medium is hard to model efficiently, since it extends very far.

We have generalized the representation of the electric field in distinct waves for periodic targets, towards a representation as a continuous range of waves for aperiodic targets. Although such representations are not new, they have not yet been successfully applied to scattering problems in layered media. The reason is that the natural way to represent the electric field as a continuous range of waves requires the electric field to be computed accurately everywhere, even at points that are very far from the target. This requires a very large computational effort. When we realized this, we found a way to formally write the electric field over the whole space, but accurate close to the target only. Since we still (at least in a formal mathematical sense) write the electric field as a range of waves, the layer reflections are dealt with efficiently. The efficiency is good, since deterioration of the accuracy at large distance allows to only spend the computational effort close to the target, there where it is needed and a sufficient accuracy is reached.

After realizing that such a representation is possible, we applied it first to two-dimensional problems. During the third year we extended this to fully three-dimensional problems, and several optimizations were applied. At this moment we are able to compute the electric fields of a targets on a laptop in fifteen minutes, whereas commercial software requires terabytes of memory and many hours to compute the scattering from targets of realistic size. An example is shown in Figure 3.

In the end I have thoroughly enjoyed working on my PhD project. I consider myself very lucky to have found a good idea after only ten months. From then on, we set a course for development that proved to be realistic. Of course, some hardcore frustrations were developed during debugging, but in the end those were only minor problems. Thanks to my experienced supervisor, Martijn van Beurden, who was able to foresee and circumvent many of the difficulties, we were able to reach our goal well in time, after roughly three years. I found it fun to work towards a clear goal and to be able to slowly but surely progress towards it. Subsequently, the last year was spent on writing. About that, it suffices to say, I am very pleased because today I can write that this is my last working day and that a long vacation awaits me. ■

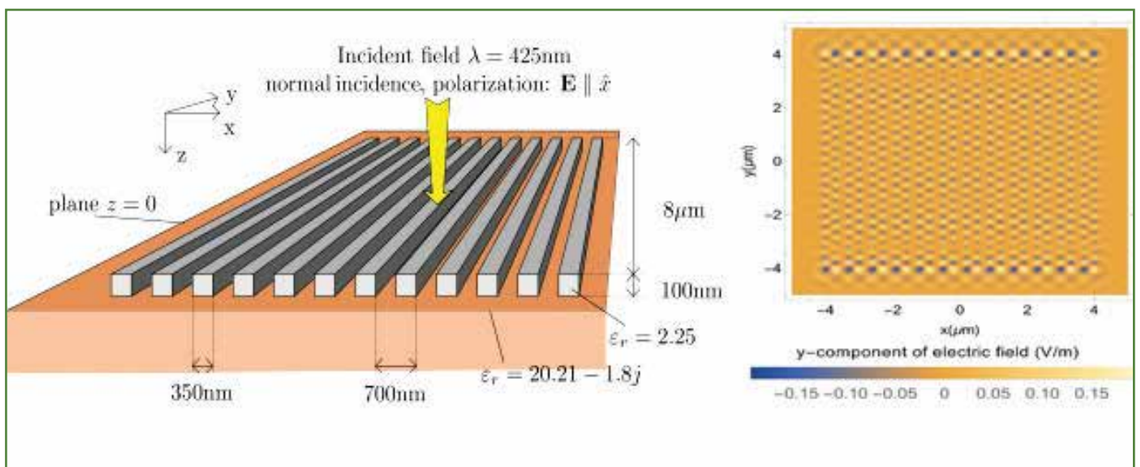


Figure 3: Top: A grating of realistic size. Right: A top view of the electric field on this grating.

Charles Proteus Steinmetz

By: Matthijs van Oord

The name Charles Proteus Steinmetz might not ring any bells, but his work as an electrical engineer helped many generations of students and scientists in understanding AC phenomena and analysis. He performed work in three major areas of AC analysis, including the Hysteresis theory, the steady state circuit theory and the transient theory. During his life he wrote thirteen books and sixty articles, which were not only about the field of engineering, but also about socialism.

Steinmetz was born in 1865 in the Polish city Wroclaw, as the son of Karl August Heinrich Steinmetz and his wife Caroline. Steinmetz was initially named Karl August Rudolph Steinmetz, but due to his immigration to the United States in 1889, and because of the fact that socialism was banned from Poland in 1888, he chose to change his name during the immigration in order to sound more American. His second name he chooses after the Greek god Proteus, which was a wise god which knew many secrets.

Charles started his career at the University of Breslau in 1883, working for his undergraduate degree which he finally finished in 1888. After arriving in the USA, he started working for a company called Eickemeyer and Osterheld, which is a company focused on transformers and electric motors. During his time at this company he became known for his law of hysteresis, which is nowadays called Steinmetz's Law. This law describes the power loss per unit volume of magnetic material due to a sinusoidal magnetic flux. This law led to major breakthroughs in the power losses in both AC and DC systems.

This major discovery was not left unknown by other companies. The USA was in its golden ages when it comes to power grids and power electronics. This was at the time that Thomas Edison formed the General Electric Company. When they heard of Charles's discoveries, they decided to buy Eickemeyer and Osterheld in 1892, to acquire Steinmetz's service as well as his patents. At General Electric his presence would impact the company immediate, as he revolutionized the AC circuit theory and analysis. Before his work this was a very complicated method, which consumed a lot of time performing it. Charles simplified this difficult method to a simple algebraic problem, which could be performed without the need of heavy education. In this simplification he used the phasor representation to symbolize the 90-degree rotation in AC system analysis.

Because of this work and all other research he performed at General Electric, he quickly became known as the engineering wizard of the company's engineering department. After his success in steady state analysis, Steinmetz started to work on the transient theory because of his fascination of the lightning phenomena. He built a football field-sized laboratory in which he placed 120 kV generators, with which he was able to create the first artificial lightning ever created. He also built a tower to attract lightning bolts from the sky in order to study the patterns and effects of lightning.

His achievements where not only noticed by scientists within General Electric. He received several visits from important scientist like Einstein, Tesla and others. He was once called by Henry Ford, because they had an issue with a gigantic generator which their engineers could not fix. Steinmetz came into the plant and only asked for a notebook and a pencil, and started listening and writing down equations for two full days long. When he was finished he climbed on the generator with a piece of chalk and draw a mark on one of the generator's plates. He told the engineers of Ford to remove the plate and replace the windings of the field coil. After they where finished the generator started working perfectly.

Though his scientific achievements, Charles had a pretty terrible personal life. He suffered from dwarfism, a hunchback and hip dysplasia, just as his father and grandfather did. In the fear of passing on the diseases genetically, Charles decided not to marry or have any children. Instead of having children, he helped out his lab assistant Joseph LeRoy Hayden and his new wife by providing them with a large house, including its own research lab. While they had an uneasy start, the arrangement worked out for everybody. He even adopted Joseph as his son, and therefore became a grandfather of his children.

Internship abroad

By: Birgit van Huijgevoort

People often say you can become anything you want, so during my internship in New Zealand I became a researcher during the week and an adventurer during the weekend! I worked on an interesting subject for my internship and loved spending time working together with my snake robot during the week. During the weekend, I wanted to explore New Zealand, so I went on adventures with my friend. So while I was in New Zealand I became many different things. Not only a researcher and adventurer, but also a programmer, communication expert, zookeeper, behavioral scientist, crime scene investigator, bird watcher and wildlife photographer.

Researcher

The life of a researcher may seem boring, but it isn't! Every day I start with a real Kiwi brekkie (breakfast); Weet-Bix with milk. The first time it tasted like wet sawdust, but eventually I loved it. After breakfast I said goodbye to the dogs and cycled to university. People in New Zealand seem to confuse the left and right side of the road. I decided it would be safer to join them than to confront them, so I cycled on the left side of the road.


View from the Port Hills

Every day at university is different. Most of the days I was a hard-working programmer writing code behind my desk. Other days I became a communication expert. However, what I loved most was my time as a zookeeper. My project involves working with a snake robot, who I named Kaa. The goal was to find out how Kaa should move his joints in order to crawl as fast as possible. Or in technological terms: my project is about optimizing the gait parameters of a snake robot, such that the velocity is maximized.

Every good researcher needs a break to give his/her brain a rest, so every day after lunch I walked with my friend along the river at the campus. This was our daily moment to become an adventurer. While it was snowing in the Netherlands we discovered an interesting substance that looks like snow, but is fluffy and not cold. We called it fluffiness. Besides that we were working on the mystery of the crystal clear rivers. Unfortunately we failed to find the reason for the crystal clear water, since we were too distracted by its beauty.


Me as an adventurer

Sometimes we also studied the behavior of people in New Zealand and noticed some interesting differences between Kiwis and Dutch/German people. Many students travel to university by skateboard, instead of cycling; an observation we cannot explain yet.

At the supermarket there seem to be two people at every counter. First we thought the second person was there to do small talk, but then she started putting our groceries into bags.

Another surprising thing is the weather. Twenty degrees Celsius feels like thirty while standing in the sun, but like ten while standing in the shadow. Besides that, the sun burns your skin very easily, since New Zealand is close to a hole in the ozone layer, making the sun very intense.

After a day of hard work at university I cycled home where I found two dogs waiting for me! One of them wants to cuddle and the other one wants to play with the ball. After cuddling, playing and walking the dogs, I spent the rest of the evening learning to be a crime scene investigator by watching 'CSI: Miami'.

Adventurer

During the weekend I mainly was an adventurer, however sometimes I turned into a bird watcher or a wildlife photographer. After going on some adventures on my own, I found out I could use the help of a fellow adventurer; Sarah. Together we went on many adventures, too many to describe all of them, so I will describe the highlights.


Fluffiness

Our first adventure was to explore the uninhabited island close to Christchurch; Quail Island. We found out that this island used to be a quarantine island for dogs. During our walk, we noticed some shipwrecks, so we went off the track and walked down to the beach and the shipwrecks. After investigating the shipwrecks we decided to walk back along the coast. This seemed a good idea until we came across some fallen trees, meaning we had to walk through the mud. We survived the crabs in the mud and got safely back to the ferry. Birgit the bird watcher also spotted some California quail and took some beautiful pictures.

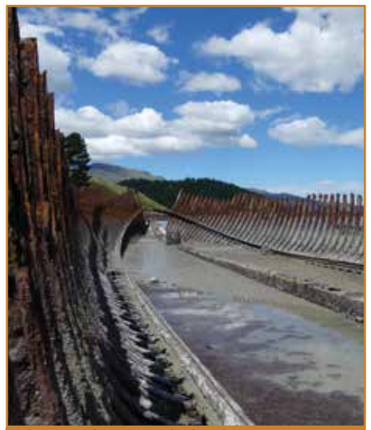
Host family

Most of these adventures took place on a Saturday, because Sunday was my family day. I did a home stay, which means I was staying in the home of some New Zealand people.

You can become anything you want!

The second adventure was very different; we took a gondola up the port hills. After enjoying the amazing view of Lyttelton harbor we discovered a path going down the hill. However, since we'd walked only an hour, we decided to not go down yet and continue walking a little more. This was a mistake; eventually we walked way too far. Fortunately it was worth it; the view from the hills is amazing. Again, the adventurers inside us decided to get off the track and we got lost for a while. We climbed some rocks resulting in a beautiful scar on my shoulder. On our way down we had the feeling we were being watched. After a while we found out there were some curious sheep hiding in the tall grass.

We went on many other adventures. I became a wildlife photographer when we visited Willowbank wildlife reserve and when we went on a nature cruise. We have seen and photographed dolphins, seals, penguins and many birds. On one of our adventures I found out I am not a very good horse whisperer, since we met a very nice horse and even though I asked her to not mess with my camera, she spit on the lens. I guess she didn't like the grass I fed her. If you want to read more about my adventures you can take a look at my (partly Dutch) blog: hhtp://birgit-stage.blogspot.co.nz/.

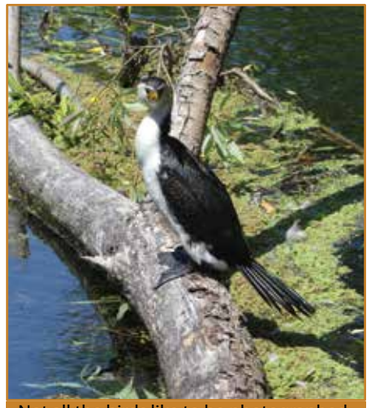

Shipwreck on Quail island

This has a lot of advantages! They took me to nice places close to Christchurch, I could play with their dogs and I got to know the kiwi culture. On Sunday we walked the dogs in a nice area, such as the beach or along a river. We also went to Akaroa, which is a small harbor town where the French influence is evident. I will definitely miss their dogs.

While I am writing this, my internship is almost finished, however my adventure doesn't stop. My boyfriend will fly to New Zealand and together we will explore the rest of New Zealand. Starting at the Southern Island and finishing at the Northern Island, where we will meet two other adventurers; my mom and dad.

I really enjoyed my time in New Zealand and made two very good friends. I advise everybody to go on an internship abroad. You will find yourself in a unique situation and you will get to know yourself better. Besides that it is a unique way to get to know a country. New Zealand is a very nice country to do an internship. On the one hand it is a very easy country, since they speak English and the cities are very European. On the other hand you can enjoy the beautiful landscapes New Zealand has to offer.

By the way, it is true; you can become anything you want, all you have to do is believe in it and never give up! ■


Not all the birds like to be photographed


Tombie and Maggie


Quail island

Puzzle

Here is snippet of section A of the curious multiple-choice entrance exam into the exclusive BrainBashers puzzle club.

1. The first question with B as the correct answer is:

A. 1
B. 4
C. 3
D. 2

2. The answer to Question 4 is:

A. D
B. A
C. B
D. C

3. The answer to Question 1 is:

A. D
B. C
C. B
D. A

4. The number of questions which have D as the correct answer is:

A. 3
B. 2
C. 1
D. 0

5. The number of questions which have B as the correct answer is:
A. 0
B. 2
C. 3
D. 1

Objective / Rules

In the puzzle to the left are five multiple-choice questions. The goal is to solve all questions using the clues provided in the questions.

Once finished, you can send your solution to connecthor@thor.edu.

Winner previous puzzle

The winner of the previous puzzle is Marjolijn Kleijer.

Puzzle solution December edition (Connecthor 40)


Marjolijn with her prize

Are they serious?

By: Tom van Nunen

The world is round. Just like a pancake. Those are also round. And you also turn those around. This is one of my favorite parts of the Dutch comedian Herman Finkers. I love the way he includes science in his work.

As funny as it might sound, there are still a lot of people around who decline science, for example climate change and vaccines, but there are even people who genuinely believe our earth is flat, even in well-developed countries. This so-called 'Flat Earth Society' has members all around the globe , so to say. They find each other on social media, where they feed each other with pseudoscience and try to keep away as far as possible from people who don't share their way of thinking. Even some celebrities seem to join them. Did anyone say 'bubble'?

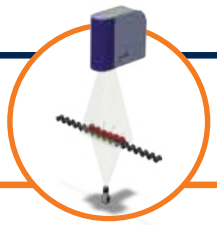
One of those flat-Earthers, Mike Hughes, is going a step further. He built a steam powered rocket with which he is planning to make a flight of little over one mile and 550 meters high into the ~~atmosphere~~ atmos-flat, in order to prove the Earth is flat. I can't imagine what data he thinks to gather from the flight – provided he survives – but maybe that doesn't matter, since Mike says: "I don't believe in science, I know about aerodynamics and fluid dynamics and how things move through the air. But that's not science, that's just a formula." Just let that sink in.

It makes sense that the rise of the internet, social media in particular, causes those pseudoscientific groups to flourish; it becomes easier to find like-minded people and to be absorbed into your own bubble. Think about it: when your Twitter and Facebook feeds are filled with stories about how the earth is flat, vaccines are bad or the climate is not changing, you will slowly become brainwashed into thinking that's the truth. When you have easy access to sources that state 'A', and access to sources that state 'not A' is harder, then the conclusion is simple. This counts especially when you're not educated in critical thinking and evaluation of sources.

When you take a look at one of the many social media pages that promote this kind of pseudoscience, sometimes you want to start to cry, but you might just as well find some hilarious posts. For example, Elon Musk, chief of Tesla and SpaceX, recently posted the question "Why is there no Flat Mars Society!?" on Twitter. The official Flat Earth Society responded "Unlike the Earth, Mars has been observed to be round." On the one hand, I'm laughing out loud about the hypocrisy, but on the other hand, I'm sad that there are actually people out there that think this way.

Some well-educated people sometimes react to this kind of messages, making fun of the people by making them sound ridiculous or stupid. I don't think this is the right approach. I think this kind of approach will drive those people back into their bubbles, making them even more ignorant for the (round) world around them. In my opinion, the answer lies in discussion and arguments. Even though it might take ages before any progress is made this way, it will result in a durable and long term change.

Secretly, I hope that the people in those social media groups are actually very bright scientists that like to construct the most ridiculously sounding theorems in their free time, and see this like a game, much like sometimes we like to do during our breaks or in Het Walhalla, or much like articles you can find on websites like The Onion or De Speld. Let's hope so. ■



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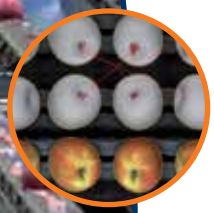

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