



Automotive Talk | Momen**TU**m | Visit to **ITER**
InMotion | New Board **IEEE** | **Internship** abroad

Connecthor

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The end of 2018 is approaching, students and staff are getting ready for at least a week leave from their education and work. It's the time of the year to look back of what we have accomplished and to make New Year's resolutions, or as the President of Thor puts it: "Mandarijnenseizoen".

On the cover of this December issue you will see a photo of our bachelor graduates taken by Bart van Overbeeke during MomenTUm. Martijn de Kok's story about co-organizing and being part of the MomenTUm celebration will give you more insight into this big event.

Lex van Deursen writes about his visit to ITER. Jan Vleeshouwers read the book "Homo Deus – A brief history of Tomorrow by Yuval Noah Harari" and reviewed it. Read more about Jan's thoughts about the book on page 9. Three new staff members introduce themselves to you: Darian Verdy Retianza, Semih Akbayrak and Sofie Haesaert.

One of our editors has had an amazing internship down under. Read all about Lisa Teunissen's experiences in Australia starting on page 18.

We hope you enjoy reading this end of the year edition.

We wish you a wonderful and joyful season together with your loved ones. Merry Christmas and a happy, healthy and prosperous 2019.

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. ■



The forgotten people of North Korea

What is North Korea really like? Read about Sander his experience in North Korea on page 23



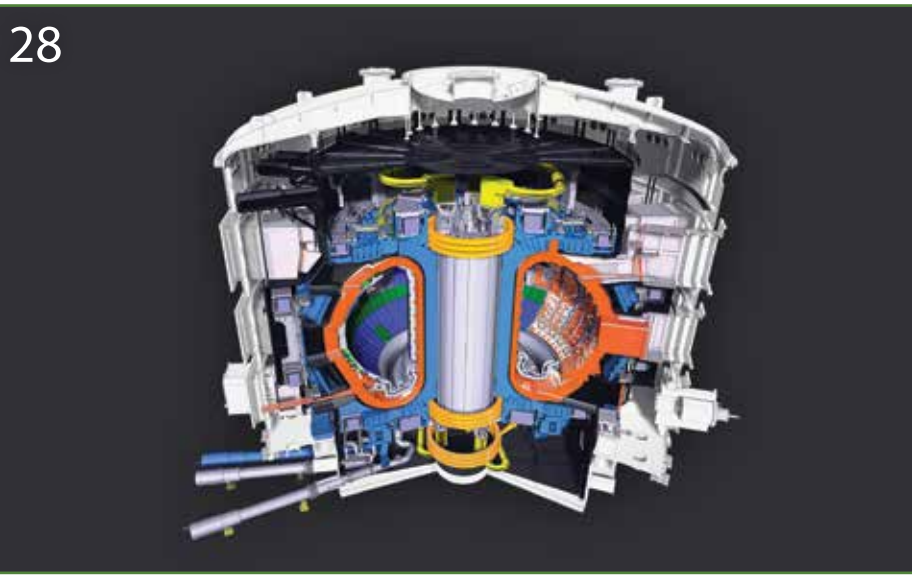
Inmotion: Charging ahead

Read all about the challenges that arrive when you are building a electric car on page 24



Intership Abroad

Still wondering where to go for your inter-ship? You can find a good example on page 18



Visit to ITER

Read about the company visit to ITER on page 28.

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What's with the old stuff?

By: Corine Spoor



Anyone visiting our department will have noticed old and strange 'objects' on display in our buildings – works of art, discarded instruments, gadgets and the like – and may have wondered: what's with the old stuff? Their presence seems more than coincidental, so why are they here? What's the story?

Just as individuals have an inner life of their own and use stories and narratives to maintain a sense of self, institutions have an identity of their own also, and use narratives to create a sense of self, a sense of community, of belonging. Our department is no exception to this general rule. The veterans among us will readily recall the 'lore' of who we once were ('ah, back in the days...') and the rookies among us will bond over the pain of this one particular exam from hell they all had to take. It is these shared experiences that make us into who we are.

The objects on display in our department are our treasure, our cultural heritage, our object trail: they help us both substantiate and recall our past, our shared experiences. By displaying and highlighting certain key items, we help to keep our stories and our sense of self alive and link the past and the future into a harmonious, continuous sense of self. These objects, which we cherish, are both expressive of and constitutive of our sense of identity, of our sense of who we are.

Adding to that, we also display, varying over time, selected works from TU/e's large art collection, mostly small sculptures, graphic art and photography. As with our own heritage, these art works will evoke a sense of wonder and beauty, we hope – ah, beauty, yes, that somewhat old-fashioned but yet still relevant concept! Recently, for instance, new sculptures were placed on floors 4, 8 and 10. We hope you find them interesting.

The Department is showcasing these artifacts and integrating them into a coherent whole, a coherent storyline for a reason, to be sure. Were we to display them as just a bunch of random items, one would be right in claiming we were hoarding 'old stuff' rather than fostering a sense of self. But no, these objects are meant to substantiate the coherent and continuous story of our Department. We have both made and preserved these objects while working on our story and hence, ours is a dual role, a dual responsibility: we are both their creators and their curators.



In short, our cultural heritage helps us recall the past, helps us sustain an interesting and intellectually stimulating environment, and last but not least helps us welcome and engage new colleagues in our story, our ongoing effort to do interesting work, the narrative of who we are. Yes, key elements in our 'institutional museum' – lighting conditions, objects displayed, background information and the like – will need to be tuned once in a while, to keep our heritage alive and relevant. Yes, this will require some effort on our part, but it is an effort that helps us build upon and strengthen our story. It's worth it, so if we need help once in a while with our collection, don't think 'old stuff' – rather, think 'ah, stories to tell!' And, by all means, go and take a look yourself, there is a lot to discover!

Corine Spoor ■



From the President

By: Dana de Vreede



Everybody knows that there are four standard seasons in a year: winter, summer, spring and autumn. Not long ago one of our members asked me which of these was my favorite, a question probably inspired by the label on his teabag. For a long time my answer to this question has been winter. I love the way the world turns white because of the snow. I love that the days get shorter, the extra blankets when watching a movie and of course the open ice skating rink. However, lately I have been doubting my answer more and more, especially since my year as President of Thor started in autumn. This is why I have decided that from now on my favorite season is 'Mandarijnenseizoen', which may leave you wondering what I could possibly mean by that.

Mandarijnenseizoen is the time period in which the mandarin orange is for sale in the Netherlands. About two weeks ago I saw the first mandarin oranges in the shop which embarked the start of what will possibly be one of my most hectic and fun Mandarijnenseizoenen of my life.

Usually there are a few standard moments which I look forward to, that come back every Mandarijnenseizoen. First of all the opening of the ice skating rink, which means

I will finally be able to skate again after a long summer. Secondly of course all of the different holidays that will follow up on each other: Sinterklaas, Christmas and New Year. All of those are times I get to spend with family and friends, something I enjoy with all of my heart. And although I am looking forward to these moments in Mandarijnenseizoen a lot, this year will be extra special because of the many Board moments I will get to enjoy.

The first big event in this Mandarijnenseizoen was of course the General Members Meeting in which we were installed as Board of Thor. At the third day of the meeting it was finally our turn to become what we had been living up to for a pretty long while back then, Board of our study association. With Laurens' last official scale of Mjölñir I was installed as President and after that it was my turn to install the other six who would join me. It is hard to describe the feeling I had every time I got to install one of my fellow Board members, I was proud, excited, happy and curious of what we would experience at the same time. The evening and meeting ended with us singing the association song as Board for the first time. Standing there, all seven of us in front of our members, that is a moment I will never forget.

Then there was our constitution drink, the second big Thor event in this Mandarijnenseizoen. An event David, our Commissioner of Het Walhalla, and I had organized. I once again want to thank everybody who was there, either to help around during the activity or to congratulate us with our installation.

Lastly there was another very important and fun event, maybe not so much for Thor but mostly for us as a newly installed Board. It was time for our photoshoot, which we did on the Paleisbrug in Den Bosch. We were lucky and had a clear blue sky, a little bit of wind (as can be seen on our group picture), and a lot of fun. This led to a series of beautiful pictures we are all proud of.

I am extremely excited to see what else this Mandarijnenseizoen will bring me, both as Board and as an individual. I hope you can enjoy it as much as I plan to!

Veel gedonder!
Dana de Vreede
President of Thor ■



Fons van der Sommen awarded during first MomenTUM

Fons van der Sommen won the TU/e Academic Award for the best PhD project, for his research into a technique in which a computer can recognize early signs of esophageal cancer in photos.



Patty Stabile (ECO group) and Alex Alvarado (SPS group) have been selected as members of the Eindhoven Young Academy of Engineering.

The goals of the TU/e Young Academy include stimulating interdisciplinary research, contributing to outreach to the general public and providing advice on academic policy.

New Director C3TE

As of November 1, 2018, Maarten Paulides will be the new scientific director of the Center for Care and Cure Technologies Eindhoven (C3TE) at the department of Electrical Engineering. In this new role, Maarten will succeed prof. Peter de With and prof. Massimo Mischi. Next to his role as scientific director, Maarten will be appointed as associate professor in biomedical electromagnetics in the EM group.



Academic Award for best PDEng Thesis for Rabia Zainab Syeda

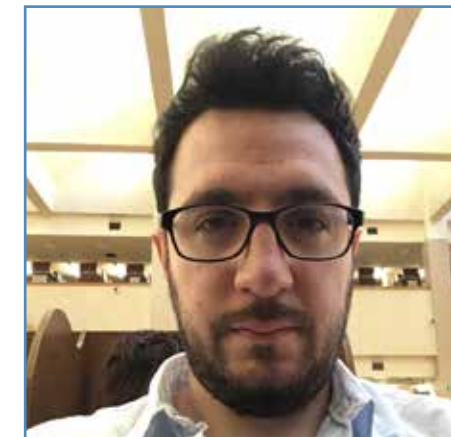
During the Momentum event on September 21st 2018, Rabia Zainab Syeda received the Academic Award for the best PDEng thesis of TU/e in the academic year 2016-2017. Rabia's PDEng project revolved around the design of a Multiple Input Multiple Output (MIMO) radar imaging system at 60 GHz, to form the equivalent of a 3D mm-wave camera.

Such radar imaging systems are a strong candidate when it comes to 3D environment scanning applications, be it in the field of security, medicine or automotive industry. Among these systems, mm-wave imaging systems are most popular. Moreover, recent technological breakthroughs in the field of semiconductor technologies have granted the opportunity to develop a low-cost low-power single-chip mm-wave radar with highly integrated transceivers and integrated mm-wave antennas. This high level of integration gives rise to the idea of a multi-node radar system, such as a MIMO radar, that can be a high-resolution, small-size and low-cost imaging system. To test this idea, Rabia designed and implemented a system-level multichip application platform for a MIMO radar demonstrator, with support from Omniradar.

Currently, Rabia is continuing as a PhD candidate in the Electromagnetics group, where she continues her research and design activities on a 3D mm-wave camera.

Introducing...

My name is Darian Verdy Retianza, but you can call me Darian, and I come from Indonesia. I grew up in a city called Semarang (Central Java). Later on, I moved to Bandung to study at Institut Teknologi Bandung in Electric Power Engineering focusing in Power Electronics. At the end of my study, I won KTH master Challenge 2016 as a First Prize Winner. Thanks to that, I was able to continue my education at KTH, Stockholm, Sweden by scholarship for two years in Vehicle Engineering. Besides my interest in sciences and mathematics, I love to go hiking, camping, and playing music.



Currently, I am working as a PhD in EPE group under prof. Elena Lomonova on the topic of development of innovative combined drive and energy harvesting for Active Suspension System under the AUTODRIVE project, in close cooperation with Tenneco. My contribution to this project is the development of a controller and a power electronics drive for active suspension actuators in order to provide satisfying riding comfort and energy harvesting capability.

I'm looking forward to my next journey here in Eindhoven. See you around! ■



Hello everyone! My name is Semih Akbayrak. I moved to Eindhoven from Istanbul in September 2018. I joined the Signal Processing Systems group as a PhD student and became a member of BIAS (Bayesian Intelligent Autonomous Systems) lab. Previously, I studied Electrical & Electronics Engineering and Computational Science at Bogazici University during my undergraduate and master years, respectively. In my master studies, I mostly focused on machine learning for a broad range of application areas from natural language processing to recommendation systems. Here

at TU/e, my research focuses on automating Bayesian inference in probabilistic models to facilitate the model development.

In my leisure time, I like to play football and basketball. I used to camp out a lot and watch the stars but I decided to take a break for a while. I love reading books, watching movies and hanging out with friends. Additionally, in the last two months, I've adopted a new hobby, cooking. Because the sandwiches and sweet sauces of Dutch cuisine taste strange to me, I am on my way to becoming a master chef :). I look forward to seeing you around! ■

Graduates October 2018



Xin Ye, Xikai Tang
Jiejie Bao
Jinjie Peng
Khashayar Sharif
Narasimha Shruti Kestur
Mariya Rustamovna Mansurova
Sjors Braam
Shirin Shadmand
Markus Hendrik Adriaan Janse

Zheng Pen
Chengcheng Guo
Yan Pan, Jiyang Li
Bram Daniels
Max Geerlofs
Lucas Louis Marie Vogels
Rafi Md Ahsanul Hoque
Rob Rudolf Franciscus Maria Romijnders

Arnau Sans Ibo
Fatima Abidine
Daan Rosenmuller
Sathiswar Jayaseelan
Hadis Pourasghar Khomami
Edgar Mauricio Salazar Duque
Sükrü Er
Berrie Dirks
Louis Daniël van Harten
Qihao Yu

Genov Genio Gonet
Menazzi Matteo
Bardia Sharif
Shah Nawaz
Mahmoodreza Mirzakhilili
Xu Zhang
Cornelis Johannes Christiaan Vertegaal
Yingxiang He
Zhaoheng Lu



My name is Sofie Haesaert. I started in September as a new assistant professor at the TU/e. I was born ('89) and raised in Leuven in Belgium. In 2007, I moved to the Netherlands to study, and I obtained my BSc in Mechanical engineering and my MSc in Systems and Control at TU Delft. I received my PhD. degree from the Control Systems group in this department in February 2017.

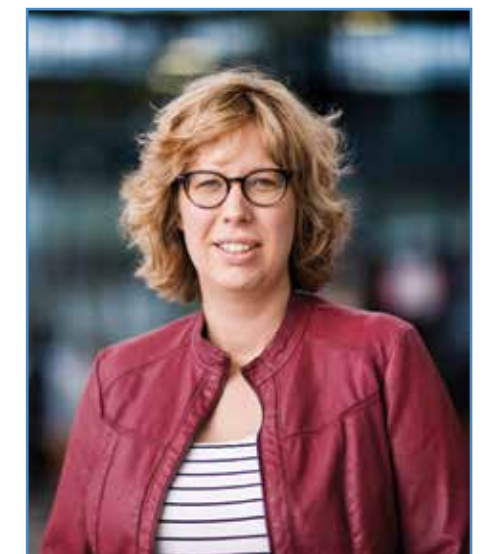
I research how critical bugs in the control systems that control cars, airplanes, robots and so on, can be avoided by using specification and verification techniques that originate from computer science.

The last year and a half, I did this research as a post-doctoral scholar in Southern California, where I worked at the California Institute

of Technology (Caltech). During my time at Caltech, I collaborated with NASA's Jet Propulsion Lab to investigate how future Mars missions can be planned autonomously based on temporal logic mission specifications.

At the TU/e, I look forward to passing on my enthusiasm for inter-disciplinary research and control theory.

I currently live in Eindhoven. I like to meet up with friends and go to good restaurants. In my spare time, I am an amateur photographer. I find making pictures via manual focus very relaxing, so in the past couple of years, I have built up a collection of old analog lenses. ■



Cisco Sales Associate Program

By: Minke en Alexander

Minke en Alexander maken beiden onderdeel uit van het global awardwinning traineeship programma; Cisco Sales Associate Program. Een programma speciaal ontwikkeld voor Graduates die een vliegende start in hun carrière willen maken op het gebied van Engineering en Sales. De achtergronden van deze beide trainees lopen uiteen; waar Alexander na het behalen van zijn Bachelor Electrotechniek voor de Master Embedded Systems aan de TU Delft koos, heeft Minke vorig jaar haar Master diploma Business Information Management aan de Erasmus Universiteit in ontvangst mogen nemen.

Alexander; *“Cisco is voor mij het perfect voorbeeld waar business value en techniek bij elkaar komen. Tijdens mijn studies heb ik mij altijd bezig gehouden met de bedrijfsmatige kant van een product of dienst wat ik kan ontwikkelen. Ik ben een “techie” in hard en nieren, maar de ondernemer in mij zorgt ervoor dat ik altijd met een commerciële bril naar het eind resultaat kijk.”*

Doordat de Master van Minke meer op het managementsniveau ligt, is het ASE programma voor haar een goede aanvulling;

Minke; *“Er is een enorm gat tussen de business en techniek. Deze beiden werelden wil ik graag dichterbij elkaar toe brengen. Mijn managementachtergrond gecombineerd met de*

technische kennis die ik tijdens het programma heb kunnen opdoen is voor mij dan ook de perfect combinatie.”

CSAP programma;

Amsterdam is een van de trainingshuizen voor Europa. In totaal starten er 45 graduates uit heel Europa op deze locatie.

Minke; *“Voor mij is dit echt een kers op de taart. Je werkt met een diversiteit aan nationaliteiten en we zijn echt een hechte groep geworden.”*

Alexander; *“In de weekenden word ik vaak ingezet als locale gids om alle hotspots van Nederland te showen haha.”*

Los van de activiteiten wordt er ook hard gewerkt. De eerste zes maanden worden er veel bootcamps verzorgd van softskills, tot product presentaties, tot netwerktrainingen.

Minke; *“Voor een “non-techie” like me, waren de technical bootcamps soms best pittig. Gelukkig zijn de collega’s binnen Cisco ontzettend behulpzaam en delen zij graag hun kennis met je.”*

Alexander *“Mijn softwarekennis was inderdaad boven gemiddeld, hierdoor kreeg ik na deze zes maanden ook meteen de kans om in een uitdagend software project te stappen. We hebben een product ontwikkeld voor een groot datacenter dat ervoor zorgt dat de juiste applicaties met elkaar communiceren en tevens dezelfde applicaties kunt beveiligen tegen het*



uitwisselen van ongewenste informatie. Zoals creditcard gegevens. Het geeft een goed gevoel om direct deel te kunnen nemen aan projecten die direct iets bij dragen.”

Minke; *“Het CSAP programma geeft je een goede basis voor een sterk netwerk intern. Hierdoor krijg je (sneller) mooie kansen aangeboden in de organisatie. Ik heb ontzettend veel zin om vanaf augustus het IoT team te gaan versterken en mij met de projecten van de toekomst bezig te houden. Maar eerst Las Vegas!”*

In augustus organiseert Cisco het jaarlijkse kickoffevent. Alle salescollega’s uit de hele wereld komen naar Las Vegas.

Minke; *“Je weet niet wat je ziet. Met ruim 10.000 collega’s volg je overdag interessante lezingen en trainingen en ‘s avonds wordt je compleet in de watten gelegd en sta je met de managers in de club. En dat elk jaar weer!”*

Wil jij net als Alexander en Minke onderdeel uitmaken van dit internationale traineeshipprogramma? Wij komen heel graag verder met je in contact!

Het CSAP programma start eens per jaar in de eerste week van augustus. De vacature voor het intership staat reeds op onze site gepubliceerd;

LinkedIn profiel Minke; Minke Huizenga

LinkedIn profiel Alexander; Alexander de Moes ■



Homo Deus – A brief history of Tomorrow : Yuval Noah Harari

By: Jan Vleeshouwers

If men become gods, as the title of Homo Deus suggests, technology must surely play a large role in it. Having read predecessor Sapiens, I was quite curious how Harari envisioned the future development of humanity and technology’s place in it.

Harari has succeeded in writing a smooth, easy-to-read discourse on the future of mankind, with plenty of reference to relevant history – after all, he is a historian. That may well be the reason why the technology-part of the story is largely dissatisfying. There is a lot of technology, but the story is full of holes, smaller or larger mistakes and uncomfortable expectations. I’ll try to describe Harari’s line of thought below and will then focus on the technical aspects of being god.

Becoming gods

Harari starts with formulating the 21st century human targets: immortality, happiness and divinity. These remain after having more or less tackled the more mundane human curses of disease, hunger and war. The three ‘remaining’ human targets are questionable, but they are not relevant per se, because in the sideline, there is another target: ‘One central project will be to protect humankind and the planet as a whole from the dangers inherent in our own power.’ The message Harari gets across is that present day technological developments open up vast new areas of applications, and these god-like powers may just as well turn out to be blessings as disasters.

Liberal humanism

To picture a likely future, Harari first sketches what is special about Homo sapiens and what the essential human drives, actions and mental mechanisms are. In brief: humans invented agriculture and industry, dominating every other species, and neutralized evolution. After scanning a large set of explanations why humans would be so special, such as having a soul, having a conscious mind, having intelligence, sensations and desires, Harari identifies the human capacity of ‘cooperating flexibly in large numbers’ as the most essential, and connects it to the talent of making up stories. Stories, he says, are the real reason people align. They don’t have to be true, but they have to be convincing. Supported by technology for distribution – once paper, now the internet – stories organize societies. They allow humans to have schools, banks and democracy, which after all only exist in peoples’ minds, and only work if people have similar ideas and

expectations about them, and believe in them.

The largest ‘stories’ are religion and science. The interplay between the two, Harari states, is because religion is focused on order and science on power. (For further comments on this, see below.) In the course of history, science has used the truths of religion to explore the ‘real world’, and religion has repeatedly reinvented itself to reflect new findings in science. Our current day religion, Harari says, is liberal humanism, with a firm belief in free will, in an individual, inner self of each human on earth, and in democracy and capitalism. The expansion of science brings more power to humanity and leads to religions with less meaning.

The future

The future is like the past: science will also corrode the central beliefs of humanism. Free will is already a doubtful concept, and the individual (‘indivisible’) self does not survive scientific scrutiny either. The implications, according to Harari, are ‘useless’ humans, the most misanthropic part of the book. Humanism will lose its foundation, after which Harari reviews a couple of alternatives, the most far-reaching of which is a data religion (‘dataism’). Dataism seems to surpass physical existence by considering all life to be data flows and algorithms, and preaches freedom of information, i.e. the right of information to flow freely.

Where is the technology?

Technology plays an illustrative role in the book, but not in a coherent fashion. The introductory chapters describe human successes, for example in fighting diseases, which in fact all are scientific and technological advances. The way in which humanity got to dominate all other species, is also illustrated with a lot of technical detail. He describes the search for immortality, for happiness and the breaking down of myths as ‘soul’ and ‘free will’ using all kinds of technically loaded examples. He never dives deep, and the tone is often disapproving. Harari expects that ‘once technology enables us to re-engineer human minds, Homo sapiens will disappear’, which is quite some power to attribute to technology. At the same time, Harari’s knowledge of technology and nature appears to be limited, for example in the description of the man fleeing for a lion. If it really worked this way, humans would be quite an easy catch for a lion.

On the whole, Harari depicts technology as a kind of an unpredictable phenomenon. It may work out good or bad, it seemingly emerges out

of thin air, and the religion of the future, ‘dataism’, must surely be full of technology but nevertheless organisms reduce to data and algorithms. Matter and energy appear to be irrelevant.

The essential trouble with the book is, that it is full of technology working ‘by itself’: ‘The new technologies of the twenty-first century may thus reverse the humanist revolution, stripping humans of their authority’. It is always humans who apply technology, so what is Harari actually saying here? Harari also uses this perspective when describing company activities. This has the estranging effect that abstract entities seem to get hold over humans, but the fact is that there are people behind these companies. Harari himself stresses that all these companies exist in human minds only. The proper perspective is that people interact with people through technology and companies, and we need this perspective to analyze the effects of technology correctly and to notice that they invariably lead to societal power shifts. This part of the story is completely absent in Homo Deus, which accounts for my dissatisfaction.

A closer look at power and order

The absence of humans behind technology is remarkable in Harari’s analysis, but the actual quirk is where he states that religion is focused on order and science on power. Power and order are most certainly an element in both. Both exert power, provide control, and as a result provide a context for effective societal ordering.

There might be a relation to the niche-construction concept, i.e. the two evolutionary movements: organisms adapting to environmental changes, and the environment getting adapted through organism activity. Religion ties in to the first (religion tends to consider the cosmos as given, fixed), science to the second (science tends to consider nature as ultimately modifiable). Both are valuable survival mechanisms, but from different perspectives.

Now if religion needs constancy and unexplained mystery, it will be increasingly hard to find a focusing point, neither in the outside world nor inside a human individual. Dataism doesn’t fit, because there is no mystery or constancy in data. But what does fit? I would very much have liked to give you an answer, but I have no idea. I do think, however, that Harari would have arrived at a different prophecy if he would have adopted this perspective. ■

Visit to ITER

By: Lex van Deursen

Disclaimer: The views and opinions expressed herein do not necessarily reflect those of the ITER organization

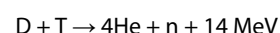
In the EMC UK conference of October 2011, I met David Beltran who was then responsible for the cabling and grounding issues of the ITER (Latin for 'The way') experimental nuclear fusion reactor, to be built in near Cadarache in the Provence area of France. In fact, I was there because I wanted to meet him, and that was reciprocal. Our common interest was in the modern approach of cabling and grounding, where the group EHC (then headed by professor Piet van der Laan) contributed through several PhD studies, journal papers and IEC documents. Piet and I worked together in a series of contracts with ITER till 2015. Since ITER is now under construction, I was curious to see how our recommendations are implemented. So I visited David at the ITER site again in September 2018.

About ITER

ITER is a large international project that started in late 80's, aimed to demonstrate the scientific and technological feasibility of energy generation by magnetically confined nuclear fusion. ITER is the first Tokamak reactor to generate more energy (500 MW) than is input to the plasma (50 MW) in a stable plasma during half an hour. The 35 contributors to ITER are China, EU, India, Japan, Korea, Russia and the US. A sketch of the reactor is in Fig. 1. Here only a short description of the

machine is possible; extensive and updated information is available on the ITER website www.iter.org.

The nuclear reactions occur in a vacuum vessel (orange), where the plasma of ionized heavy isotopes of hydrogen – deuterium and tritium – flows in a torus around a central set of coils (yellow). Coils and plasma form a transformer with 15 MA of plasma current. The reaction



occurs at a temperature of about at 150 million K, 10 times the temperature in the center of the sun. The vessel is made of several centimeters thick stainless steel, double walled to allow for water cooling. The inner wall of the vessel is covered with water-cooled beryllium blanket modules that absorb the neutrons and their energy and protect the outer elements. A set of 18 D-shaped coils (blue, <https://www.iter.org/newsline/259/1524>) on a circle keep the plasma in the toroidal shape, far from the walls as no material exists to withstand the plasma temperature. Other coils control the position of the toroidal plasma. All coils are superconducting Nb3Sn or NbTi.

The vacuum vessel and coils are embedded in the cryostat (outer stainless steel structure), with diameter and height of approximately 30 m. At three levels a total of 44 ports around the circumference allow access to the plasma for feeding the D-T mixture, energization and diagnostics. Everything on ITER is enormous, see the website for details. For instance, the magnetic energy in the D-coils (windings at about 4 K, 9 x 17 m, 64 kA of current, 12 T maximum field) is 41 GJ. They are designed to withstand an emergency shutdown, where the energy is evacuated in about 7 seconds. That power is readily comparable to the total day-time electrical energy consumption if the Netherlands. When in operation, ITER consumes 2 GW, reason why it is the only installation directly connected to the French 400 kV grid.

The ITER site is half a square kilometer, and thus an impressive amount and length of cables is needed, inside and outside the buildings. All cables have to be protected against interference, natural (e.g. lightning), home-brewed (switching events such as an emergency shutdown and power electronics), or external (e.g. intended EMI). Earlier tokamaks relied on 'single point' grounding, where a point (usually under the center of the tokamak) is chosen as 'reference'. With ITER, such an old-fashioned approach is unrealistic because of the huge amounts of metal in vessel and cryostat, and construction steel in the building. Piet proposed a better approach in a 1989 paper in the 'Fusion Engineering and Design' that stimulated David to contact us. In a series of contracts we joined forces with him to come up with solutions.

Outside the cryostat

All cables are to be laid on trays and ladders that are interconnected to form a meshed grounding structure, or parallel 'earthing' conductors (PEC) in IEC terminology. Construction steel, reinforcement of the concrete and grounding electrodes are integrated in this concept. Fig. 2 give an impression of the re-bar density in the concrete under the cryostat. It is difficult to 'single' a point in this mesh. Fig. 3 shows a set of trays and ladders inside the Tokamak building. The solid bottom trays protect cables serving sensitive signals. Ladders are for cables for electrical power and control.



Cable shields are integrated in the PEC structure. The Fukushima accident demonstrated the necessity of an earthquake-proof installation. For EMC purposes, thin PEC metal would already suffice. But to withstand earthquakes it required supports of the order of 1 cm thickness.

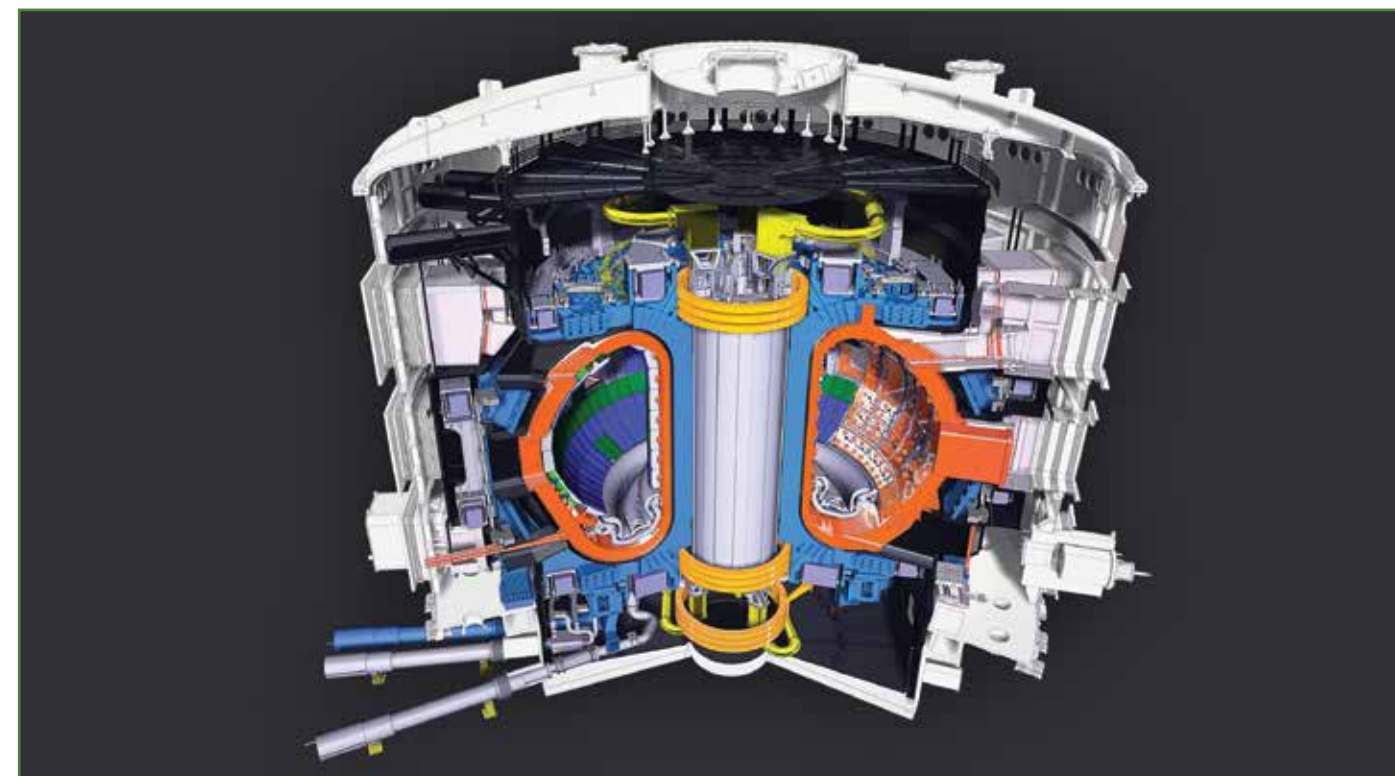
Inside the cryostat, outside the vessel

Here we must reckon with high vacuum, strong magnetic fields, fast field variations dB/dt (shutdown), limited space, and

temperatures between 500 and 5 K. To give an example: only a few centimeters are between the 5 K toroidal D-coil and the 150 MK plasma, where the space between the coil structure and the vessel is shared with the 80 K thermal shield. An additional requirement is a maintenance-free operation over several decades for the sensors for temperature, strain, position, vibration, etc., in the presence of the residual neutron flux. The governing principle is that all cable routing minimizes the magnetic flux variation dφ/dt between cables and surroundings. To this end cables

follow magnetic field lines or are placed radially. The thermal shield helps, as it is made a set of 2 cm thick silver-plated stainless steel plates. The shield is cooled by helium gas at 80 K to minimize the thermal radiation to the superconducting coils. The plates are electrically insulated with respect to each other in order to reduce the eddy currents and their Lorentz forces. Cables can be attached to and protected by the plates, with due attention at the gaps. As even small induced current in signal cable shields would cause large Lorentz forces, it is necessary to insulate sensors and shields with respect to the plates.

In the three years of the cooperation with David, Piet and I addressed many issues on grounding, shielding and physical aspects of the cabling and insulation. The challenge was to find acceptable solutions that could be realized within the constraints put by the ITER environment. And it was a pleasure to see the work going on in September. Site preparation, building construction and installation continue till 2025; commissioning with non-reacting plasmas follows till 2035. Real fusion experiments with D-T plasma will take 20 years. And the successor of ITER, DEMO is now being planned to generate 2 GW of electrical fusion power delivered to the grid. ■



IEEE Student Branch Eindhoven

By: Thomas Lippens

When you have walked past the sixth floor of Flux lately, you might have noticed a change in the layout of the floor. What once was a space with workplaces for Master students is now a workplace for the boards of the four master associations at our department. Next to the associations that are focusing on one of the strategic research areas of the department, Waldur (Smart and Sustainable Society), Odin (Connected World) and Eir (Care and Cure), there is also another association that probably is less known to you: IEEE Student Branch Eindhoven.

IEEE Student Branch Eindhoven is the association that forms a bridge between the global organization IEEE and the students in Eindhoven. We are able to arrange your IEEE Student Membership that comes with quite some benefits, such as discounts on congresses and admission to certain competitions such as the 24-hour programming competition IEEEXtreme. We also take care of the membership administration for PhD students at Electrical Engineering. Furthermore, we organize quite some activities each year, such as the infamous sailing weekend with the Belgian IEEE student branches, several workshops, and of course some drinks and dinners. Most of these activities are targeted at students finishing their bachelor or doing their master, but activities are also open to other interested students.

The recently installed board consists of four people: Jelle Verest (chairman), Thomas Lippens (secretary), Michiel Arts (treasurer), and Ramon Hameleers (vice president). All four of us are in the final phase of our bachelor in Electrical Engineering and were looking for opportunities to develop ourselves. As IEEE SBE has been going through some quiet times we accepted the challenge to reinvigorate the branch. Although this means there is a lot of work for us to do, the flipside is that we have the opportunity to rebuild the association following our own ideas. That is also why we are really looking forward to the coming year.

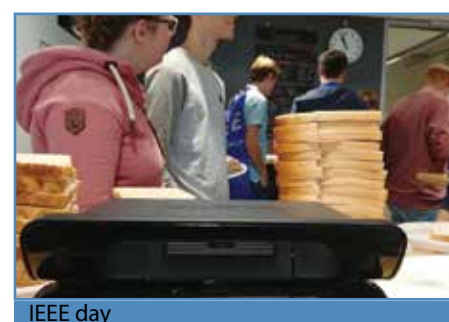
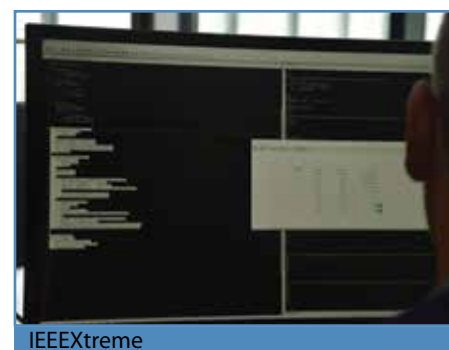
Since the beginning of the academic year we have been taking over tasks from the previous board, promoting the association and organizing activities. During the



master's introduction we organized a well-received barbecue and pub quiz for students at Electrical Engineering and Applied Physics. During IEEE day on the 2nd of October, we promoted IEEE and the student branch in Eindhoven with free toasted sandwiches for everyone during the full day. We managed to prepare almost 300 toasted sandwiches, and as this activity was quite successful, we will try to do this more often. We also competed in the IEEEXtreme with several teams from our branch, which resulted in a very good time for all of the contestants.

In the near future we want to put IEEE Student Branch Eindhoven back on the map as an active association with lots of networking possibilities and not only educational activities, but also fun activities. In the future, we will keep everyone up-to-date via our website www.ieee.tue.nl and a newsletter. If you want

to know more about IEEE Student Branch Eindhoven or the benefits of an IEEE membership, or if you have some great ideas you want to share with us, feel free to send us an email at ieee@tue.nl. Of course you can also visit us at our workplace! If you want to become a member, we have a registration form on our website, or printed copies at our workplace. ■



The forgotten people of North Korea

By: Sander Verdiessen

Two weeks after I booked a group tour to North Korea a CNN headline read the following: '21-year old American student detained in North Korea'. As I continued reading I found out he had stolen a poster and was traveling with the same travel company where I had just booked my trip. Shall I cancel the trip? Is it still safe to go? Do I still want to go? All these questions went through my head, but I decided to trust the experts who said it was perfectly safe to go as long as I behaved. And I am very happy that I did.

I first needed to travel to Beijing. From here all tours into North Korea depart. After a pre-tour briefing I boarded a train for a 24-hour scenic drive to Pyongyang. I was joined by a group of international travelers for the 12-day journey through the country. As soon as we crossed the Yalu river into North Korea the scenery changed and it appeared that we had travelled back in time 50 years or so. Upon our arrival we met our Korean guides and we checked into the hotel.

Many people have asked me why I went to North Korea when the country is known only for the wrong reasons. Ever since I first learned about the country I have been wondering what it would be like to live there. There are over 20 million people living there in hardship and yet 90% of the news coverage is about their nuclear program. I wanted to go to the country to try and meet the people and get a glimpse of what their daily life is like.

I spend a total of twelve days in the country enjoying a very tight schedule. Our days were filled with excursions to museums, landmarks, theater shows, factories and the list goes on. And a lot of long bus rides. Most nights were spent mingling with the Korean guides and other tourists at hotels.

Pyongyang is a fairly modern, but quiet Asian city. There are many large buildings amongst which the largest (unfinished) hotel, stadium and triumphal arc in the world. I was told the city has changed a lot in recent years and some shops now exist and even taxis roam the streets. Outside of the capital the country is completely different. It feels as if the countryside has not changed in the last fifty years. The main highways were built by the Soviets and are in desperate need of repair, which results in very bumpy bus journeys. Many nights were spent in the dark, because only Pyongyang has a reliable supply of electricity.

A few days into the trip I got a very strange feeling that lasted for the remainder of the trip. I could not tell most of the time whether or not I was told the truth. I just did not know what was staged and what was not. Later I found out that some questions kids asked us were staged, because a few vloggers on YouTube showed that the exact same people had asked them the exact same questions. Some things on the other hand turned out to be surprisingly true. Such as some of the sneaky things that the USA has done throughout the years. Mostly concerning espionage and false accusations. Other things cannot be fact-checked and will forever remain a mystery to me.

A trip to North Korea is not complete without a visit to the DMZ with South Korea. We were allowed to stay for much longer than tourists on the South Korean side, who get only about ten minutes. This was a very exciting part of the trip, because the tensions between the two Koreas can be felt.

During our pre-tour briefing it was stressed that everybody should dress formally and show respect during one of the visits. This was the visit to the Mausoleum, where both Kim Il-sung and Kim Jong-il are on display. Throughout this visit I had to keep my arms to my side and be quiet. The Koreans were very strict on this. And given the number of soldiers that were present I was keen to follow the rules.

The most memorable moment of the trip was during a visit to the beach. Here I was able to really interact with some of the locals. I found some teenagers who spoke decent English. Although they were hesitant to talk to me I had a good talk with them. When I left one of them said to me while looking quite astonished: 'You're friendly'. This goes to show how cut off they are. These guys had never actually met someone from Europe before. They had only seen and heard the propaganda. In order not to jeopardize their safety and that of others I did not add any recognizable photos of people to this column.

The most insightful conversations by far I had with the Korean guides (especially after a few glasses of soju ;-)). It struck me that it was not only me being interested in their daily lives, but also them being interested in mine. Occasionally one of the guides sat down next to me and asked if he could see some photos on my phone. They asked about my family, school, but most of all

they loved looking at photos of different places I had visited. There is truly no other way for them to see those images.

Another question I often get asked is: 'Doesn't it bother you that your money goes to the government?' Quite frankly it does, but I am also a firm believer that proper and peaceful change in North Korea must come from within. Nowadays the only way to show these people that they are living in a bubble is through tourism. Next to this the money the regime makes through tourism is infinitesimal compared to the cost of their nuclear program. The regime makes money in many different legal and illegal ways. Selling cheap labor forces to Russia and elaborate banking schemes to name a few.

A year later during a study trip to South Korea the strength of the bubble was demonstrated once again. We had organized to speak to some North Korean refugees living in Seoul. One of them told us that some people know that the outside world is better off. However they simply do not believe they can ever get there. He compared it to a situation where you are given 1 million euro, but it is on the moon. You want to get the money, but you simply cannot get to the moon.

My message is that we must not forget that over 20 million people live in oppression in this country. They are oppressed by a few powerful individuals and they would like nothing more than to be free like you and I. With all the rhetoric in the international news nowadays I simply hope that when the Kim dynasty comes to an end, the transition will be without bloodshed. ■





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|----------------------------|---------------------------------|
| 1. Allander publecture | 10&11. Promotion stunt |
| 2. AME Excursion | 12. Secretary trip |
| 3&4. Constitutional drink | 13&14. Sioux lunchlecture |
| 5. IHC lunchlecture | 15 till 17. ThEW |
| 6 till 8. Candidates drink | 18&19. WALV |
| 9. LANCo Mario kart | 20&21. Pie from our new presser |

MomenTUm

By: Martijn de Kok Photos by Bart van Overbeeke

The Federation of Study Associations Eindhoven (FSE) is the umbrella organization of the ten largest study associations, such as Thor, at the TU/e. Traditionally, the board of the FSE is tasked with the organization of the Opening Academic Year (OAY). When I and three others started our own board year just over a year ago, we expected this to be the case again. Little did we know at the time that a number of people amongst the TU/e's higher-ups had a different idea. This year, the OAY would be



replaced by the new MomenTUm celebration. Simply put, the MomenTUm celebration would combine several yearly academic celebrations into a single day. Most notably the bachelor diploma ceremonies would all be held this day, but also the academic awards and a special honorary degree would be combined into a single event on Friday the 21st of September.

At this point I found myself in a unique position: as a member of the student working group I would be assisting the organization of the day, but at the same time I would be participating in MomenTUm as a graduating bachelor student.

The diploma awards were handled individually by all departments. This gave the departments the chance to give the diploma awards a personal touch, since the afternoon ceremony would be for all bachelor graduates of the entire university at once. The diploma award ceremonies for Automotive Technology and Electrical Engineering were both presented by Sjoerd Hulshof, who preceded the award ceremony with some facts and interesting statistics about the pass rates of the studies. These numbers reminded the graduates and their parents that it had not been easy to achieve these diplomas.

After all diplomas had been handed out, the students and parents gathered separately at the Markthal for the celebration. After the professors and student board members had arrived in the traditional cortege, the graduate students entered the hall in their gowns and hats. The ceremony, which lasted for two hours, had a tightly packed schedule. Graduating students, performances, award winners and speeches followed each other in rapid, almost seamless succession. The event was concluded with the ceremonial throwing of the graduate hats.

A lunch followed the ceremony, so the students and parents could have a drink and something to eat on the Flux field. At this point I had some time off from any responsibilities as a working group member, so I could spend some time with my own family like the other graduates. There were many happy faces to see there on the Flux field, both of proud graduates and proud family members. I made use of this time to briefly visit Het Walhalla with my parents and sister, to show them where I have spent a number of my late afternoons in the previous years. However, after a short while I had to return to duty and help with the final preparations for the closing party.

Of course, MomenTUm would not be a worthy successor of the Opening Academic Year without a massive party to close the day. This



took place from 8 PM to 1 AM in the Markthal of Metaforum, and featured student-DJ duo Mystery Beats, DJ Donnie D, and starred coverband Proost! and Kraantje Pappie. The party was the perfect wrap-up for the first edition of MomenTUm, which paved the way for many more future editions to come. ■



Icons of EE: Mihajlo Pupin

By: Matthijs van Oort

When telephone lines were introduced, the communication between people changed a lot. Close friends could be called, even if they were miles distance apart from each other, or even on the other side of the world. Nowadays there is no life without this kind of connectivity as we are all connected with each other via social media, the internet or just by phone calls. This however did not always go with huge 4G networks; it once was a real struggle to send and receive messages over long distances. This is where Mihajlo Pupin played a role, as he extended the range by placing loading coils on predetermined intervals.

Mihajlo was born in a village called Idvor (located in the modern day Serbia) at the 4th of October in 1858. Pupin's mother was of great influence for the rest of his life, by teaching him that the only way to go into the world around him and be successful is to learn how to read and write, as there is so much knowledge in the world to learn about just by being able to read. And this knowledge could then be used to climb the ladder to a successful life.

Pupin went to elementary school in his birth town, while going to the high school in Pancevo. One of the archpriests there saw the potential of the young Mihajlo, which

was one of the best students at that moment, and made sure he got a scholarship for further education. After a difficult time in Prague due to financial problems because his father died in 1874, Pupin decided to immigrate to the United States.

During his first years in America, Pupin had to do manual labor to finance his living there. When he had worked hard enough and raised enough money, Mihajlo entered Columbia College to continue his education. When he completed his studies in the fields of physics and mathematics with honors in 1883 (and became American citizen), he decided to leave the states for Europe, where he first finished his schooling at the University of Cambridge and later obtained his PhD at the University of Berlin under the supervision of Hermann von Helmholtz.

After all his studies he got to work at the Columbia University again as a lecturer in the newly formed EE department. His research initially started with carrier wave detection and current analysis. He was one of the first people that were working on the newly found X-rays, and did a lot of research in X-ray imaging. Initially this process took more than an hour of exposure time in order to get a sharp image. Not very convenient for patients to stand still for such a long time. With help of

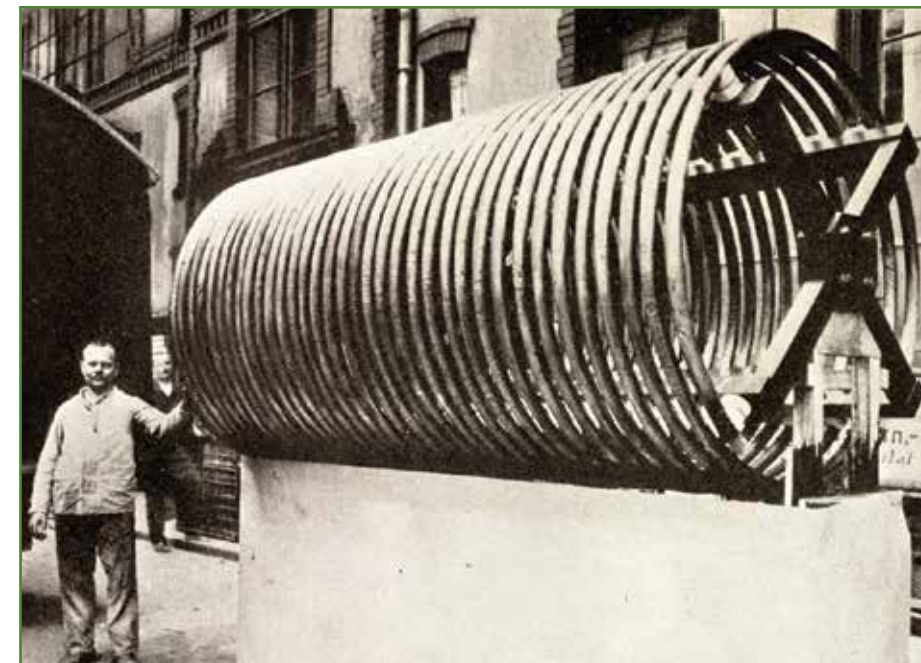


Edison, they developed a fluoroscopic screen which should be placed in front of the film in order to reduce the exposure time to mere minutes.

Despite the great reduction of the X-ray imaging time, this was not the invention where Pupin is most famous about. In 1899, Pupin got a patent for loading coils on telegraph transmission lines. The idea behind the loading coils was to increase the inductance of the line after a predefined distance. This would result in much faster transmissions. It also reduced the attenuation at higher frequencies, such that the distance reached with transmission lines with Pupin coils was dramatically increased.

As with many famous electrical engineers of his time, Pupin had to contribute in the first World War as well. He did this by organizing a research group which was determined to generate a technique to detect submarines. Next to this he also helped establishing communication between different places and he was a member of the state council for research.

During his life Pupin had a lot of achievements, like his patents for loading coils and X-ray imaging techniques. He also got the IEEE Medal of Honor and the Edison medal. But in his later life he also spent some time making sure that new generations would be able to learn and grow as he was able to. He started the Mihajlo Pupin foundation, to enable young Serbian people to read, gather knowledge and be successful. ■



Life in the 'Fast Lane'!

By: Lisa Teunissen

Four months have flown by (all too quickly) since I started my internship at the Australian Centre for Robotic Vision, based in Brisbane on Australia's sunny east coast. In hindsight, you could say I lived life in the 'fast lane' Down Under; developing a lane-following algorithm with a crosswalk detector before venturing off on a 'holiday' road trip, covering more than 6,500km in three weeks!

It has always been my dream to travel far and wide. And so, the University's encouragement of students wanting to broaden their horizons and complete part of their studies abroad has allowed me to mix my two greatest passions: adventure and autonomous cars.

As an Automotive Technology master student (based at the Video Coding and Architectures research group in the Signal Processing Systems department), Australia seemed like a very big adventure. I certainly couldn't have gone much further.

My internship at the Australian Centre for Robotic Vision

The Australian Centre for Robotic Vision, headquartered in Brisbane, is the world's first research centre to focus on the critical challenge of marrying computer vision and robotics. This is a hurdle considering the 'Final Frontier' of creating truly useful robots for the good of all people and our planet. The Centre also steps up as the largest expert body of its kind, comprising more than 200 researchers from across Australia and the world. It houses the world's biggest university-based robotics lab, across four Australian universities (QUT, The University of Adelaide, The Australian

National University and Monash University), supporting the largest pool of PhD students working alongside the world's top researchers. Further, the Centre's interdisciplinary team extends beyond four Australian universities to include CSIRO's Data61 and overseas universities and research organisations including INRIA Rennes Bretagne, Georgia Institute of Technology, Imperial College London, the Swiss Federal Institute of Technology Zurich, University of Toronto, and the University of Oxford.

I literally had to pinch myself during my three-month internship. Not just because of the incredible people I had the chance to work with and learn from, but because the Centre's culture of inclusion and innovation made me instantly feel like a part of the team. The advantage of stepping out of your comfort zone and considering an internship outside of the university is that it can change your life and outlook, and land you with a 'family' of sorts in far-flung places. Many of the PhD students and researchers I met during my internship move around the world.

As part of my internship, I am proud to have developed a lane-following algorithm based on camera vision and conventional image



The moment when my professor laid down to make a great photo of me logging data with the car

processing methods. In order to make the demonstration with the miniature car even more appealing, I extended the algorithm with a crosswalk detector to stop in front of a pedestrian crossing. By a fortunate coincidence, the Centre's annual science symposium was planned during my stay and I

seized the opportunity to demonstrate my algorithm to more than 100 researchers in Australia's capital Canberra.

After the successful online open-loop demonstration at the symposium, I integrated my algorithm onto a scaled autonomous vehicle research platform, developed by the Centre, and let my algorithm control the car. What an amazing feeling! I got portable street maps and scenery banners to move my car on. A true paradise for me as well as my enthusiastic professor, who kneeled and eventually laid down to make a great photo of me and the car to place on his Twitter. Unimaginable here in the Netherlands, not mentioning hierarchical Germany where I grew up. I have enjoyed every minute at the Centre, immersed in a unique working environment packed with robotic vision expertise and passionate, helpful colleagues.

Life Down Under

On my way back to Brisbane from the symposium in Canberra, I visited Sydney. Standing in front of the iconic Sydney Opera House, it finally struck me how far I have come: to the other side of the world. I also did weekend trips to Fraser Island and 'Straddie', as locals call Stradbroke Island, the two largest sand islands in the world. Fraser Island is a 4WD (4-wheel drive) paradise where you can see dingoes (wild dogs), and 'Straddie' is the best place to see dolphins and whales in the wild and offered me the most amazing sunset. I also got my scuba diving certificate in Brisbane and there were daytrips aplenty to the Gold Coast, Brisbane's coastal haunts and so many other places on my beloved bike.

Brisbane

One of my favorite weekend activities is discovering new places by bike. You can't beat bikes in the adventure and flexibility to go wherever you want, whenever you want. The bicentennial bikeway – my daily



My epic Aussie road trip - here at Lake Argyle

commute to the Centre – which snakes along the Brisbane River is stunning. The Brisbane River offers another great method of transportation, the CityCats (cat being an abbreviation of catamarans) are one of the fastest, and most enjoyable ways to get around the riverside areas of the Brisbane CBD. They are exceptionally quick, don't get caught in traffic jams, and the view is better than what you see from behind a car windscreen. But a bike is still my preferred means of transport. A good thing too, because Brisbane's winter is amazing – dry, sunny and about 20°C. Perfect conditions to cycle! Running a close second to cycling, I also loved the free fitness classes held in numerous parks around Brisbane – in the glorious sunshine.

Australian culture

Over the past four months I have learned so much about Australia and, importantly, Australian people. Friendly, relaxed and always ready with a smile. Australians are fanatic about football, so I watched a match in the stadium when the opportunity came up. Australians actually spend a lot of time in the parks especially during the weekends, like the Russian way of life we experienced during last year's study tour of Thor. If Australia has a cuisine, it's definitely barbecuing, and therefore there are public BBQ facilities in every park.

My epic Aussie road trip

At the end of my three-month internship, my boyfriend joined me for a road trip adventure around Australia. We hired a 4WD complete with a rooftop tent in Darwin (Northern Territory), with the ambitious goal of driving all the way to Perth, Western Australia.

Going off-road

Driving more than 6,500km in just three weeks may sound boring. It was anything but that! The landscape constantly changes and makes the journey just as exciting as the destination – especially if you venture off-road on 4WD tracks. Our longest 4WD track was the 660km Gibb River Road, only accessible during the dry season and originally 'constructed' in the 1960s to transport cattle from outlying stations to the ports of Derby and Wyndham. Turning off the bitumen and going 'over the range' on the Gibb River Road was a truly unique Aussie outback adventure through the Kimberley region's vast untouched wilderness, ancient gorge country and epic cattle stations (the size of small countries).

Diversity

We drove through mountains and flat land, grassland and savanna, woodlands and tidal flats. We also had to cross several river crossings, which was extra thrilling. We saw saltmarshes and mines for iron ore and



My working algorithm - following the lane and stopping at the crosswalk



Standing in front of the iconic Sydney Opera House, it finally struck me how far I have come



Just one of the amazing gorges in Western Australia



Termite mounds that are dressed up



Australia's most iconic animal, the kangaroo

diamonds. We also visited Harold E Holt Naval Communication Station which played an important role in Very Low Frequency (VLF) communications during World War II. It was the base for passing messages between Australian and American command centers, and their ships and submarines. We also spotted very intelligent traffic lights (a person with a sign that says slow on one side and stop on the other) and termite mounds that are dressed up. My personal highlight was Lake Argyle, a huge freshwater lake with 30.000 freshwater crocodiles which, luckily, we didn't bump into. Canoeing on the blue water surrounded by mountains and many little islands, we felt like we were the only ones in our own paradise. ►

Wildlife

Australia and especially Western Australia has unique untouched wilderness and wildlife. Seeing Australia's most iconic animal, the kangaroo, for the first time in the wild was a truly special moment for us. As Australia is a leader in the export of red meat and livestock, we also saw a lot of cattle (small groups to huge herds) all roaming freely. And have you ever seen white parrots or even black

parrots? Marine life is equally mind-blowing. Snorkeling in the Ningaloo Reef felt like we were swimming in an aquarium, packed with fish of all kinds, rays and white-tipped reef sharks. We also marveled at dolphins, whales and freshwater crocodiles (which, unlike saltwater crocodiles, are not dangerous to humans).

The luxury of simplicity

We loved being on the road – which we called RGB road because of the red dirt, the green trees and the blue sky. It's hard to write in words the feeling of freedom – to go wherever we wanted, whenever we wanted, not forgetting the beauty of sleeping under the stars. The majesty of the Australian outback comes to life at night, when the sky comes alive with stars. The sky is so big. You can't help but feel tiny, lulled into the deepest sleep. We also saw a lot of shooting stars and awoke each day to the most incredible sunrise. If you have ever seen the sun rise, you know that sunrises are even more beautiful than sunsets. And can you image watching them from your bed inside your tent? Life's simple luxuries that can take your breath away. Another one came in the form of Mother Nature's hot springs; so much better than soaking in a bath. The

biggest luxury on the road, however, came in the form of open roads, friendly drivers and no traffic jams to content with.

No-rain guarantee

The 'no-rain-guarantee' lasted all the way to Perth. In the Northern Territory, temperatures hovered around 40°C (thank goodness for waterfalls). The more south we got, the temperatures got more human and the waterfall became freezing. On our way along the west coast we learnt that a lot of Dutch discoverers visited Australia too.

Looking back

Looking back on my time in Australia, I'm very happy that I took the opportunity to venture abroad. I not only learned a lot in my own area of study but also made some new friends for life and got to know myself better. I managed challenges I wouldn't have experienced otherwise (and they were totally worth it!). To quote a favorite Aussie term, my experience was 'awesome'! My advice? Consider stepping out of your comfort zone and planning an internship abroad. Take every chance you get in life, because some things only happen once. ■

AME excursion

by: Lucia Kalkman

We, as freshmen, the majority of the participants of this excursion, didn't know exactly what to expect when going to AME. Of course we'd all seen the name before, for example on our intro T-shirts, but we had no idea what this company was doing, so we were all very glad that we got a chance to look behind the scenes.

After a short bike ride we entered one of the two AME buildings in Eindhoven, where we got a short introduction by a few Electrical Engineering students. The advantage of working at a relatively small company like AME according to them was that they were involved in the entire process of developing a new product. All of them were very happy with the chances AME gives them to combine their studies and a job.

Next up we finally got to see what we were waiting for: on a tour through the two AME buildings we saw all their products in real life. AME is an independent developer and manufacturer of high quality electronic products,

and their technology can be found in a very broad spectrum of products, ranging from automatic toilet seats to the user interface for coffee machines to a communication system for mobile column lifts and lots of other cool products.

After the tour we got a chance to show and test our skills on some case studies that AME developed, where we got to apply our Circuits skills.

Unfortunately, all good must come to an end, and we went back to Flux. All in all it was a very interesting excursion where we got to see a lot of the products AME is currently working on. ■



Automotive Talk

with Robin en Menno

Every beginning is difficult. This also holds for starting this column. Imagine how difficult it was for inventors and entrepreneurs to start their companies. Did they already have the vision of what their companies would become one day? Did Ferdinand Porsche truly believe that his Volkswagen would be the people's car? Or did Carl Benz ever envision Mercedes Benz as a global market leader? We like to imagine what they would think of the technology of today. What would they think about Stella Vie, or electric cars in general? We almost know for sure that mister Benz knew about electric cars, since they were a direct competitor to his own gasoline-powered car. The electric car was for some time even preferred over gasoline cars for its reliability and ease of operations. Who knew that that would all change...

The people we meet on a daily basis here at the university could be the "Carl Benz" of our age. It's weird to think that some of us might end up in the history books, and that we could be a topic discussed at USE Base, if that course still exists in the future. It is also weird to think that technologies become obsolete and will

be replaced by better solutions. The holy grail of engineering that we are developing today, could be useless in the future.

The development of technology is not only depending on the level of the engineers. A new technology product can be revolutionary, but it will be useless if nobody is able to use it.

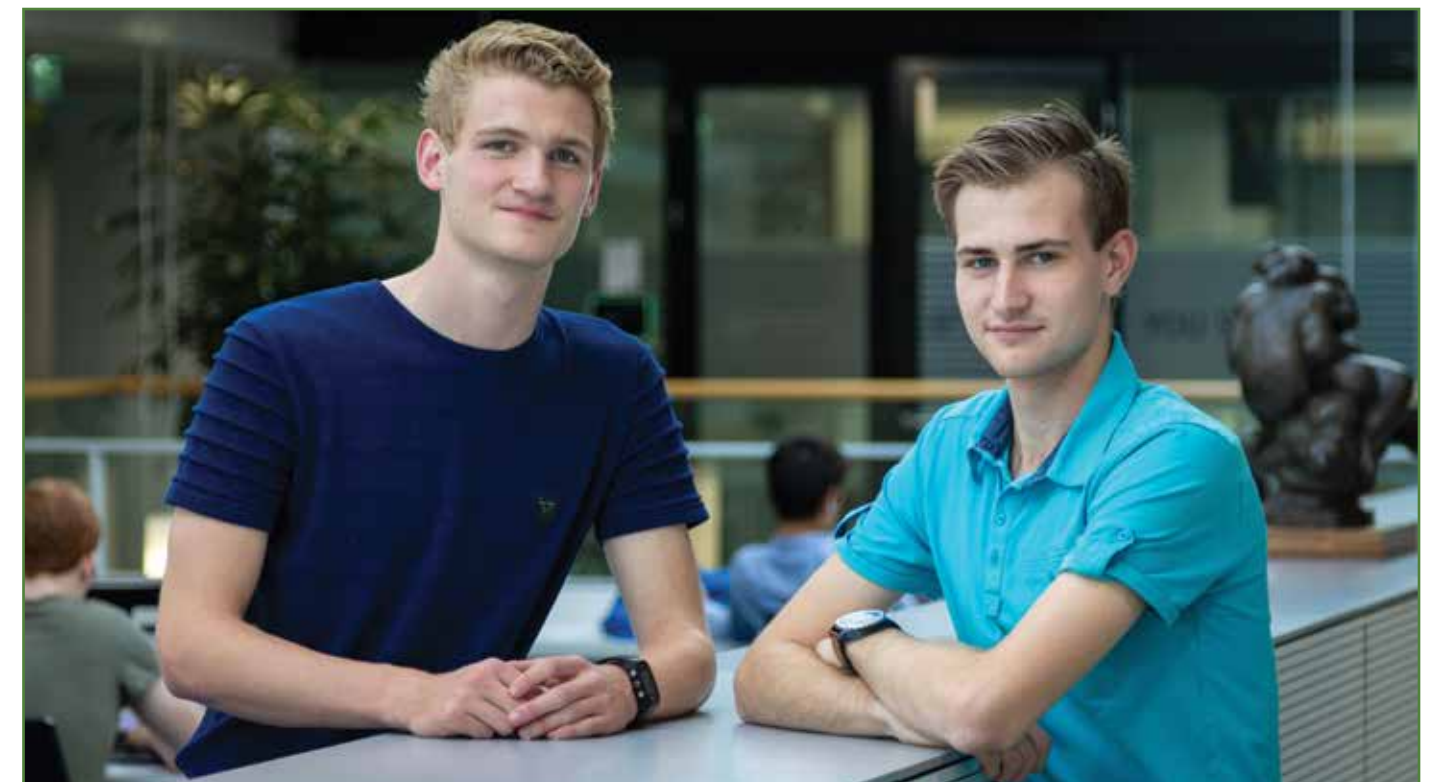
Recently we read a news article about drivers with "smart cars", cars with adaptive cruise control, lane keeping, park assist or other "self-driving features". In this article they said that most users do not use the full capability of their vehicles. We wonder if this is because people are just not interested or if there are other things behind their reasoning. Are they afraid of new technologies and if so how can we take this away?

Is it the responsibility of the engineers to build the systems as user-friendly as possible or is it the responsibility of the users to read the manual instead of throwing it away? We believe it is a combination of both. Discussing these things makes us more aware of small details of our own user experience.

While writing this column, we got into discussion about more features on a device: are more features always desirable since it makes devices (not only cars!) more complex? Another risk when adding features is that it enables misuse in ways we could not envision.

When Tesla Motors launched the first version of autopilot, they knew there was going to be misuse. They envisioned it as people using the system outside of preferred environments, distracted driving and a number of other scenarios. What they did not foresee was that people misused their product in many more (dangerous) ways. People enabled autopilot and climbed out of the driver's seat to the back seat to read a newspaper. It might be strange to think that what is now undesired behavior might be normal in the future.

The use of products is constantly changing, and so is the misuse. We think a bit of misuse should be desirable, although it sounds contradictory. It changes our perspective, and by learning from it we can create better products, or at least safer products! ■



Credits photo: FabicoVideo

Working on solar panels at Arcadis

By: Erik Rietbergen

Solar panels are part of the design of building-related installations. When calculating and/or implementing a Photo-Voltaic (PV) system a several factors have to be countered and/or implemented to make the system safe and the design optimal. Not implementing these can result in a less effective or even dangerous (Health & Safety) PV system. In this advertorial these factors/subjects are brought to (sun)light and provided with a solution.

Intro

A PV panel consists of multiple solar cells which are electrical devices. These cells convert light into direct current (DC) electrical power which is transported via cables to an inverter which turns the DC energy into alternating current (AC) power.

can create enough shade to the panel for it to 'restrict' the flow of the current through the cell string. For these reasons extra design calculations and research needs to be done, which is often forgotten. Implementing the equation in the image below we can counter the shadow cast by the panels on each other.

By utilizing Direct Current optimizers the influence of shade is countered by adjusting the output voltage and current and maintaining the maximum power of the system. These optimizers will boost the decreased current so it matches the current of the unshaded panels.

By utilizing Direct Current optimizers the influence of shade is countered.

Shadow influence

Shading is one of the biggest influences on the performance of a PV system. An inch of shade on a panel will result in a decreasing output of the panel and if not designed effectively the whole series of panels will decrease their output. An exhaust on the roof, a speck of dirt (lack of maintenance) or even another panel

A string of solar panels usually are connected in series. In which the current produced by the first panel is the maximum of the second panel, etc. This combined by a restriction of the current created by the shadow will have a chain reaction that can reduced the output of the whole string of panels.

Gradual Degradation

The next factor is the degradation (in percentage) of the panels, as soon as a panel is exposed to sunlight it's cells start to degrade. This degradation reduces the output of the cells and thus the output of the whole system. The amount of the degradation varies from

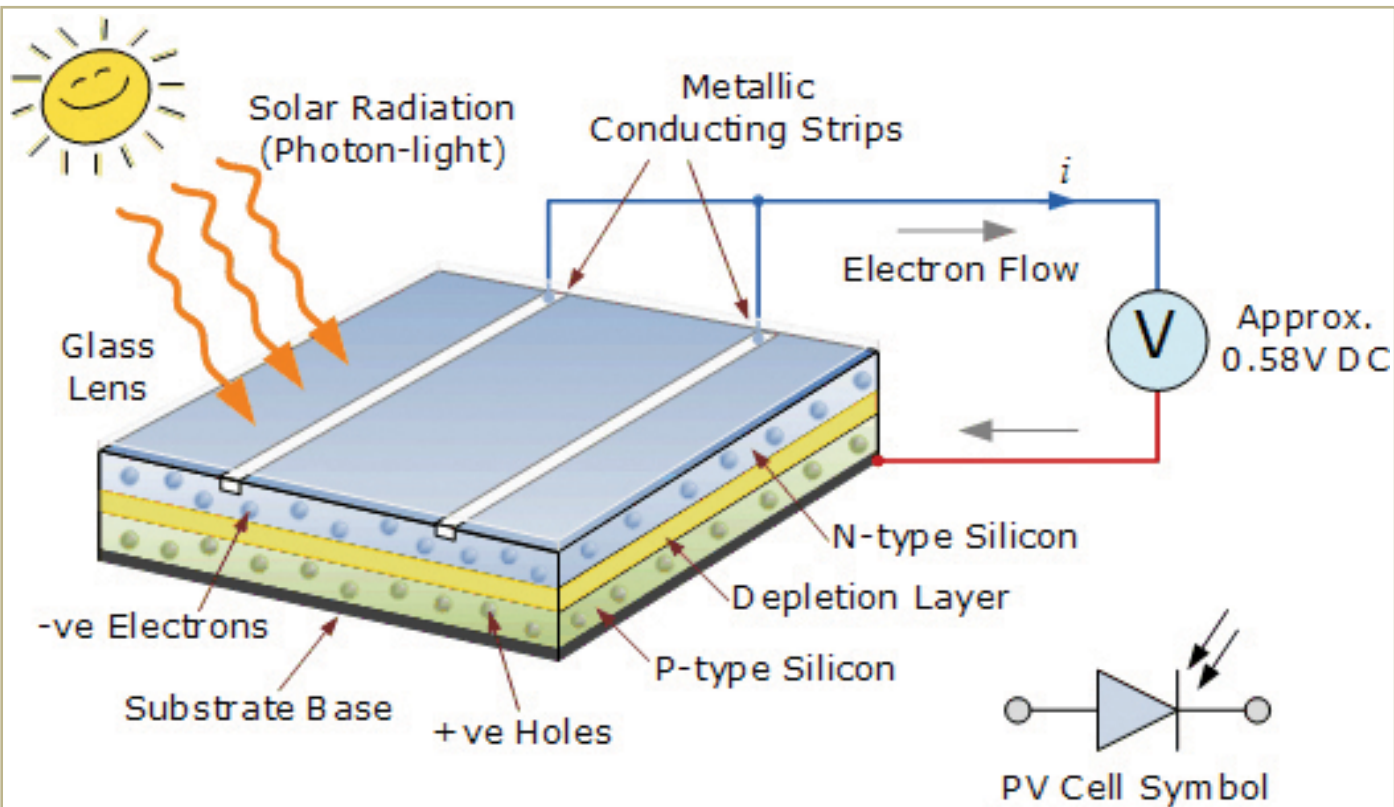


Figure 1. Solar cell (source: Alternative Energy Tutorials)



less than 1% to even 3% in the first year and 0.3 to even 1% in the years following. Causes of degradation are:

- Quality of the panel's materials;
- Weather conditions;
- Physical damage;
- Maintenance (panel cleaning).

When the degradation is sub 80% it's seen as the system has reached its end of its lifespan and will need to be replaced. This percentage is achieved faster with implementing low quality panels as seen in figure 3.

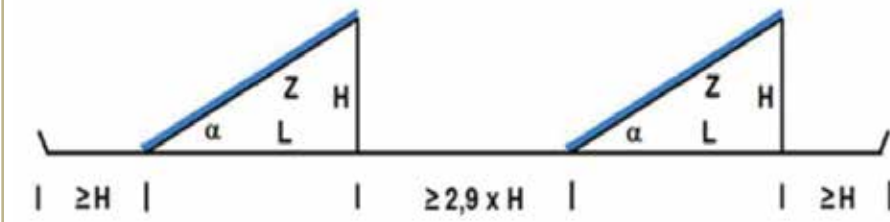


Figure 2. How to counter shadow influence

When an inverter is switched off it will only interrupt the current of the system but the voltage will remain at a dangerous level (>120 DCV). The height of the voltage is dependant of the number of PV panels that are connected to the system, for example four panels will generate more than 120 DCV which will create a risk of electrical shock. Larger systems for residential or commercial projects have dozens or even hundreds of panels in which the voltage can go up to 1kV.

At Arcadis Erik has many opportunities to develop himself personally with Arcadis Imagineers and a personal action and development plan. Next to his work and personal development he has multiple opportunities to develop his technical skills via the varied projects and his bachelor Engineering and Applied Science at which he is going to graduate in 2019. ■

What happens to a PV system when there is a power outage?

Next to the lifespan the degradation is important when the reason to implement a PV system is to counter the energy usage of an installation. If not implemented in the design there's a possibility that after a couple of years (or even after year 1) the output of the system is lower than the to be countered usage.

Power outage (blackout)

What happens to a PV system when there is a power outage? Is it smart enough to power down or will it continue to produce power and thus create a dangerous situation?

Unfortunately most PV systems will continue to operate as if the grid or the connected distribution board is still active. This not only create a fire hazard when the produced power is "piling up" in the distribution board but it also creates a electrocution hazard, which are specified below according to the standard NEN-EN-IEC 60038/NEN 1010.

An effective solution to counter these risks is using the optimizers (explained in "Shadow influence") to lower the voltage per panel. These optimizers can be provided with a modus which switches off the panel and the string cables. This modus is activated when the connected inverter signals that the power supply from the grid or distribution board is gone.

The output from the panels while switched off is 1 DCV each. The capacity of the string cables has to be designed so that the output is lower than 120 DCV which equals to less than 120 panels per string.

Outro

Erik Rietbergen is an electrical designer and PV specialist for Arcadis in the division Buildings department Building Services, where he designs and engineers a wide array of projects from offices to laboratories.

IEC voltage range	ACV (rms)	DCV	Risk
High voltage	> 1000	> 1500	Electrical arcing
Low voltage	50 to 1000	120 to 1500	Electrical shock
Extra-low voltage	< 50	< 120	Low risk

Figure 4. Electrocution risks

Example of Gradual Degradation			
LQ panel		HQ panel	
Year	Efficiency	Year	Efficiency
0	100%	0	100%
1	97%	1	98,5%
2	96,1%	2	98,2%
3	95,2%	3	97,9%
4	94,3%	4	97,6%
5	93,4%	5	97,3%
6	92,5%	6	97,0%
7	91,6%	7	96,7%
8	90,7%	8	96,4%
9	89,8%	9	96,1%
10	88,9%	10	95,8%
11	88,0%	11	95,5%
12	87,1%	12	95,2%
13	86,2%	13	94,9%
14	85,3%	14	94,6%
15	84,4%	15	94,3%
16	83,5%	16	94,0%
17	82,6%	17	93,7%
18	81,7%	18	93,4%
19	80,8%	19	93,1%
20	79,9%	20	92,8%
21	79,0%	21	92,5%
22	78,1%	22	92,2%
23	77,2%	23	91,9%
24	76,3%	24	91,6%
25	75,4%	25	91,3%

Figure 3. Gradual degradation (quality panel)

Inmotion: Charging ahead

By: Fercan Molenaar

What is the main reason for people not to buy an electric vehicle (EV)? The driving range for EVs is improving still and if you ask me, they are fun to drive. The electric powertrain provides significantly high torque at low RPM, which makes driving an EV more fun in a city environment. Also good to mention: they are greener than petrol cars. Then there's the financial side of the story. EVs are definitely more expensive on short term, but can be worth it in the long run. For example, you can read on prof. dr. ir. Steinbuch's internet blog that he spent 3 cents per kilometer on the first 100.000 kilometers that he drove with his semi-famous red Tesla Model S (this was in 2017).

It is a common opinion that the biggest obstacle for people to 'go electric' is simply the time it takes to charge the battery. Even with the Tesla supercharger it takes about 75 minutes to charge the Tesla model S to a full 100%. But imagine you could charge it in 2 minutes. Or better, imagine you can charge an electric race car in 20 seconds during a pit stop at Le Mans! When this is possible, would you go electric? Of course you would. At InMotion we try to solve this problem of charging times by implementing our technology in the race world. In this article I will try to give you an impression of how it is like to be an engineer at the team!

Short intro about myself

I am a third year mechanical engineering student and I have two functions in the team. I am a member of the board as financial manager and I am an engineer. You can read about what technical things I am working on in the section below. The finance part of the job seemed like a big challenge to me at the beginning of the year. However, I think it is very doable for students with only a technical background like myself. Working for the team full-time felt like a big transition at first. However, you get used to it pretty quickly and I feel like I have a good idea of what is currently happening at the team.

Project 'BMS'

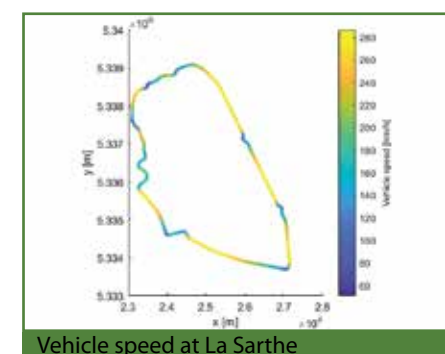
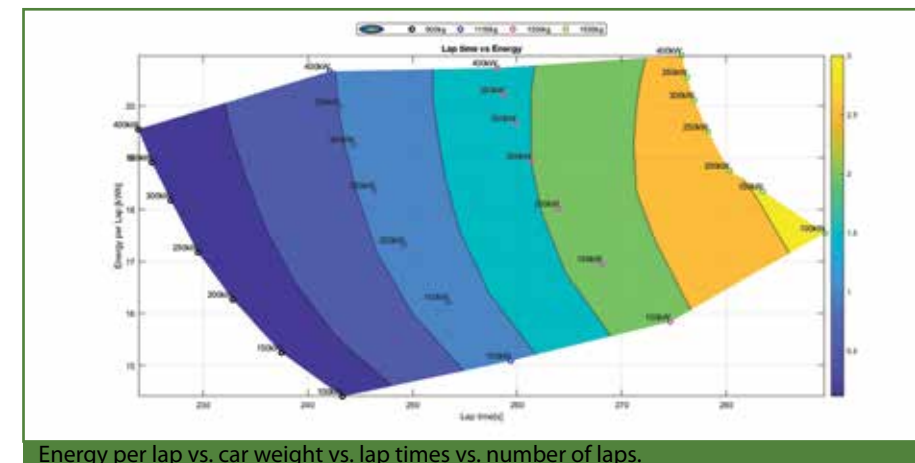
Since we want to achieve fast charging, battery technology is the focus of the new car. I currently carry responsibility for the selection of a battery management system, or BMS, for the new batteries. As an electrical engineer, you probably have a good idea of what a BMS is. Just in case though: the BMS acts like a monitor and a controller and keeps track of important parameters like cell voltage, current and temperature during (dis) charging. BMS technology already exists, but the hard part is implementing it in our car. First we make sure we have a good understanding of the technology and we set up requirements for the system. Next are practical problems like the exact placement of the

BMS in the battery pack and wire connections form the cells to the BMS. You can imagine that I have to consult with other engineers that work on the packaging of the cells.

After making requirements I can continue to the next phase of the subject: consulting with BMS suppliers to develop a system together that meets our requirements and that we can implement in the battery pack/car. For proper implementation we have to have considered packaging issues like the harness of the car and the way the cells are structured within the pack (how many in series/parallel). Finally, when the system is implemented, one can begin to test the system, including batteries, to see if what we developed is doing what it should. The BMS is only one of the many departments that the team is currently working on, so you can see how it might get busy for us engineers. Besides the BMS there is the matter of the layout of the battery pack, cooling the cells and implementing an electric drivetrain, amongst other things.

Drive cycle analysis

Another engineer at our headquarters currently works on a drive cycle model. He made a script that simulates a car driving around Circuit de La Sarthe, the circuit where the 24 hours of Le Mans is held every year. The first plot displays the cars speed at every part of the circuit. The speed in corners is



determined by comparing the maximum speed the tires can handle at current conditions with the centripetal force at the car in the corner.

The second plot shows data from several iterations of the script. The contours represent the amount of laps the car can drive until the batteries are drained. The color of the dots represents the total weight of the car. More weight only means more cells and more capacity. The numbers next to the dots represent the power at which the engine is cut off. A higher power limit results in better lap time, less laps and more energy per lap. The model helps to determine requirements for the battery pack like max weight, capacity, and power limit. It gives a good insight of the effects of these parameters on lap times and the number of laps one can drive with the battery.

The amount of kWh per lap is an output of the model and the numbers depend on assumptions for some parameters. Here are a view of the most important ones:

- Energy density of the cells of 224 Wh/L and 171 Wh/kg.
- Simple battery model with internal resistance

- Driver skill of 100%. The driver's skill is linear with the speed in corners. 100% is reached when the driver basically drives as hard as the car allows him to.

The model is also used by one of our engineers for his BEP. His task is to determine what is the best transmission for the new car on the Le Mans circuit. We have lots of projects like these for (electrical) engineers, so if you are choosing a BEP topic, feel free to get in contact!

The model is validated by comparing the data from the lap records at Circuit Zandvoort and Circuit Zolder with the Fusion (the car in the picture below). However, the focus of the team now lies on building a new car.

Goals for this year

Our team has the main goal to deliver a rolling chassis by the end of the academic year. Unlike with the white Fusion, the chassis, suspension and such are not engineered by the team. Instead of that we plan to buy these parts and spend more time engineering the battery pack. This makes sense, since the next car needs to be more of an endurance racer and the limiting factor for that is the battery pack. If you feel like you are willing to contribute to this ambitious but awesome project, or if you have questions about the team / this article, please do not be shy and look up contact info at the website. Good day to you! ■



The current cars september 2018



Merlin looking at test data at the Circuit Assen (2018)

ThEW

By: Lucia Kalkman

The ThEW started on the 14th of September. We gathered in front of Flux to have dinner, and after that we were sent away with a route description and some beer.

It took us more than two hours to get to the accommodation, and when we arrived, we saw some guys in suits looking very seriously at us. We were told to get to a field and form a straight line based on our names. They started calling us in in groups of four while the rest had to wait in front of one of the serious guys. Of course this didn't go well for a very long time, very soon the first K3 songs were sang. This lasted for a while until the serious guy thought it was time to interrupt, which he did by placing some people at the end of the line.

Finally called in with three others, we got our instructions: we all had to put our phones in big envelopes and hand them in and we all got an egg which we were told not to lose and keep on us at all times. After that, we were guided to the dormitory and we got some time to make our beds, get our intro T-shirts on and get to another room, where the cantus started quickly after.

The cantus was a lot of fun, for the most of us it was our first cantus and therefore a bit uncomfortable at the beginning, but it got better and better once we all had a few beers (water for the under aged people of course) and got used to the singing. At the end of the cantus we sang the Thor song while the Board walked in to sing a few more songs with us before going to bed at around 0:30 o'clock. Most of us were pretty tired and fell asleep very soon.



To wake up after just a few hours of sleep. We were told to put on some warm clothes and to get outside. In small groups we were transported to the starting location, where we got instructions on paper on how to walk, and we were sent away. Not too long after that, we arrived at the first campfire, which was hosted by the active members of Thor, where we played a quiz and got some food. Two more campfires followed with more games, food and drinks. Back at the accommodation we got some soup and we tried to get a couple more hours of sleep.

The next morning started with a small workout and after breakfast we could get our stuff to go the center of the town where we were staying. Here were played a couple of games, like collecting phone numbers. Back at the accommodation we got some time for ourselves and the BBQ was lit. After dinner we were divided into four or five groups to make a nice parody on a song about the candidate board members. We started the campfire and

chatted while waiting for the candidate board members to show up one by one to sing them our songs. Afterwards they joined us at the campfire to chat and play some games, the last people went to bed at 5 a.m.

On Sunday, the last day of our weekend away, we were told at breakfast to get some dry clothes and put them in a separate bag and pack the rest of our bags, because we would go canoeing! But before we left for the canoe rental, a very important thing had to take place first: we had to thank the Board for organizing this great weekend by giving them our very nice gifts, some better than others. After a canoe trip where everyone, of course, got thrown into the water at the end, the ThEW came to an end. We cycled back to Flux where we grabbed our bags and found our ways home. I think no one will ever regret signing up for such a great weekend. ■



Let's make it better

By: Tom van Nunen

The Ocean Cleanup Project was tested near San Francisco some months ago and should by now be collecting the plastic that we, as humans, didn't dispose of properly. I think we're all aware of the consequences of the presence of plastic particles in our rivers, seas and oceans.

The Ocean Cleanup Project is the secondary school final project of Boyan Slat (from the Netherlands). I really admire his style: he notices a problem, decides to do something about it, comes up with a solution and doesn't stop until this solution is actually implemented. As a bonus, his efforts have not gone unnoticed by the media, boosting the global awareness of the problem. I'm really curious about his preliminary results and future work.

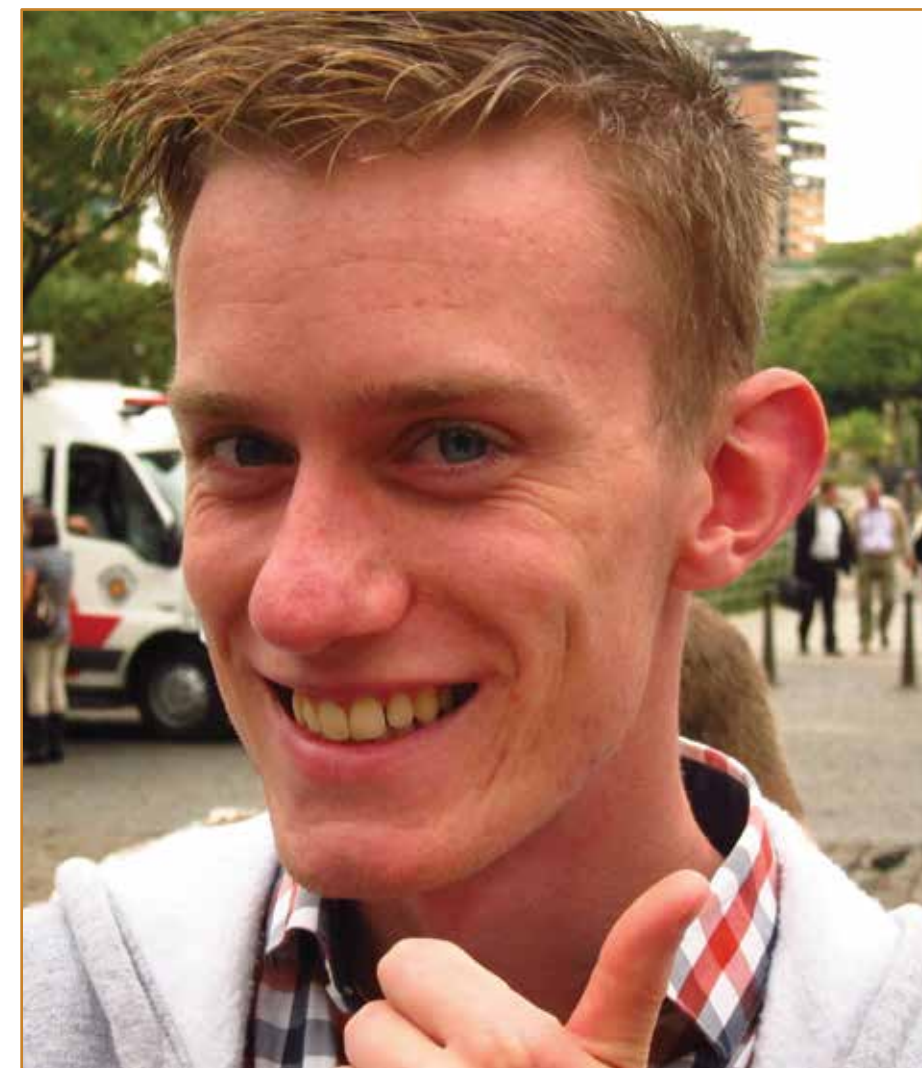
Although I admire the Ocean Cleanup Project and also all other efforts to repair the damage we've done to our planet, there might be a downside, in particular to the media coverage. Allow me to elaborate on this thought:

Imagine the average human, let's call her Nellie, watching the eight o'clock news and hearing the story 'plastic in the ocean is bad because of [reasons]. Luckily, a group of 80 bright minds have been working 5 years to come up with a solution to all the plastic in the ocean. The full-scale system could reduce the Great Pacific Garbage Patch by 50% in 5 years.'

This sounds of course like great news. Nellie might think all our problems with regard to plastic in the ocean are solved, and that we can focus on other problems from now on. What Nellie doesn't know, however, and what the media didn't research or found too boring or too specific to mention, is the following:

The Great Pacific Garbage Patch contains over 79 million kilograms of plastic. The aim of the project is to reduce it by 50% in 5 years, so let's say 8 million kilograms will be removed annually. Still sounds – and is – very impressive. Now when I tell you that in this same period, humans dump approximately 8 billion kilograms of plastic into the oceans, you will agree with me that this solution doesn't solve the whole problem.

I have no intention of discrediting Boyan in any way, I fully support his project and the awareness he creates



,but I want you to realize that the problem is much more complicated than you might think.

Sometimes I fear that similar things might be happening regarding the way we generate energy. We need to go green if we want to save our planet, and even if you don't believe in human induced climate change, you can at least agree on the fact that fossil fuel sources are simply depleting.

In the media we hear and read about solar and wind parks being opened, and houses having more and more solar panels. Superficially informed people might thus have the impression that everything is going well, and we'll be at break-even in no-time.

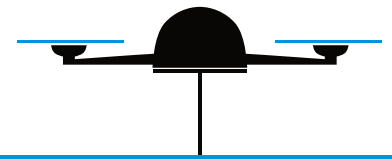
The fact remains that wind and solar supply only about 2.1% of our energy. The percentage of renewably generated energy is increasing, luckily, but the largest share comes from biomass, which sometimes is nothing more than woodchips from a cut-down forest coming all the way from Canada by ship. Is that the way to go? The total amount of renewable energy is about 6.6%, whereas the aim is to have 14% in 2020. The way we're progressing right now is simply not going to be sufficient.

Let's hope the people in charge are well informed about the current situations, and base their plans on long-time goals. I'm sure we can solve the problems ahead of us, but it will not be easy. ■

A challenge to celebrate our 25th anniversary

At Prodrive Technologies we are confronted with challenging technological problems on a daily basis. Prodrive Technologies was founded in 1993, which means that we are 25 years old!

To celebrate this we made a puzzle about one of our projects, the AGV (Automated Guided Vehicle).

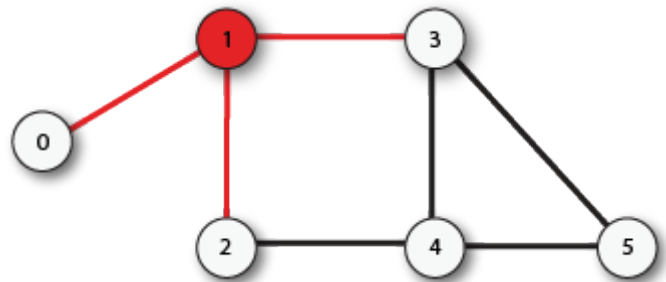


Win a drone

Puzzle

The challenge is to flood a map with AGVs such that all paths can be reached by an AGV.

Take a look at the example, Node 1 is occupied by an AGV, this means that the red paths are reachable by an AGV already. How much more AGVs do we need to make all paths reachable?



The answer of course is, at least 2, one on node 4 and one on either node 3 or 5. The goal is to use as few AGVs as possible. The puzzle we prepared for you has 1993 nodes, which obviously refers to the birth year of Prodrive Technologies. For the graph, goto the website below.

Prize, submission and info

For more information on the assignment, submitting your solution, the scoring, the deadline and the current standing of your submission go to:

thor.edu/prodrivepuzzle

