



Life after EE

Quarantivities at Thor

Antenna system for 5G base stations

Optical chips: old-fashioned or the future?

Connecthor

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The first edition of the year 2021 lays in front of you, hot off the press. Again, delivered by mail to your home address. Being in lockdown for the umpteenth time in one year it seemed the most sensitive thing to do. 2020 has definitely been a year to remember and the start of the new year so far is no different.

And yet, we have managed to create a magazine full of interesting, inspiring, and creative articles. The yearly new year's gathering was arranged via a Zoom meeting. Our Dean Bart Smolders talked us through many highlights and a few lowlights of the past year. You can read his speech on page 3.

Martijn Heck gives us a little insight in the work he has been doing within the Photonic Integration group on pages 10 to 13. An article written by Teun van de Biggelaar about his PhD research on an Antenna System for 5G Base stations can be found on pages 22 and 23.

Organizing activities during lockdown is no simple task. Jurre Wolters writes about the Quarantivities at Thor on pages 14 and 15. Who would have expected that doing an internship abroad was even possible, during a year that has been marked by the COVID-19 pandemic? Elwin Hameleers was fortunate enough to experience such an internship in Germany in the middle of South-Thüringen, see pages 16 and 17.

With the Eindhoven railway station being in the news in unfortunate circumstances during the first day after the curfew was put in force, we thought to bring you something positive. Please view our cover of the train station nicely lit up as town of light (lichtstad), as part of the #EindhovenIs initiative, early February.

We like to take this opportunity to thank Matthijs van Oort for writing articles for the "Icons of EE" item. Matthijs has been doing that for the past four years, from March 2017 till March 2021, which means that he wrote sixteen articles in total. We are grateful for his continuous dedication to the magazine.

We would also like to thank Mark Legters for his six-and-a-half-year membership to the Connecthor editorial team. Mark sometimes gave us a much-needed kick in the butt to get things done, he made sure to keep us on our toes. He was very precise when it came to proofreading the articles. Mark is a one-of-a-kind guy. We are very sorry to see him leave the team.

We wish both Matthijs and Mark all the best in their future careers.

The Connecthor editorial board ■

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Internship Abroad

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Life after EE

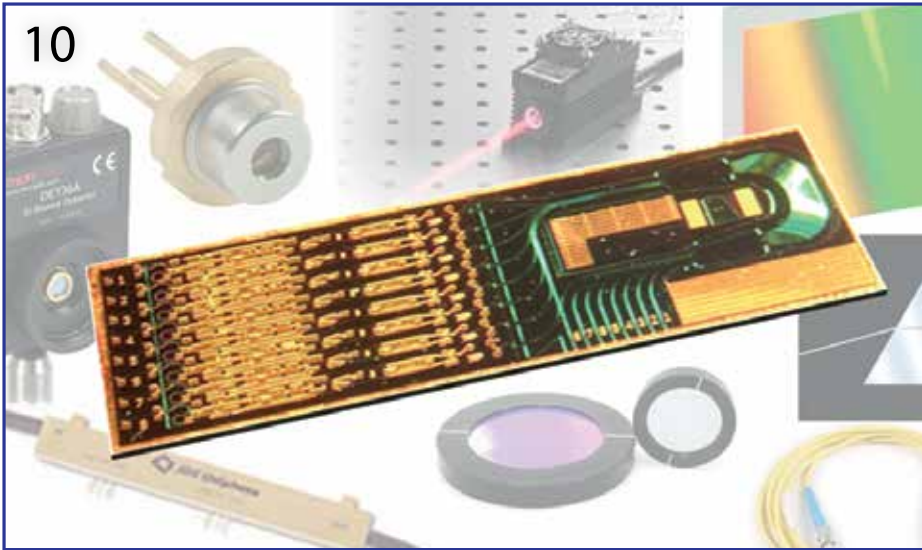
Read more about Mark Kleijnen's life after graduating on page 28.



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Brewing beer

Read more about Thomas' hobby on page 20.



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Optical chips, "old fashioned" or the future?

Are optical chips really the future or is it just some old technology? Read more about this on page 10.

New Year's speech

By: Bart Smolders



First of all, let me wish you a happy and healthy new year. I am looking forward to work with you all in the year 2021!

2020 was a very special year with many highlights in the department, and the coronavirus pandemic as a major low-light, even though we were able to continue most of our education and research activities. On March 20, 2020, we had the first crisis team meeting in the EE department. Already a few days later, the University closed, and we were forced to stay at home with an almost empty agenda. It has been a difficult period for all of us, and I am proud that we were able to switch to online teaching within a week. I am sure that we are going to re-use our online experience in the post-corona era. For example, what about working part-time at home in the future, and what kind of impact will this have on our Flux building? Do we need less traditional offices and more flexibility?

My main worry concerning the corona pandemic is the impact it had and still has on our students. In particular, I am very worried about our first-year students. We really need to take care of them in the upcoming period and we should try to organize on-campus activities as much as possible.

Budget-wise, EE did very well last year. We received a major increase in our first-tier budget in the past year, partly due to the so-called *sectorplannen* (sector plans) of the Dutch government. We were able to recruit many new very talented employees (of which six female staff members), and we still have a couple of open positions available. Despite corona, we were able to submit many new project proposals, which is crucial for our future. Our centers are doing excellent work here and I am very pleased to see that our relatively new center, our Cyber-Physical Systems center (CPS/e) led by Jeroen Voeten, has been very successful in 2020, with many new initiatives.

2021 outlook

This year will hopefully lead us to a post-corona period in which we can again organize all our activities on campus. I am sure that all of you are looking forward to this. The good news is that we again have a solid budget, including several scientific-staff vacancies, to further strengthen our department.

The agenda for our department for this year includes the following specific topics:

Research

- On February 1, a committee will visit our department to assess the implementation of the sectorplannen in our department. It is very important that the committee leaves the university with a positive mind-set since part of our budget depends on it.
- The launch of the fourth TU/e institute, with focus on photonics and quantum, is scheduled for September 2021.
- Since our department has grown significantly, the acquisition of 2nd and 3rd-tier budget is key to safeguard our future department budget. Therefore, I would like to encourage you all to take initiatives for new national and European project proposals.

Education

- We formed a taskforce to address the outcome of the NSE student enquiry, in which we scored extremely bad last year (lowest of all technical programs in the Netherlands). The taskforce will focus on quartile 1 of our first-year Bachelor program and will look for improvements which can already be implemented in September 2021.
- We are working towards a new Master program on AI Engineering Systems (AIES). AIES is a multi-disciplinary program, which we have defined together with other departments, e.g. Mechanical Engineering and Computer Science. We are coordinating this program and are finalizing the required documentation for accreditation. Our plan is to start AIES in September 2022.
- We will continue to work on the re-design of our Bachelor program. This will be aligned with the Bachelor College re-structuring.

Please contact me personally if you have a question or suggestion related one of these topics.

Bart Smolders, a.b.smolders@tue.nl

From the President

By: Jurgen Kok



When I was just a child, I would always rush down the stairs when I heard a ringing sound. Either for someone at the door, often to get the satisfaction of putting coins through the opening in a collection box or, most often, for the ringing phone. Seldomly, they called for me, but I just really enjoyed picking up, saying my name so quickly I often had to say it twice (some things tend to stick with me) and then having some small talk. I just really enjoyed calling. A sign of a fear for calling or phone phobia was nowhere to be found.

For some reason, this changed when I hit puberty. I do not know the precise reason for it, but a reason I can think of, is the most common reason people are afraid to call or to pick up phones: the uncertainty it brings. You'll never know who's at the other side of the line. You'll never know why they call and, most of all, you'll never see their facial expression. I can second the latest argument, because words can never say everything someone is trying to tell. The complete message only gets to you when seeing someone face-to-face, but only hearing a voice also gives you a lot of information.

This is something a lot of people, including myself, missed out on when they started replacing a lot of their face-to-face or phone contact with text messages. This type of communication just lacks something: human interaction. By calling, you still do not get the same amount of interaction as in a face-to-face conversation. Hearing someone's voice does however tell an awful lot more than just the words. For example, the part of the day on which I especially like to dial someone's number is the morning. This is not caused by the cheerful mood I usually have, because I can't really describe myself as a morning person, but because of the funny conversations you can have on the phone during these hours, usually because people were late. My voice often ends up being the first voice they hear in the morning. Where you would get a sloppy excuse in a text message, there is no place to hide your sleepy voice during a phone call.

Apart from being fun, phone calls are also really practical. If my Board year, and especially the lockdown, has taught me one thing, it is that calling is much faster than sending a text. A quick message might be useful and permanent, but nothing can match the instant response

you'll get with a phone call. Besides this, it also often leads to a quick talk after you've got the answer to that problem you dared to call for. Especially that moment of social interaction, even if it only lasts for a minute, already makes the call worthwhile.

It is hard to get your daily dose of social interaction nowadays without the small conversations, being it in a lecture room about that one exercise everybody is struggling with, or in Het Walhalla with a drink in your hands. To solve this, just ask yourself the question before sending a text if you can't also reach your goal with a seemingly spontaneous phone call. I guarantee you; it will be fun. If these random calls are not enough, try calling other random people, your parents, your friends or even me. It doesn't matter who you are or what you want to talk about, you'll enjoy it! Phone phobia or not, calling is fun, but you first have to start doing it!

Veel gedonder!

Jurgen Kok

President of e.t.s.v. Thor ■

Introducing...

Hello everyone! My name is Chris Verhoek, and I am currently 26 years old. On the 6th of October I started as a University Researcher in the Control Systems group, and I will start with a PhD trajectory on first of February.

I was born near Dordrecht, and I moved to Breda when studying Mechatronics. During my masters at the TU/e, I moved to Eindhoven, to the most 'gezellige' street of Eindhoven – the Kleine Berg!

My PhD project (and current research) will be (and is) focused on data-driven control with guarantees, so direct controller design based on data, such

that you can give stability and performance guarantees on the closed-loop system. I received my BSc degree in Mechatronics from the Avans University of Applied Sciences in Breda and my MSc degree in Systems & Control in the Control Systems group at Eindhoven University of Technology. Parallel to my bachelor and master, I worked part-time at Prodrive Technologies and Sioux CCM as Test Designer and Mechatronic Designer, respectively.

Next to professional work, I have a passion for jazz music in the sense of playing (drums) and listening. Furthermore, I'm quite into hiking and swimming. ■



Hello everyone! My name is Gustavo, I'm from Brazil and I started as Postdoc in the Control Systems group on November, 2020.

I hold a PhD in Electrical Engineering (area: Control Systems) since October 2019, and I have a BSc formation in Control and Automation Engineering (Mechatronics). My main area of research is data-driven (DD) control for multivariable systems, and I have been working on controller tuning designs from the first design choices, i.e., the reference model, up to the tuning algorithms themselves, including DD methods for non-minimum phase systems and for LQR design. Recently, I focused my work on a DD approach to the controller certification problem (whether inserting a

new controller in the loop will result in a stable closed-loop) by estimating the infinity norm of a target transfer function.

As part of my Postdoc at TU/e, I will be working in an approach for DDEco-driving Control for Improving Fuel Efficiency of Heavy Duty Trucks. Eco-driving is a strategy that aims to determine an optimal velocity profile and driving mode sequence (e.g., cruising, coasting, etc.) over a future finite road segment, such that the fuel consumption is minimized, while a target velocity is still attained. The project is collaboration with DAF, and I'm supervised by prof. dr. Mircea Lazar.

In my spare time I like to go hiking and 'uitwaaien'. I also like to play the bass or the acoustic guitar, and go out for a few drinks. I'm not a sportsman, although I enjoy playing volleyball. ■

My name is Songda Wang and I am a new postdoc in TU/e within the EES group. My topic is about power quality and power electronics-based power systems. My hobby is listening to music (my Spotify: user:ysqfqx4t3th0fp9bzau7sc16m) and playing basketball. During this special time, it is hard for us to meet each other face to face, but I believe we will meet each other very soon! ■



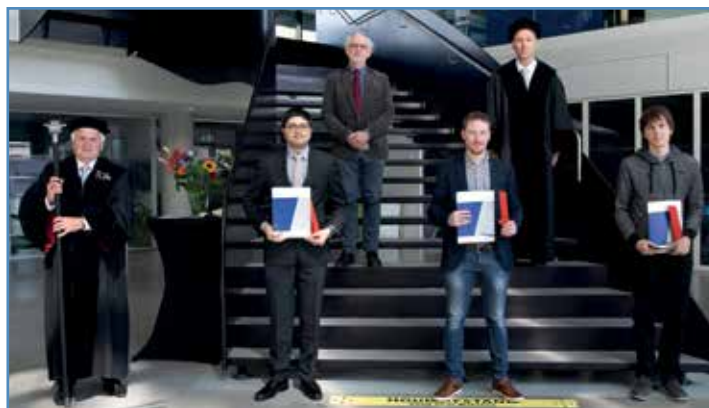
Master graduates July 6th 2020



Master Graduates – July 6, 2020, 2PM session

Wielen, B. van der (Bas)
Salemink, P.J. (Peter Jan)

Congratulations!



Master Graduates – July 6, 2020, 4PM session

Kneppers, C.D.M. (Casper Dirk Maria)
Hees, J. van (Jos)
Desikan, A. (Arvind)

Congratulations!

Master graduates July 7th 2020



Master Graduates – July 7, 2020, 4PM session

Boopathy D. (Shree) Dhana
Breukers, H.G.L. (Henricus Gerardus Leonardus)
Hermans, S. (Stef)
Pronk, R.A. (Radolf Antonius)

Congratulations!



Master Graduates – July 7, 2020, 4PM session

Hoof, H. van (Huub)
Montree, R.J.H. (Roel Josef Hendrikus)

Congratulations!

Master graduates October 2020

Master graduates October 12th, 2020, 12pm session.

Freire Santana, H. (Henrique)
Kabir, T. (Tasfia)
Kaplan, H. (Hasan)
Mukit, M. (Mohammad)
Feyisa, D.W. (Desalegn Wolde)

Congratulations!



Master graduates October 12th, 2020, 2pm session.

Janssen, S.A. (Sam Adriaan)
Adrian Dewanto
Lam, V.T.T. (Victor Truong Thin)

Congratulations!

Master graduates October 12th, 2020, 4pm session.

Boerman, F.J.L. (Frank Johannes Lukas)
Vos, Z. (Zowi)
Bütler, R.M. (Rick Maarten)
Houben, T. (Tim)
Timmermans, M.W. (Martijn Wilhelmus)

Congratulations!



Icons of EE: Max Planck

By: Matthijs van Oort

Although this icon in electrical engineering is not officially an electrical engineer, his influence on the field of electronics has been quite remarkable. Not every engineer will use his principles on a daily basis, but I think every engineer will recognize his name. Already at secondary school, they start teaching students how to calculate the emitted electromagnetic energy based on Planck's constant.

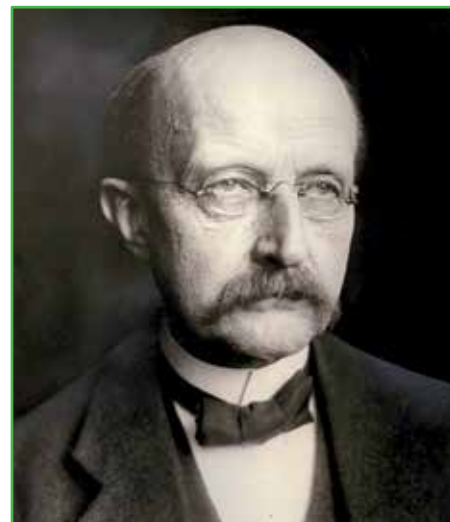
Max Planck was born in 1858 in a German city called Kiel. He grew up in a very traditional but also intellectual family, as many of his family members were professors at universities. He grew up with five brothers and sisters in a time which was marked by years of war. Due to the war between Prussia and Austria, the Planck family moved from Kiel to Munich in 1867, where he was enrolled at the Maximilians gymnasium. At this school his interest in the field of physics was triggered by one of his teachers, who taught Max the principles behind astronomy and mechanics, and the laws of conservation of energy. Besides physics, Max was very gifted in creating music, mastering the piano, organ and cello.

When he left his secondary school at the age of 17, he tried to enroll at the university of Munich. However, one of the professors at the university advised Planck against enrolling into physics, because the professor believed that nearly everything in the field was already discovered. Going against this advice, the stubborn Planck enrolled himself into the physics department in 1874. He was

taught by famous physicists like Gustav Kirchhoff and Hermann von Helmholtz, and even became friends with the last one. By the year 1880, Planck (at the age of 22 by then) had obtained the two highest academic degrees offered in Europe, namely a doctorate degree and a post-doctoral degree.

While Planck had shown his talents during his studies, he was initially ignored by the academic community. While he was not offered an academic position, Max started working as a teacher in Munich. Besides his work, he also dove into the field of heat theory and, without knowing it himself, came to the same thermodynamical formalism as Josiah Gibbs. Eventually he was offered his first position in 1885 in the university of his birth town, where he further worked on his findings within the thermodynamics. Eventually he was appointed to a academic seat at the university of Berlin, as a successor to Kirchhoff. At the end of his academic career, he was succeeded by another famous physicist named Erwin Schrödinger.

In 1894, after being appointed at the university of Berlin, Planck started working on his most famous work: the problem of black-body radiation. This problem was first introduced by his predecessor Kirchhoff, where they tried to relate the emission energy of electromagnetic radiation to the frequency of the radiation by a black body. This was already explored experimentally, but they could not find a theoretical explanation which could validate the



experimental results. In order to close this gap, Planck proposed a black-body radiation law, which could explain the experimental data, but did not yet include energy quantization and statistical mechanics, because he was fundamentally against it. After a while however, he revised his approach by relying on Boltzmann's statistical interpretation of thermodynamics, which eventually led to the Planck postulate, which is one of the building blocks of quantum mechanics.

Next to building the theorem behind black-body radiation, Planck contributed a few more things from his chair at the university. He was one of the first scientists to recognize the significance of Einstein's theory of special relativity, and with his influence helped the academic community to accept this theory in Germany. Eventually, Planck received the Nobel prize in physics for his work on the black-body radiation problem.

Overall, Max Planck did some important work in the field of quantum theory, and showed the field of physics that they certainly did not yet know everything. His later career was disturbed by the start of the First and Second World War, which meant that research could not be performed in the way they were used to (much like the recent pandemic). During these harsh times, Max helped motivating his colleagues by using the slogan "persevere and continue working", which represented the type of man Max was. ■



Optical chips, “old fashioned” or the future?

By: Martijn Heck

Lasers have always fascinated me. So, optics was one of the main reasons for me to start my study Applied Physics at the TU Eindhoven, back in 1995. The so-called internet and telecom boom – well, bubble, as it turned out – was a big motivator for me to look into the field of optical communications, as here you could very nicely see where lasers would be the key enabling technology for the information age we were about to enter.

In this article, I hope I can give you a little insight in the work I have been doing, and will be doing, here in the Photonic Integration group. But more importantly, this is a nice opportunity for me to introduce myself to the Department of Electrical Engineering, as I only started in April of last year. And that meant that I have not seen so much of my new colleagues and our students.

Let's start with myself...

I have joined the department in April 2020 as a new professor, but I'm not so new to the university. As said, I studied Applied Physics, about right where Flux is now, and where N-laag used to be. I moved to E-hoog for a PhD position, as I wanted to work in a more applied field than physics. But still with lasers, obviously. The Opto-Electronic Devices group (OED) of prof. Meint Smit suited me perfectly. After a short postdoctoral stay at the Laserlab at the VU Amsterdam, I needed a change, and went abroad in 2009. My first stop abroad was the University of California Santa Barbara, at prof. John Bowers' group, where I worked on a novel technology to bring lasers on silicon substrates. I think that resonates well enough with the readers to understand why Intel has picked up that technology, and built it into a billion-dollar business. So yes, Intel sells lasers... Intel even makes lidars, but more on that

later. My second stop abroad was Aarhus University, where I became an Associate Professor, and got the opportunity to set up my own group. I built this group to ten people, which was a great and rewarding experience. But after eleven years abroad, and given the great opportunities for photonics, not only at the university here, but also as part of a greater eco-system of industry around it, I took the offered opportunity to return here.

So, what are optical chips?

Optical chips, or PICs, are quite comparable to electronic ICs. An IC combines building blocks like transistors, resistors and capacitors into a larger, functional circuit. One can think of processors, sensors, memory chips, etc.

In a similar way, we can say that a PIC brings together the fundamental building blocks of an optical system or circuit, such as photodetectors,



modulators, waveguides, filters, and – of course, and as you anticipated – lasers. In the same way as electronic ICs, PICs are made of semiconductor material (Fig. 1), such as indium phosphide or silicon.

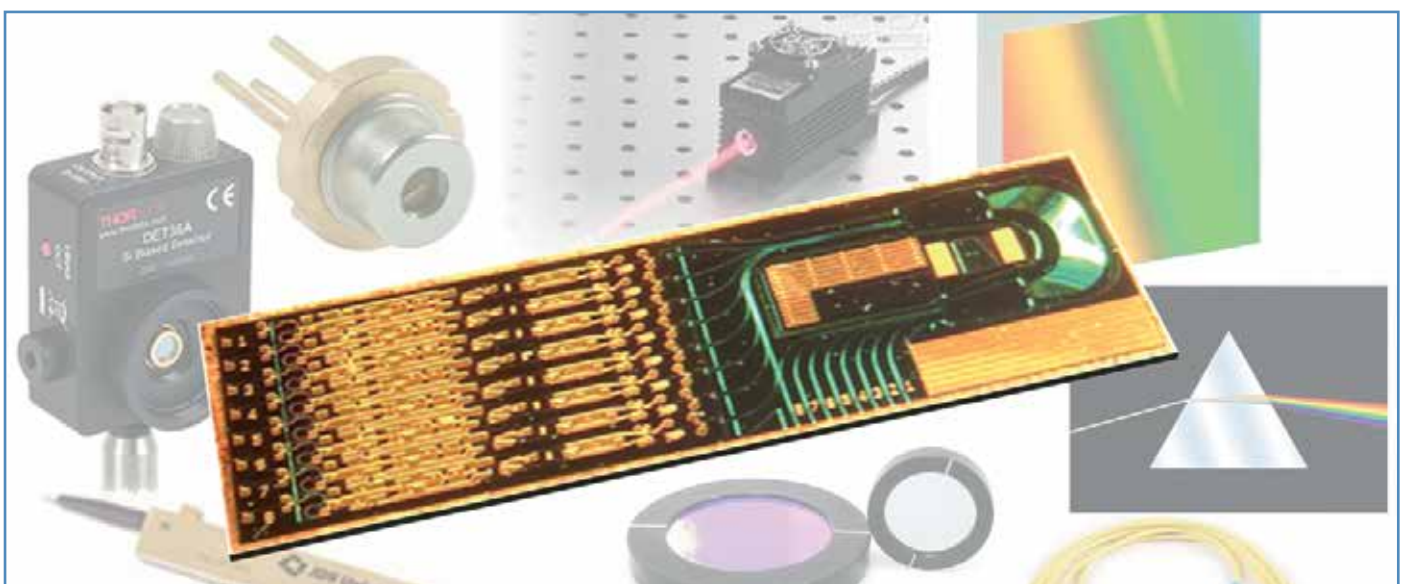


Fig. 1 Picture of a PIC, with all components that could be integrated in the background.

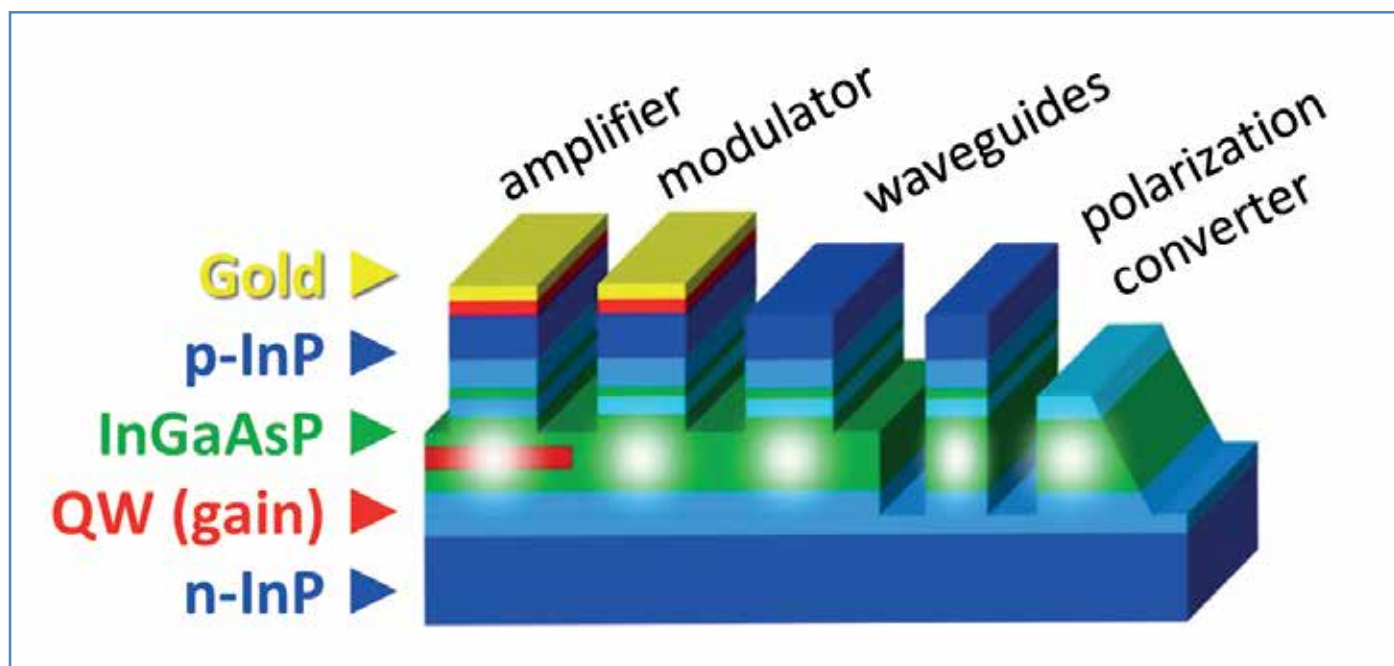


Fig. 2 Schematic cross-section of an InP PIC, with the different materials shown in different colors. The green InGaAsP layer can guide the light (white spots). The red active layer, composed of so-called 'quantum wells', can amplify or absorb light. Picture adjusted from [1].

Fabrication of optical chips in the cleanroom

When I did my PhD, I made the chips myself, in what we now call the NanoLab@TU/e. In our PhI group we still do that, and that is necessary to stay at the forefront of the new technology developments. A typical cross-section of a PIC is shown in Fig. 2. We start with the wafer, which has to be grown epitaxially, i.e., a seamless stack of atoms. Different material compositions can be grown on top of each other, which results in the ability to tune the electronic bandgap and the optical index of refraction. By sandwiching a layer with a higher index of refraction between two layers of lower index, the light can be trapped inside the center layer, due to the total reflection that appears at the interfaces.

To confine the light also in the horizontal direction, we etch ridges, and these then act as so-called waveguides. These waveguides are defined by optical lithography, which actually is a nice link with ASML, and shows the similarities between PICs and ICs, again. These waveguides can be laid out in various ways, so we can make splitters, delay line, or just go around a corner.

You can further see in the figure that the layers above and below the waveguiding layer can be doped, thus forming a diode. Unlike CMOS processes in silicon, where doping is implanted, we can already add the doping during the epitaxial growth of the wafer in the InP technology, thereby making the process more easy. Through metal contacts, we can then apply a voltage over the diode. The electrical field slightly alters the waveguide properties, and changes the phase of the light. This can be done at bandwidths of tens of gigahertz. In an interferometric structure, the phase modulation can then be turned into an amplitude modulation, for example for high-bandwidth communication.

A last important point is that the waveguide can contain an active layer, with a bandgap below the wavelength of light, or, more specifically, the energy of the photons. This means we can get absorption of light and (stimulated) emission. Under reverse bias, the diode will absorb light, and extract the generated carriers as a photocurrent. This is used to detect light, possibly at tens of gigahertz bandwidth. Under forward bias, we can inject electrons and holes. These can then recombine to generate photons, or light, and with this we can make optical amplifiers and lasers.

Of course we can think of various ways to make new platforms, and find different ways of making the same components, or better ones, but my personal research is aimed at figuring out what we can do with these components. Can we unlock new applications for PICs? Where can we make a real-world impact?

PIC for lidar – a game changer for autonomous driving

One clear example of such a new application is lidar technology. This will have a major impact in the field of autonomous driving. The market wants smaller and cheaper lidar systems with, ideally, no moving parts. PICs would be the perfect solution for that... if they can meet the performance targets. I have been doing research on this application since 2010, focusing on a so-called optical phased array. Maybe you know about phased array antennas for wireless communication and radar technology. In optics, the antennas are optical emitters, all emitting coherent light, and interfering into a beam. By controlling the phase of the light in each antenna, we can then shape and steer the beam. With our PIC technology, we can do this beam steering at nanosecond speeds, if necessary, which allows for very high-frame-rate mapping of the environment. ▶

[1] Smit, Meint, et al. "An introduction to InP-based generic integration technology." *Semiconductor Science and Technology* 29.8 (2014): 083001.

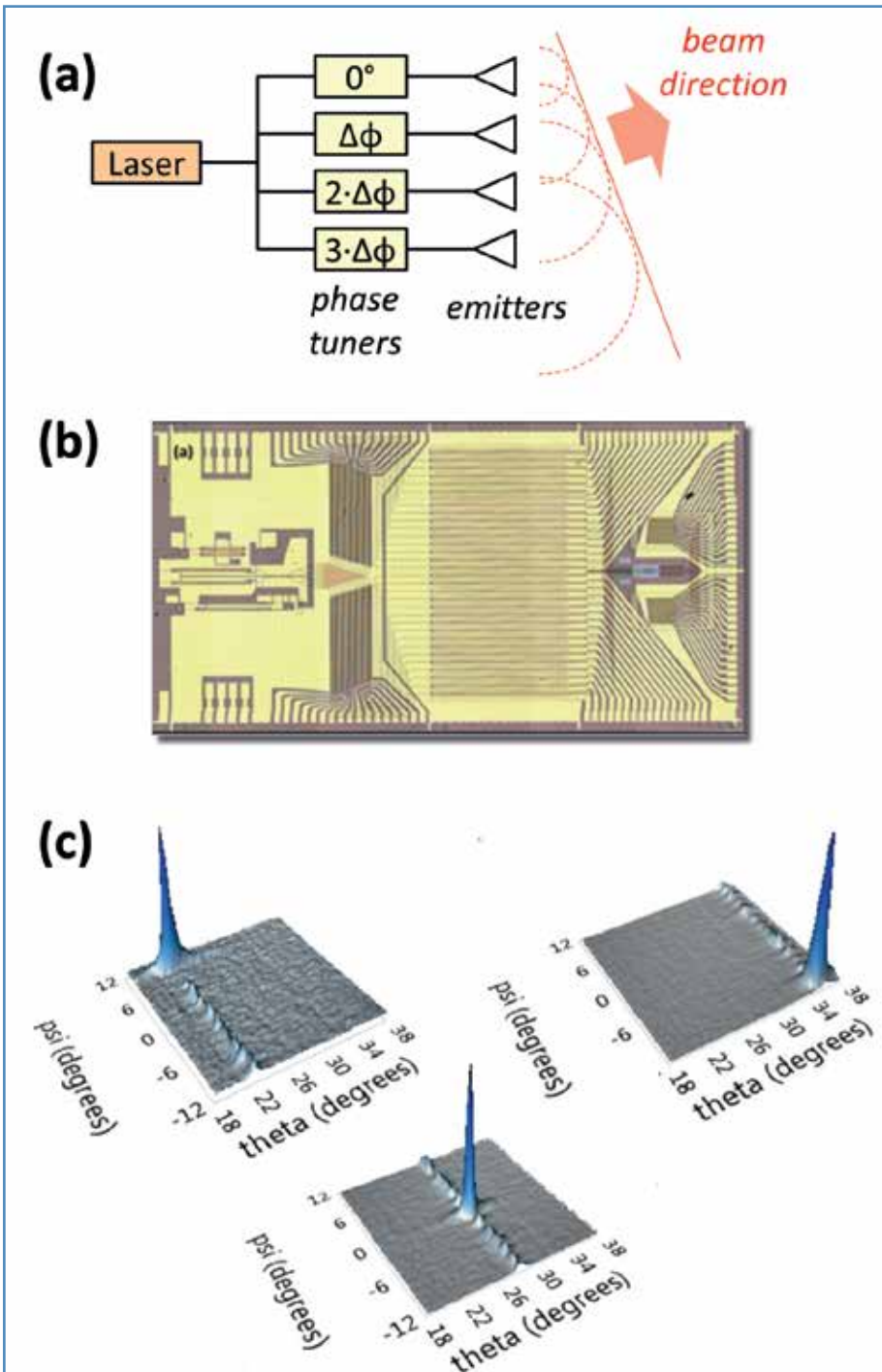


Fig. 3 The concept of optical beamforming is shown in (a). Laser light is distributed over an array of optical antennas, where in each of these the phase of the light is controlled. A picture of a PIC for beam forming is shown in (b). At a large distance of the PIC, the emitted light forms into a narrow beam, and this beam can be steered, as shown in (c). Pictures adjusted from [2].

Fig. 3 shows how such a system can be implemented on a PIC. Since we started this work, there have been quite some startups pitching this technology, such as Quanergy, but the latest impressive

move came from Intel, which announced their Mobileye Lidar in January 2021. And of course, to generate the coherent light, we need that laser again.

Microwave technology... with PICs?

The field that I focus on most is microwave photonics. The idea here is to use photonics to achieve better microwave performance, for a variety of applications. The basic concept is to use the light in a PIC, which is about 200 THz, as a carrier for the microwaves. So, for example, with a modulator, we can transfer a microwave, driving this modulator, onto the carrier wave, as a supermodulation, with frequencies anywhere in the range of kilohertz up to and exceeding 100 GHz. If this modulated light falls on a photodiode, only the supermodulation, or the microwave frequency, is detected and converted into a microwave again. This is schematically depicted in Fig. 4.

So why would we want to do this? I mean, I do not want to insult my colleagues and our students in microwave electronics: they do a great job! A main reason is physics: photonics can easily cover tens to hundreds of gigahertz in bandwidth, far exceeding what electronics can (easily) do. Also, optical fibers can transport a signal over tens of kilometers, without too much loss, whereas cables for microwaves, copper and coaxial, have increasingly high loss at the higher frequencies, limiting transmission distance to a few meters only. This is a main reason why photonics is very interesting for 5G networks.

One example I have been working on is a microwave oscillator. Crystal oscillators are well-known, but their noise is too high for future applications in, for example, high-bandwidth analog-to-digital conversion (ADC). The highest-analog-bandwidth ADCs are actually based on photonics. We make such oscillators, using a laser on the PIC, coupled to a waveguide with low losses. The laser emits pulses at about 20 GHz – and as a reminder: as a modulation of the 200-THz optical field! – and these travel through the long delay line. After this delay, the pulses are detected by a photodiode, which then generates a 20-GHz microwave signal, This signal is then fed back onto the laser current, thereby modulating it. Or more precise: synchronizing the existing modulation. In this way we can make a so-called opto-electronic

[2] Heck, Martijn JR. "Highly integrated optical phased arrays: photonic integrated circuits for optical beam shaping and beam steering." *Nanophotonics* 6.1 (2017): 93.

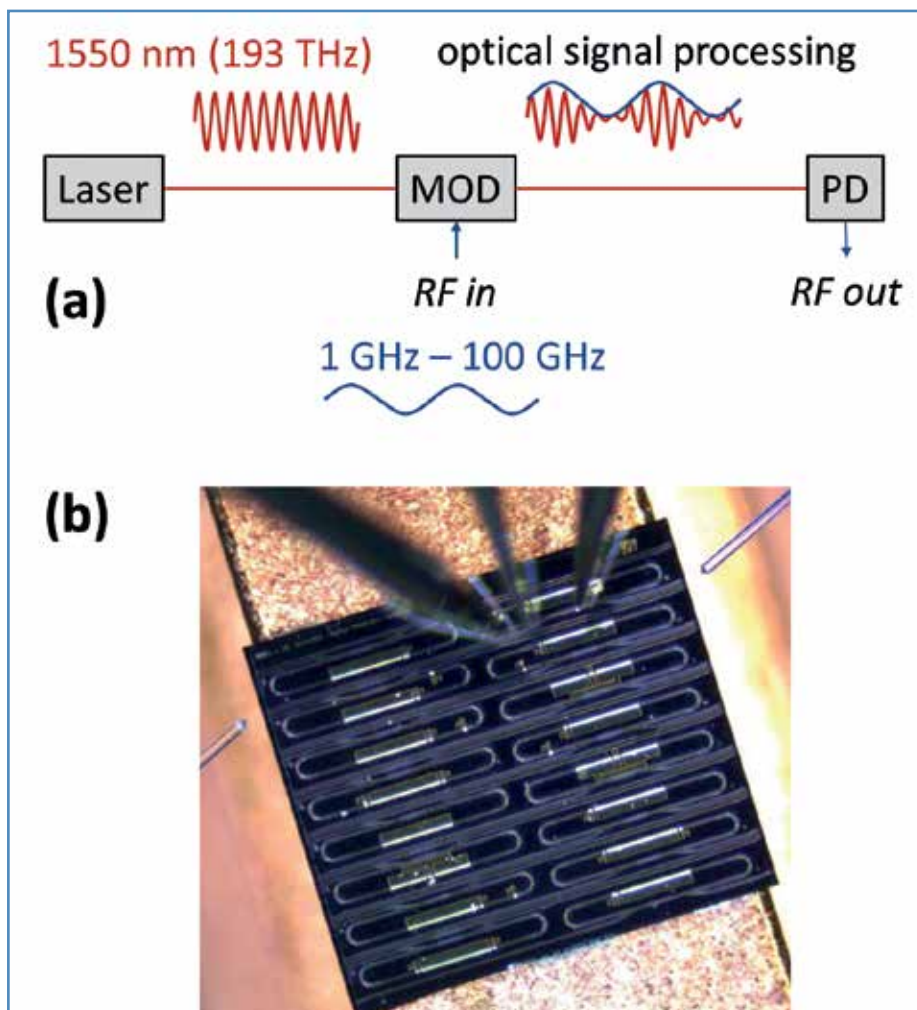


Fig. 4 The principle of microwave photonics is shown in (a). It can be seen that the RF or microwave is transferred onto the laser light, using a modulator (MOD). This optical signal can then be processed, for example through a filter. Hereafter, the light can be converted back to a microwave, using a photodiode (PD). An example of a set of pulsed lasers, emitting optical pulses at 20-GHz repetition rate, is shown in (b). In our lab, we often measure unpackaged chips, so you can also see the optical fibers (left and right) and the needle probes for electrical contact (out of focus, above).

oscillator, which are among the 'quietest', or low-jitter, oscillators in the world. Ours is not yet, but that is ongoing research.

My work at here at Electrical Engineering

Work here has started slowly, at least with respect to my own research, but already we have some exciting projects we are starting up. One project is to work on a versatile tunable laser, that can be used for virtually anything. From fiber sensors to lidar to spectroscopy and gas sensing: all of this needs tunable lasers. And I am happy to say that very soon we will be starting a project with ASML on new metrology tools, but now miniaturized on a PIC. It is great to see how multinationals like ASML and Philips are now

showing real interest in this technology. Of course, I am part of a large group, and we already have many projects running, so there is plenty going on here.

As a final note, I want to get back a little to the title of this article: Optical chips – "old-fashioned" electrical engineering or the technology of the future? Our field is, in many ways, not unlike what the average electrical engineer had to work on in the 1970s. We make our own chips, calculate with physical design tools how our chips will work – and need to experimentally verify that – and scale to hundreds of components per PIC maximum, with tens typically. That sounds like the status of IC technology about fifty years ago. This is highlighted if we plot the number of

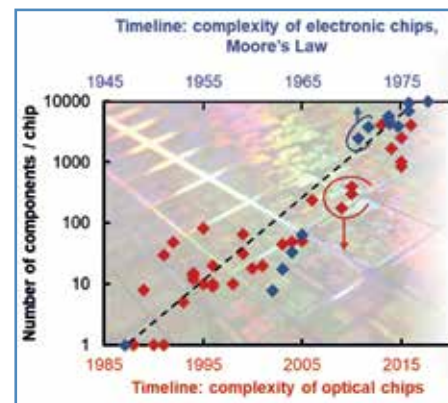


Fig. 5 Increase of complexity of PICs over time, indicated in red. For comparison, Moore's Law is also shown, in blue, but with a time offset. The exponential growth is the same, but the time difference is about 40 years. The data are from references [1,2].

components on a PIC in the same plot as the well-known Moore's Law, as is shown in Fig. 5. Both curves show the same exponential growth, but with forty years offset. What does this imply?

Well, it does not imply that PIC technology is behind IC technology. It is a different technology, with different physics, and different applications, despite the huge similarities in materials and fabrication technology. It is something new, something beyond ICs. It's actually often called a 'beyond Moore' or a 'More than Moore' technology.

So what does it mean? We see curves with exponential growth for IC and PIC technology, both are at the same growth path, but with an offset of forty years. What happened a little over forty years ago? Steve Jobs founded Apple, and Bill Gates founded Microsoft, based on the opportunities that they thought ICs would bring to the world... ■

Quarantivities at Thor

By: Jurre Wolters

The current situation brings a lot of challenges when organizing activities, since offline activities are mostly full of restrictions or aren't allowed at all, like the last few months. Therefore, we had some problems we needed to solve in a creative way. This brings a lot of challenges, like how to make the activity interactive, how to let people know about the activity etc. I learned a lot in the past months about organizing activities and I developed myself outside my studies, and that is the whole reason I joined ACCI in the first place!

Since we are the first ACCI year that organizes online activities, we had to figure out ourselves what works and what doesn't, and I think this is the biggest

challenge. Normally we would look at activities that were organized the year before, and see what worked well and what did not. It's also possible to organize the same activity from a year before again, since there is documentation on how to organize the activity so we can build upon that. This year, we had to try out a few things and just hope that people liked them. I think this is the first time that there are online activities. This gives a lot of uncertainty when you organize an activity, since you have no idea whether people will like it or not.

A good example is the 'Wild Wild Flux' murder mystery game I helped organize. I think nobody ever participated in a murder mystery game before, and

we certainly never organized one. I was nervous about how it would turn out, but I was surprised to see the activity was fully signed up before we could make any promotion for the activity! And it only got better. On the evening of the activity, the people came into the Discord server dressed as their character. At the end of the activity, I felt relieved and happy that everyone had a great evening and had fun. The participants were so enthusiastic, even though some things went wrong. Some of the participants even made plans to organize another murder mystery game outside the ACCI.

Another challenge is letting people know about the activity. There are only a few ways to contact people, and the



Fig. 1 Everybody dressed up at the Wild Wild Flux activity



Fig. 2 Me and some ACCI members at the last offline activity

most effective one is to talk to people and make them enthusiastic about the activity. Sadly, this is harder in these times where everybody is studying at home. Another way to promote the activity is to send some promo in group chats and hope that it won't get buried by all the messages in the chat (which probably will happen). But, even though it's hard to promote an activity, I found out it was easier than expected since people want to interact with others in these times, and it's nice that we can give them something where they can interact and have a good time, even in the time of a pandemic. It also helps that people are more used to online activities, which lower the threshold to sign up.

It is still hard to get first-year students to join the activity since we never really got a chance to talk to them. Therefore, we don't know them, and they don't know us either. The few first-year students that are joining, are already interested in Thor. But there are still a lot of first-years that I have never even seen or spoken to, and that's unfortunate, since we as an association would like to get to know the new students. I understand that it's maybe a bit overwhelming to join a big group of people that you don't know yet. I had the same problem at the beginning of this year, since I never really went to activities of Thor last year, but after joining a few activities and even organizing a few, I discovered that the people are nice and welcoming! So, if you are a first-year student and ever hesitated to join an

activity, I can only ask you to try it one time and then decide if you want to join another activity or not.

It is also hard to make an activity interactive, as most of our activities have an interactive part with them. And I think this is one of the most important parts of organizing an online activity, because just sitting behind your computer screen with a beer (or soda) in your hand can get boring really fast. Giving people something to do makes it easier to stick around, and go on with the activity. It's also important to find a balance between depending on people and making it interactive, because if a lot of interaction is needed for the activity, you're dependent on the number of people joining the activity. It's hard to keep a balance in this, when you depend on your participants too much, it introduces a lot of stress when somebody unsubscribes from the activity at the last moment. However, having too little interaction can make the activity boring. Upon this point, we tend to rely on the input of the participants to create a successful activity (for instance the enthusiasm or fulfilling a certain role in a game). Because there is not much else to do in these times, people are more likely to join. Even if someone decides last minute to unsubscribe from the activity, it is often easy to find a replacement, so this isn't a big problem as far as I experienced.

I hope this is a clear look at what challenges we encounter when organizing online activities. Maybe it looks like I'm complaining, but it is far from that. I think I speak for the whole ACCI if I say we are grateful that we have the opportunity to learn so much by coming up with creative solutions to the challenges thrown at us this year. I also want to thank everybody who participated in our activities, and the compliments we got. The best compliment I got so far is that the 'Werewolves in ACCIdam' is a real competitor for the yearly 'ACCI tag'. It is great that an online activity we organized was received so positively. At the time I am writing this, it is even almost certain that there will be a second edition of this activity. It was nice to see that most people were so enthusiastic about trying to become the mayor in the game by even making whole campaign posters. And then I have not even have talked about the other great activities we organized this year, like the pub quiz, the game night to relax after exams and the children's party. Thanks again for all the positive reactions this year, and I hope to see you again at one of our online activities, and hopefully, even during an offline activity later this year. ■



Fig.3 Presidential campaign poster for Werewolves of ACCIdam

Internship abroad

By: Elwin Hameleers

In the middle of south-Thüringen, far away from German cities you have ever heard of, lies the small town of Meiningen. It is famous for its theaters and museums, and apparently also for its high-tech industry. However, the best part about the town is the nature which surrounds it, as it is located between the Thüringer Wald and the Rhön.

From September until Christmas, I had the opportunity to experience living and working in Germany. From the time that I started as a first year student at Electrical Engineering, I heard about Master students traveling far and wide, across the entire globe, for their internships. I was somewhat jealous and excited, however it was an adventure that would come to me some years later. Then finally getting further in my studies, my friends were the students who could travel for my studies. They went to the U.S.A., Australia, New Zealand, South Africa, etc. Exiting and exotic places where I have never been before. Then finally, last year it would be my chance. I started my Master courses and little by little I started to score ECs To be able to get through any rigorous visa procedure, I started asking for options for an internship somewhere around Christmas 2019.

As a student with the ECO specialization, and with a great previous experience with my BEP, I went to Chigo Okonkwo. I knew he has numerous contacts, and would be able to get an awesome internship. And I was right. He provided me a list with companies from all over the

world. And Germany. When looking at the list at first, Germany was not really the top pick. A few-hours drive, and a country I have been to many times before, is clearly not as exciting as the faraway lands I have heard many stories about. However, deciding an internship is not only deciding to which country you want to go. The nature of the company (or university) you go to, the work you will be doing and, most important, the supervision you get at the company should be major factors in your internship puzzle. My puzzle lead me to ADVA Optical Networking. To be fair, even before I left I knew an internship at ADVA would be anything but boring, as from all those stories I heard about an internship in Het Walhalla, internships to ADVA were among them (just take a look at Connector issue 34).

My original plan was to ace my courses in the fourth quartile in 2020, so I could leave for Germany and experience the amazing Thüringer nature in the middle of the summer. However, then the coronavirus came. I want to mention the pandemic as little as possible, but there is almost no getting around Corona when



mentioning 2020. COVID turned everything around when preparing for my internship. For a long time, it was not sure if I could even go to ADVA. I did not know whether the department would allow me to leave for Germany, or if ADVA would have me. Also communication with about anyone was extremely difficult; the entire world was in crisis-mode. Unsurprisingly, this caused delays, but eventually I was allowed to leave for Germany starting from September.





MALZEIT lunch at ADVA

All Corona panics aside, I started my internship at ADVA Optical Networking on September 4th. ADVA is a telecommunications company that makes network equipment. Within the Advanced Technology group at the Meiningen office, I worked on Raman amplification, and ended up making a model to simulate the Raman scattering effect, which causes the amplification. Stimulated Raman Scattering is a very cool process, where a photon interacts with a molecule (in an optical fiber this is often a Silica molecule). In this interaction, the photon might scatter and transfer some of its energy to the molecule. This loss in energy translates to a loss in frequency of the photon, which can be used as an amplification mechanism. Let me make it a bit more practical. If you put two light signals (signals A and B) that differ in frequency by approximately 13 THz into a fiber, some of the photons of the higher-frequency signal (signal B) will

interact with the Silica molecules. These photons lose some of their energy, and continue with a lower frequency. Some of these photons end up having exactly the same frequency as the other signal (signal A). In other words, these photons have transferred to the lower-frequency signal A, therefore transferring power that amplifies that signal. This is Raman amplification.

Life in Germany is not very different from life in the Netherlands, however the environment is. Meiningen is an incredible combination of a medieval town, with old typical German houses and a palace, mixed with concrete GDR apartment bunkers. I was lucky enough to experience it in bright sunny days of summer, as well as finding myself in a true winter wonderland. However, the region is especially great when leaving Meiningen. Thüringen has an amazing nature and hiking there is awesome,

especially when you can stop for a beer and bratwurst. Professionally, ADVA is not as you would imagine a (former eastern) German company. Everyone is very kind, and the atmosphere is great. There is always time for discussion, both technical and non-technical. It is also very important to drop whatever you're doing at exactly 12:00h to go for lunch, and greet everyone with "Malzeit!"

During the second half of my internship, the COVID cases started to rise. First in the Netherlands, which made it impossible for anyone to visit me in Germany, and later in Thüringen. With bars, restaurants and museums closed, and the autumn weather of fog and drizzle, I had to spend more and more time in my apartment. The coronavirus did limit me in all the things I could do, and I still have a list of awesome places to visit. This just means I must (and will) go back to Meiningen whenever the world opens up again, so I can go to the Baumkronenpfad, Großer Beerberg and Rhönpiraten Brauerei.

I had a great time at ADVA, and I want to recommend everyone to leave the comfort of Eindhoven and go on an adventure. If anyone has any questions, feel free to ask me anything about my internship in Het Walhalla, around the coffee machine at Thor, or for the time being: digitally. You might be nervous and it might look scary, but it will be an amazing experience whatever happens. Go for it! ■



Photo contest

With less and less (physical) activities organized in times of corona, the photo committee of e.t.s.v. Thor suddenly had no real tasks left. However, when you can't take pictures of members during activities, you can start an activity by yourself in which the Thor members, who are usually captured by members of the photo committee, are now picking up the camera themselves. And thus, the FotoCo photo contest was born. In this contest, participants were given a weekly theme joined with some background information. Themes ranged from 'black and white' to 'tasty' and from 'nature' to 'light'. After sending in a picture, participants and other visitors of the website could decide on a winner for each week and thus for each theme. The winners and their photos can be seen on these pages.

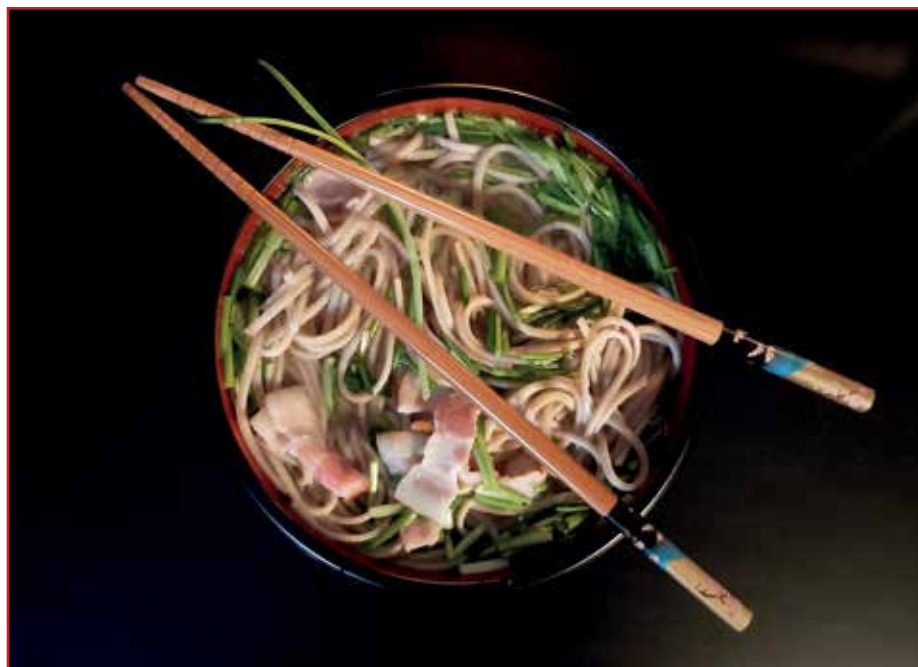
After all, there was one person who especially stood out during this complete contest. With a staggering four wins and one second place, Jurre Wolters was the undisputed winner of this contest.

Week 1: Nature

Winner: Jurre Wolters with the composition "Curious Sheep".

"After two trips to the woods with no results, I was on my way back home where some sheep were curious but hesitant about my camera."

Camera: Canon 650D
Lens: Tamron 70-300mm
Post-processing: Adjusting contrast and exposure.



Week 2: Tasty

Winner: Fer Radstake with the composition "Still-life of a Japanese-inspired noodle soup".

"I think the result nicely shows an analogy between cooking and photography: just as in cooking a few well-chosen ingredients quickly thrown together can be as delicious as a laboriously constructed dish packed with different flavours, in photography some creativity and a careful composition are perhaps more important than the camera or lens you use."

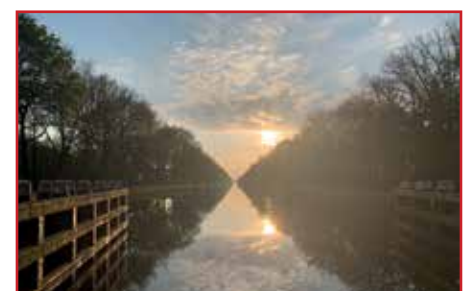
Camera: Samsung Galaxy A50 with
Post-processing: lighting curves, some blurring in the corners



Runner-up Nature: Sven Bierenbroodspot



Runner-up Tasty: Jurre Wolters



Runner-up Mirroring: Mark Legters



Week 3: Lights

Winner: Jurre Wolters with the composition "Life is a highway"

"I tried this effect a few years back, but I was never completely satisfied with the result. This week's theme gave me a reason to go back and try again."

Camera: Canon 650D with a Canon 18-55mm lens

Post-processing: Adjusting contrast and exposure. Removed some weird spots on the sidelines

The runner-up, Bram Lustenhouwer, is displayed on the back cover.

Week 4: Black and White

Winner: Jurre Wolters with the composition "Light at the end of the tunnel".

"This was the first time I tried shooting in black and white, and it was really fun to play around with composition instead of the colors!"

Camera: Canon 650D with a Canon 18-55mm lens

Post processing: Adjusting contrast and exposure. Rotated the picture to perfectly align with the edge of the tunnel.



Runner-up black and white: Lucia Kalkman



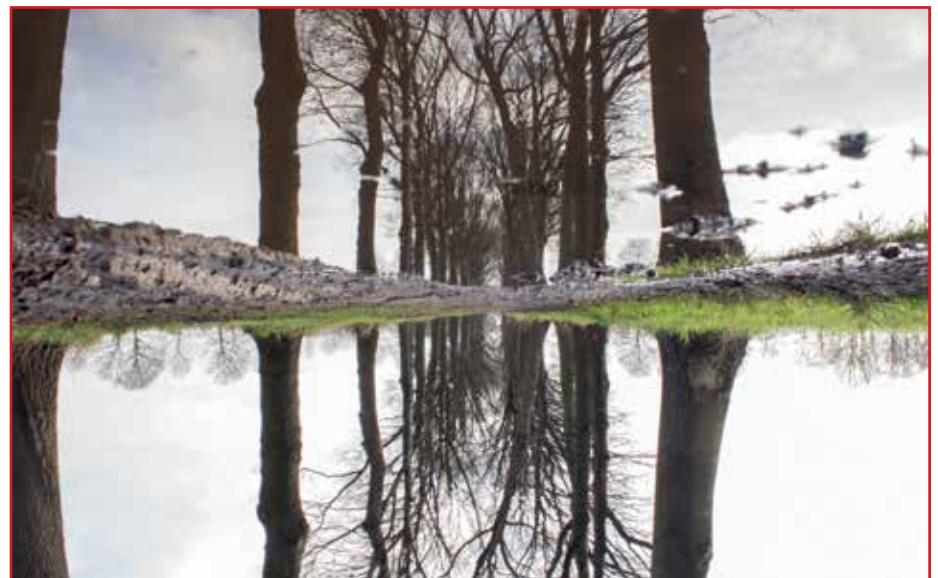
Week 5: Mirroring

Winner: Jurre Wolters with the composition "The upside-down"

"I was a bit busy due to the exams, but during a little walk I took some pictures of trees through the reflection of a puddle and turned the whole picture upside down. The only sad part was the rain on my way back."

Camera: Canon 650D with a Canon 18-55mm lens

Post processing: Adjusting contrast and exposure. Rotated the picture 180 degrees to turn the picture upside down.



Brewing beer

By: Thomas Lippens

Since I was young, I've always enjoyed cooking. I still love the creative process of combining flavours and textures to create something that tastes good and that others can enjoy. When I started drinking beer, I quickly became interested in the process of brewing it. Reading about the process, I saw that with some relatively basic tools, you can create beer yourself. This of course sounded interesting to me, as brewing beer isn't that different from cooking. To give you an idea of the necessary steps, I will quickly explain the process.

The brewing process

Milling: The base ingredient for beer is malted barley. To be able to extract sugars from the malt, it first has to be coarsely grinded. Grinding too coarse will mean that not all starch is transformed, and grinding too fine, will result in trouble during filtering.

Mashing: The malt contains enzymes which can transform starches into smaller (fermentable) sugars. Those enzymes work at a temperature between 60°C and 75°C. During the mashing process, you extract those sugars, and dissolve them in water.

Filtering: After mashing, you need to separate the spent grains (solid) from the wort (liquid). The spent grains are a great addition to some home-made bread (depending on the type of beer).

Boiling: After filtering, the wort has to be boiled for approximately an hour and hops can be added. Adding hops early in the boil will increase bitterness, and adding hops at the end will increase the hop flavour and aroma.

Cooling: The boiled wort is now the perfect nutrition for all kinds of wild yeast and bacteria, which love temperatures around 30°C. Therefore, we need to cool the wort down to 25°C or less as fast as possible.

Fermenting: Now the wort has cooled down, it can be transferred to a fermentation vessel and yeast can be added. Beers have to ferment for at least two weeks.

Canning: After fermenting, the beer can be put in a can, which can then be sealed. All my beers re-ferment inside the can, to carbonate them.

Cleaning: Maybe the most important step in the whole process: everything needs to be sanitized and disinfected



before and after every step, to make sure there are no possibilities for micro-organisms to spoil the brew.

Experimenting

The aspect I think I enjoy most about the whole process, is the possibility to endlessly experiment with flavours. Often this results in satisfactory results, but of course, sometimes this also goes completely wrong (I've had those experiences as well). ■



Milling the malt



Mashing the grains



Transferring the cooled wort to the fermenter

Putting the lunch in lunch lecture

By: Gerbrand Wit

I am half a year into my Board year now, and one of my tasks is to make sure that the association provides career activities throughout the year. As with all the other activities Thor organizes, these too have taken a different form, mostly in the online direction.

Online career activities come with quite some challenges. For example, you can't expect participants to stay focused for a long time during an online activity. This is something I noticed quite quickly by asking around after the first couple of online lunch lectures. Only listening to a lecturer in a lunch break while occasionally looking at an object which has been brought along might work in an on-campus lecture, this however is not the case for an online lecture. By working together with the committee Kvasir, which helps with the organization of the lunch lectures, we come to a solution to tackle this problem.

During my conversations with the companies, I would advise and encourage them to add a sort of interactive component to the lunch lectures, which for example could be a quiz. It is here I noticed that it is not only us who are looking for new ways, but the companies themselves are also constantly looking for new methods to work with the current situation. Therefore, they always reacted really enthusiastic to our advice and would even ask for more ways that I would recommend.

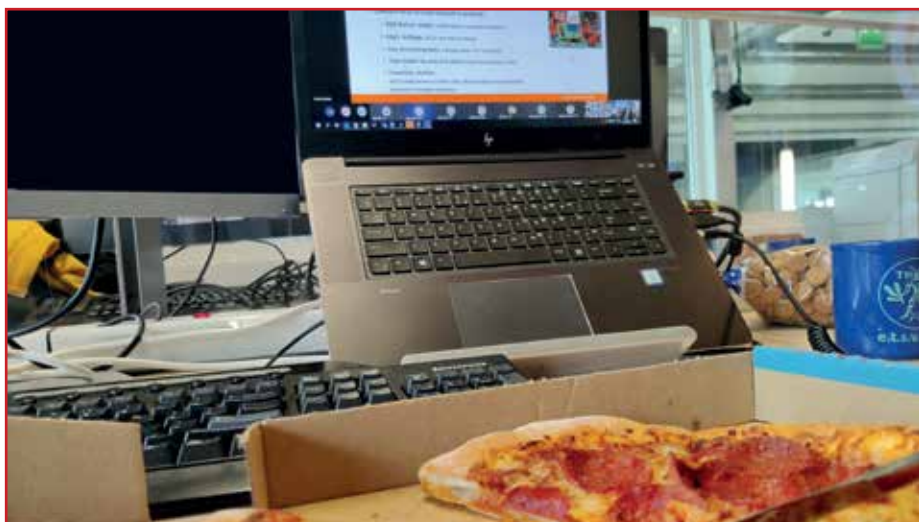
Another challenge I faced is promoting the lunch lectures. Normally, you could see the Commissioner of External Affairs making a lot of promotion on floor 6 of Flux, and in Het Walhalla. This even came to the point that sometimes their ways of making promotion was getting irritating. However, I secretly always admired them for how well they were able to promote the activities. During my year so far, I encountered some problems with making promotion, as most of the lectures are online and Het Walhalla has been closed for most of the time. This means that there is much less on-campus interaction with the members, and the people who we encounter online, consist mainly of a small and select group of members. Most of the members who have seen me on campus when it was still allowed, have probably heard me at least once ask: "What are your plans for coming Wednesday?" The thing for which I admired my predecessors, has now become something I have learned as well. This however was an effective way of making promotion, as the participation in lunch lectures also increased as I felt more comfortable with making promotion in such a way.

The last challenge I faced may have been the one most members also were really disappointed by. Namely, with the online lunch lectures, participating in a lunch lecture didn't always make you end up with a nice lunch. This is something which turned out to be quite the problem



to solve. The moment I still remember quite well is the lunch lecture which would have been the first on-campus lunch lecture that I would have arranged together with Kvasir. Unfortunately, a week before the lecture, an update from the government came, which made it impossible to have an on-campus lunch lecture. As this company's lunch lecture is the one during which we've had pizza for the last few years, I was really looking forward to this afternoon. Of course, I also didn't want to be the person to break this tradition, so together with Kvasir we managed to deliver everyone who was in Eindhoven, pizza at home. A while after this lunch lecture we settled on a more doable alternative; giving everyone a gift card for the Subway after participating in four lunch lectures.

All in all, something which has been dominant throughout my board year is that there are a lot of changes with regard to how it normally would go. This often brings challenges along with them, but solving these challenges is partly what makes it fun. By, despite of all the challenges, making an activity into a success, you get the most satisfying experience. You only have to deal with a bit more stress on the way to success. ■



Antenna System for 5G Base Stations

By: Teun van de Biggelaar

Our society relies heavily on wireless communication. Almost everyone around us has (at least) one mobile phone that is connected to a cellular network. In fact, more mobile phones are currently connected to a cellular network than the amount of people living on this planet. Especially with the rise of the so-called Internet-of-Things (IoT), the number of devices using the cellular network will only increase in the future. It is predicted that in the coming five years, more than four billion additional devices will be connected to a cellular network. This prediction is visualized in Figure 1.

An obvious consequence of connecting more devices to a cellular network is that the overall data traffic grows. Additionally, as the performance of our electronic devices increases, so does the data traffic. Both consequences translate to an exponential growth of data traffic that the cellular network has to accommodate. This growth is depicted in Figure 2. To prevent congestion in our current cellular infrastructure, hence, to maintain the quality of service that users are experiencing at present, the 4G cellular network must be upgraded. This results in the current development of the fifth-generation mobile communications, or in short 5G.

5G mm-wave cellular network

Compared to 4G, the promise of 5G is to have higher peak data rates, lower latency, more data traffic, and higher connection density, among other

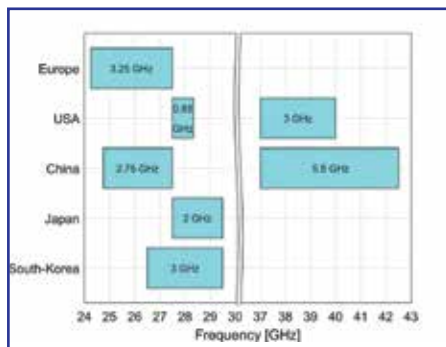


Figure 3: allocated 5G mm-wave frequency bands including their bandwidth for different regions. Based on 3GPP TR 38.815 V15.0.0.

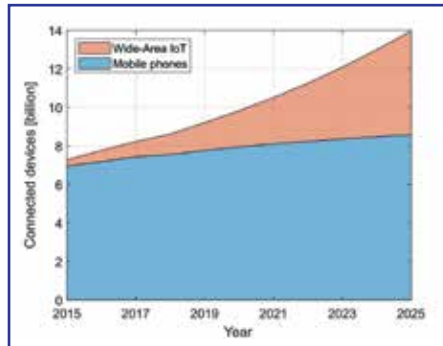


Figure 1: number of devices connected to a cellular network (forecasted beyond 2019). Based on the Ericsson Mobility Report, November 2019.

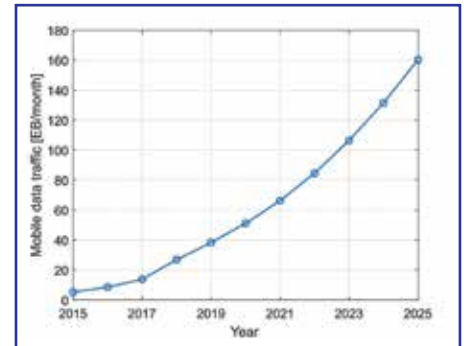


Figure 2: global mobile data traffic (forecasted beyond 2019). Based on the Ericsson Mobility Report, November 2019.

improvements. For these improvements to become reality, additional frequency bands compared to 4G must be used. Despite the fact that the exact allowable frequency bands are region dependent, the frequency bands which are going to be used for 5G are typically divided in two frequency ranges; FR1 and FR2, or often referred to as the sub-6 GHz and mm-wave frequency bands. In Figure 3, the mm-wave frequency bands allocated for 5G for some regions are shown.

Although the 5G wireless systems utilizing the sub-6 GHz frequency band will be using new waveforms and new technologies like MIMO, these frequencies are similar to the frequencies used in current 4G systems. From an RF research point of view, the antenna design and characterization challenges, therefore, are more interesting in the mm-wave frequency band. At the EM group, the present research to 5G cellular networks is focused on challenges and implications associated with the utilization of 5G antenna systems operating at mm-wave frequencies.

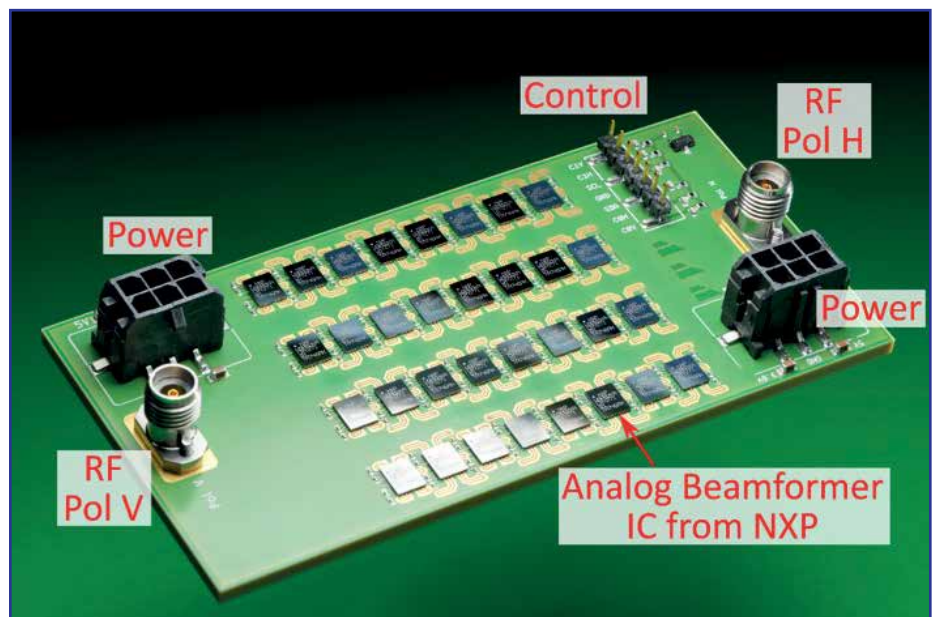


Figure 4: the back side of the developed antenna module, including its 32 analog beamformer ICs that are provided by NXP Semiconductors.

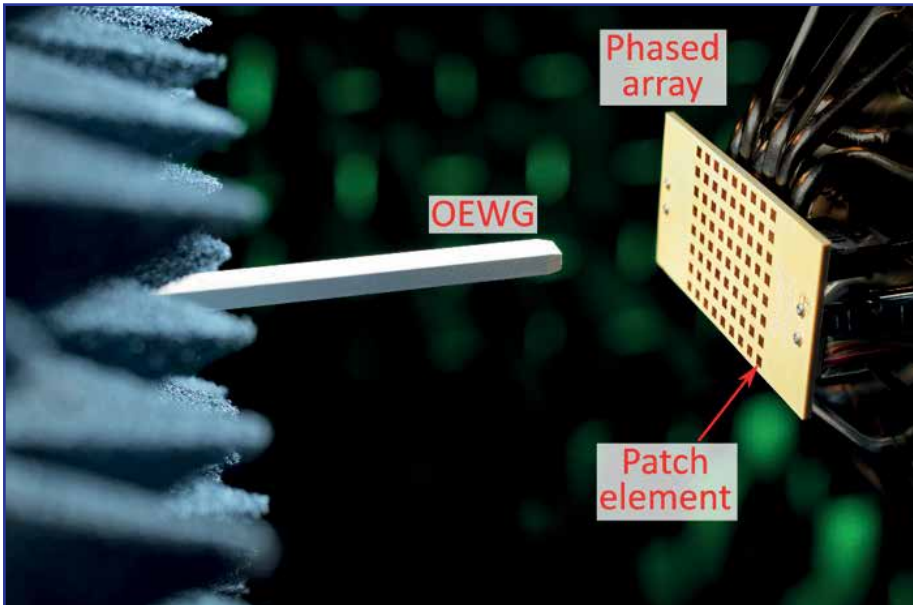


Figure 5: the front side of the developed antenna module in a measurement setup, including its 72 antenna elements.

5G base station antenna concepts

Three different concepts of antenna systems for 5G mm-wave base stations are currently being investigated, realized and evaluated at our group. The first concept is a static antenna system based on cell partitioning. Using this approach, the base station is equipped with tens of high-gain antennas and each antenna is used to illuminate a small part of the cell. The second concept is a phased-array-fed reflector system. In this concept, a phased array is used to illuminate a reflector, in turn creating a very directional beam to each mobile user. By changing the active elements of the phased array, it is possible to dynamically adjust the direction of the beam and

maintain a high-quality data link. The third concept is based on using a phased array antenna system to perform beamforming without utilizing a reflector. This phased array concept was the focus of my four years of research.

Active phased array antenna system

The back side of an active phased array antenna, manufactured in collaboration with NXP Semiconductors, is shown in Figure 4. In Figure 5, the front side of the array is shown in a measurement setup. This array is the university's first prototype of a 5G mm-wave base station and is developed to perform in-house experiments. Each of the analog beamformer

ICs (see Figure 4) is connected to 4 patch antenna elements (see Figure 5). The beamformer ICs allow for changing the amplitude and phase of the signal fed to each of the patch antennas, enabling control of the array's radiation pattern.

As an example, the upper hemisphere of the array's measured radiation pattern for different beamforming scenarios is shown in Figure 6. In all three scenarios, it is attempted to point the main lobe in a certain direction while having a side lobe level of 20 dB, i.e., having a minimum reduction of the radiation at other angles than the main lobe by a factor of one hundred. The desired scan angle and achieved maximum are indicated by the red cross and purple dot, and radiation that is exceeding 20 dB side lobe level is visualized using the black dashed regions. Although the main lobe is not always at its target location and the side lobe level is higher than 20 dB at some locations, these results exceeded our expectations of a first prototype and look very promising for future prototypes.

These results, along with results generated using other over-the-air characterization methods described in my PhD thesis, serve as input for NXP Semiconductors and other companies to improve the performance of mm-wave components and mm-wave antenna array designs. This will ultimately enhance the reliability of the 5G cellular networks such that network operators can continue to guarantee a high quality of service in the future. ■

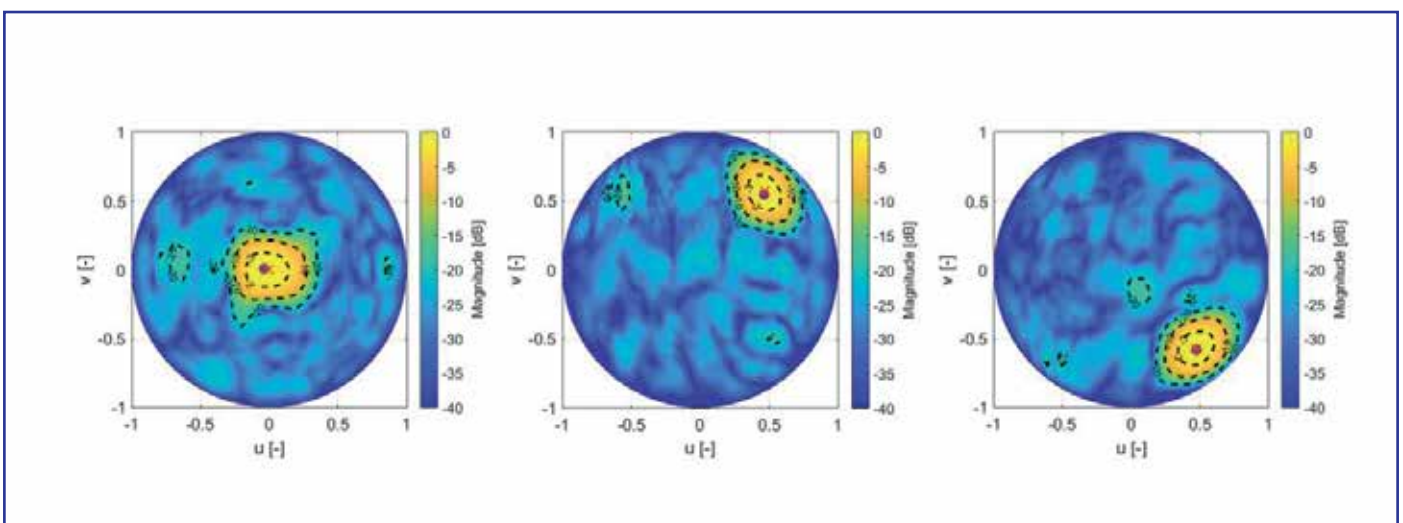


Figure 6: measured radiation patterns for different beamforming scenarios.

An once in a lifetime Dies

By: Jos Willems

Organizing a birthday party in corona times can be a real struggle, especially when you have to choose who to invite. And with around 950 members and an entire department who can join you on this occasion, it is not an easy choice. Thor's 63rd birthday week was entirely made up of online activities, with a number of them having some packages that could be picked up in Flux.

Traditionally, the Dies week is opened with the pie reception, where the first floor of Flux is home to dozens of pies for a few minutes, which then magically disappear. Since a birthday without pie was no option for us, we made sure that you could nominate a friend and then we would select ten of those nominees and deliver them a pie – on their very own doorstep! We made sure that all the pies delivered were a surprise to the receiver for the best effects.

The day after, we had a cartoon drawing workshop. In the engineering world, there are not always illustrations available of what you want to explain, so sometimes you have to make them yourself and this workshop really helped with that. The day ended with a pub quiz, from which we learned that it is also fun for participants if you make questions that they can actually know the answers to. The winning team had just over 50% of the questions correct. However, we made sure that the participants had plenty



of new knowledge at the end of the evening. Personally, my favorite round was the one where we had a number of songs of which the lyrics were translated dozens of times via Google Translate and asking our participants what song they were from. The round on countries scored the lowest, with only 2.9 points out of 11 on average.

Wednesday is Thor's standard day for lunch lectures, so the lunch break then is the moment you should block in your agenda for career development! During the Dies week the lunch lecture was from ASML, and it included free lunch again for the attendees, which was a nice extra for an online lunch lecture. In the evening we had a workshop on making cocktails,

which was hosted by two members of the Dies committee, where we made a number of fancy cocktails.

Thor's day had another two activities planned, of which the first one was a tournament of the famous board game 30 Seconds. Multiple duos shouting at one another via Discord still catches the chaotic but awesome vibe from this game. In the evening we had the activity which went over its maximum number of available spots in the blink of an eye: a wine tasting. This caused some loss of sleep for us since the shipment of the wines was delayed by almost a week and when it finally arrived it turned out that a part of the delivery was not what we had ordered. However, we still made it work and everyone had a fun time.

The final day, we had breakfast boxes that made sure everyone could start the day nice and fresh. The new yearbook of Thor was presented that day, and it turned out beautifully. The week ended that evening with an online dinner. We still hope to catch up on the missed (real-life) dinner one day.

All in all, this week was a great success and we entertained the members from Thor throughout the entire week. We achieved something really important this week: we brought many people together (online) during these times of isolation and gave them some distraction. ■



From woodblock to hardrock

By: Bram Groenen

Hey there reader! My name is Bram Groenen, I am a third-year Electrical Engineering student who loves to play guitar, listen to metalcore and tinker with electronics. I am going to tell you the story of how I built my own electric guitar.

My nephew and I were getting off topic from playing a guitar to building one. One thing led to another and suddenly we were browsing eBay for guitar wood. We stumbled upon a few beautiful pieces of pale-moon ebony. We came to the agreement that we would just buy the wood and make an electric guitar out of it. This is how the journey begun for me with this project and for my nephew as making guitars as a side gig. Next, I ordered a few blocks of wood which were suitable and would look good in a combination. Then, other building materials and hardware such as wood glue, frets and other things had to be ordered. When those had arrived, I began gluing



Korina body, wengé and padouk for the neck, pale moon ebony for the fretboard and ziricote for the top plate being glued together

the woodblocks together to form something that can be processed through a CNC machine. After going through the CNC machine, it finally resembled something that actually looks like a guitar and after sanding, it started to feel like one as well! Then the gluing of the fretboard took place, which was followed by some more sanding and placing the frets in place. This was a terrible job to do in the peak of summer heat under an open-aired porch. The stainless steel frets had to be grinded to length, fit and form. This took multiple days as it was horrible to do in this heat, even with two people. Then, the time came to put in preparations for the hardware.

For those who are interested: the pickups installed in this guitar are Fishman Fluence Moderns. They are high-output pickups, which means they put out a higher voltage signal to the amplifier. The bridge and locking tuners are both made by Hipshot. The wood chosen as seen on the pictures was wengé wood with padouk strips and korina bodywings. As a top I chose 5A grade ziricote, and as a fretboard I chose pale-moon ebony. Now the smelliest part has to happen: putting the lacquer on. I chose to use Tru-Oil as my surface finish, which I later

matted with steel wool. This took more than a week of putting on one layer per day, making sure not to hit the fretboard with it. The oil smelled horrible but had to dry inside due to dirt in the air outside.

The guitar was almost done and was looking great, the only things that were left were finishing up the frets, fitting the hardware and having a photoshoot of course. After all that, I finally had made my own guitar with a lot of help of my nephew. This is definitely the project of which I am the proudest. This one was the first, but definitely not the last one to be built by me! ■



The top being machined out in the CNC machine

In retrospector

By: Martijn van Eerd

At Thor, a board of the association is usually referred to by their board number, ranging from the 1st board at foundation, up until the current 64th board. As we've recently passed the golden boundary of 50 Connecthor issues, we're closing in on 'recent' board years. In the upcoming Connecthor issues, we ask a member of the board matching to the issue number to look back at their time at Thor. What has this former board member done at Thor? Has being an active member been a benefit to life after Thor?

For this 53rd issue, Martijn van Eerd, Treasurer of the 53rd Board of e.t.s.v. Thor, has written all about his experiences.

Time certainly flies when you are having fun, so both my time in the 53rd board and the surrounding years studying and being an active member have flown by. September 2020 already marked the 10-year anniversary of my discharge of the board of the e.t.s.v. Thor, and it has also been almost five years since I graduated and finally had to close the chapter of studying at the TU/e. So, it now seems an appropriate time to actually look back and share what I learned of my experiences.

Think in possibilities, not problems

When you are a board member, or, for that matter try to organize anything, you will run into problems. This is inevitable. The question is how you want to deal with it. The easy way out is to get angry, ignore the problem or just plainly give up. If this would have been our attitude during our board year, we would have missed out on a lot. Luckily, Thor always has excelled in promoting creative solutions.



The 53rd board with their "tapauto"

So, when at a Tuesday morning our secretary came into the board room and told us our nice and freshly painted "Tapauto" wouldn't move anymore, we did not give up. The problem was quickly diagnosed to be a worn clutch. So, we got a shop manual, (which I still have as a memento by the way), got a second-hand clutch, and negotiated with the lab owners from mechanical engineering to use

their tools and car bridge. It took us a full day of work because, of course, we had no clue what we were doing, but at the end we had removed the transmission, swapped over the clutch, put the transmission back in and, also to our surprise, our car was functioning perfectly again.

This can-do attitude is something which has helped me greatly over the past years. It allows you to take initiative, lets you think of creative solutions to problems you face, and means that you keep moving forward instead of getting stuck. It is way more fun when you find solutions and contribute, instead of being a glass half empty kind of person and dig your feet into the sand. It also allows me to think in possibilities in my job. I work at ASML System Integration, so it is actually my job to find issues. Being creative allows me to find solutions quickly, so we can keep moving forward.

I am very happy to see that Thor is also still thinking creatively. This year has obviously been very different and a lot of things are not allowed, but Thor has always been looking into what is possible instead of what is not. The outside drinks in the Markthal during the summer holiday, all the online activities during the year to keep people connected, and



The board car of the 53rd board



Beerfest

even bringing around pie to celebrate the Dies. A great effort and a great example of thinking in possibilities, not problems.

Understand other people's views

Another very interesting thing I learned at Thor, and I currently still highly value, is to get an understanding of other people's views. When you organize or arrange something, you need to make choices. Sometimes, these choices are very basic, such as the kind of sandwiches we provide. Everybody understands that when you choose to only provide buttered cheese sandwiches you will have a group of people who are not happy. When you provide more variety, the number of people not happy will go down but presumably you will always have a few who have something to moan about. How far you go in providing different sandwiches is a choice you have to make. But to make that choice you will need to predict what people want, what is their view on the matter. If you do not do this, you either put in way too much effort, or you will have angry people who have nothing to eat.

When I was in the board, I tried to approach a lot of the decisions we made in this way. If we choose option A, what will the members think, what will be their counter argument why we are wrong. By doing this, the discussions will be smoother, because you have already weighted their arguments and you should have the counter ready. Or, of course, by doing this you found out you

were making the wrong choice because your decisions are not supporting the majority view.

Naturally, this is not only helpful in very serious matters such as decisions at the GMM (General Members Meeting). I vividly remember that I once made the mistake to accidentally leave the board room unlocked when we were watching a movie in a separate room. Luckily, the well-known "Man met de Pijp" was there to safeguard the valuable items in there, such as the counter, the Fish, all the administration and so on. It was a real relief, because at least everything was safe. What if Simon Stevin would have passed by! We knew the "Man met de Pijp" wanted and deserved a reward for his actions. A common mistake in these instances is that the "Man met de Pijp" wants to be paid in beer. But by understanding the views of him we quickly understood that while beer is always

Name:	Martijn van Eerdt
Current job:	System test engineer at ASML
Studied EE:	2007-2016
Activities at Thor:	OHD, ACCI, Board (treasurer), Yearbook, KasCo (3 times), Lustrum Committee
Other:	Honorary member

welcome, it is the effort and our learning what counts to him. So, we proposed to organize a Beerfest, to thank him for all the effort, which was highly appreciated, and our offer was immediately accepted.

Also at work this knowledge is really helpful. Do not think that because you are working for the same company, everyone has the same views and goals. Everyone has a different background and different tasks, meaning that people are always trying to defend their own view. People are busy, try to shrink or deflect the amount of work they have to do. Sometimes this is valid, sometimes it is not, but by understanding their point of view it becomes easier to find the middle ground and complete your own goals.

Friends for life

Lastly, and this one can be very short, it has been made absolutely clear that during my time at Thor I made friends for life. Not only the people from my generation 2007 whom I see still very often, but also especially the people I do not see so often anymore but when I do it is always immediately like it was ten years ago. The type of bond which has been built by organizing, having a drink, having arguments, learning together and having a common goal goes very deep. And the nice thing is that this group of people is still growing. I hope to go back to Het Walhalla again in a few months, talk to the new board and all the rest, and still feel at home. Knowing that you belong somewhere gives a stable base, and the confidence to go on and excel.

Geen Gedonder! ■



Life after EE: has it really been 5 years?

By: Mark Kleijnen

Time really does fly by. Without much thought, I have passed the five year mark at Philips Innovation Services. Even though I have been working in the same department, my work has always been varied. It is no exception to work on connected toothbrushes, MRI scanners and hospital patient monitors on the same day. It is this variation, together with a good atmosphere and an environment that fosters personal development, that made the time fly by.

How I became an RF designer

Throwback to 2015: I was nearing the end of my graduation project at the Philips MRI division. I had already applied for a few jobs, but none of the applications were successful. Then, while I was presenting part of my thesis work at a seminar, I blurted out at the end of my presentation that I was still looking for a job. Apparently, this was a good call, as someone from Philips Innovation Services came to me after, who was looking a junior RF designer. At the end of my graduation, even though there were more successful job applications (including a PhD position), I felt that this position at Philips offered the best learning experience for me. I would be coached by Gert, a senior RF designer with long-standing experience from

Philips Semiconductors and TNO. Much of the RF knowledge (except for MRI) had been transferred to NXP, and it was up to me and Gert to bring back this competence.

Why Philips

I enjoy working for Philips because we make a tangible contribution to society. Philips focusses on improving people's health, from healthy living and prevention, to diagnosis, treatment and home care. Additionally, Philips sets ambitious targets for renewability and is recognized as a leader in the transition to a circular economy. While these company goals do not have a direct impact on my day-to-day work, they do provide an answer as to why I start up my laptop each day.

Additionally, Philips is a vibrant company. For instance: it organizes many events for young professionals. Among other smaller events, I have participated in the Race of the Classics for Young Professionals, a tall ship race with twenty companies, like the student-organized Race of the Classics. I also organized a trip to CERN in Geneva myself. There is a lot to do aside your regular job.



Starting my career

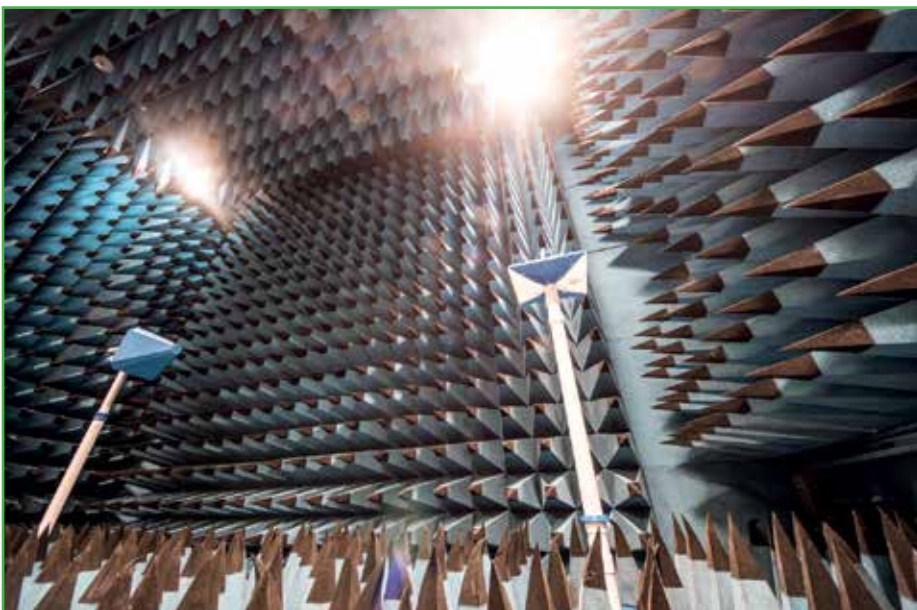
Starting out, I quickly got involved as a domain expert in research projects about measuring vital signs using RF and applying RF for smart readout of catheter sensors. Besides this, I started gathering RF equipment: Vector Network Analysers, Spectrum Analysers, and to top it up an anechoic chamber with antenna measurement facility. After a few years, I pivoted from a research focus to a development focus. I developed antennas for a body-worn patient monitor and for various personal health products. I was getting the hang of it, and I started supervising TU/e students myself.

Growing into new roles

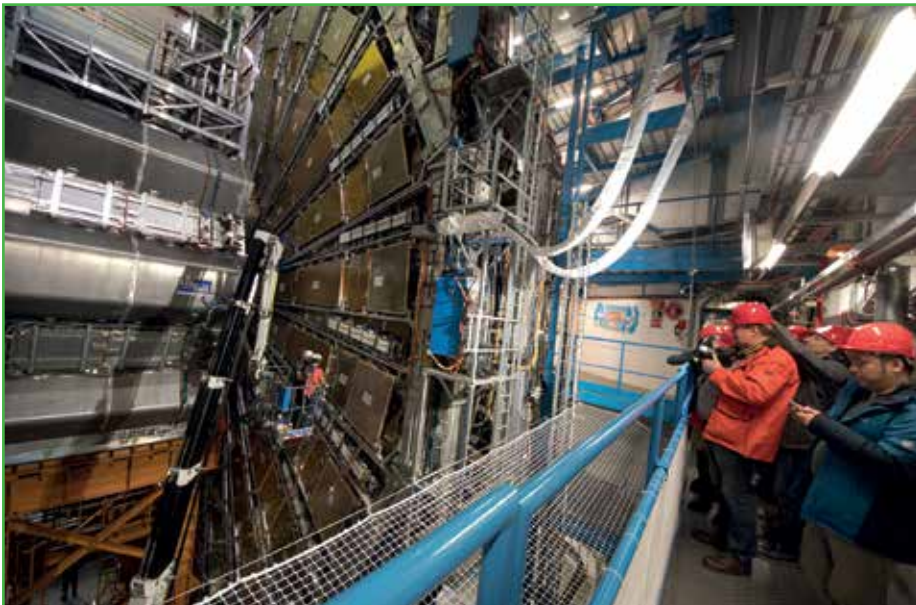
A great thing about working in industry is that the environment keeps on changing, which gives you the opportunity to grow in new areas. The EMC expertise was transferred to my group, after which I took on the additional role of competence leader for RF and EMC. As competence leader, I identify the areas in which we need to grow and define internal projects and student assignments to accommodate that growth. Since then, we have expanded the RF and EMC team from two to six, and together we are supporting Philips sites across the world.

Outlook on the future

I really enjoy engineering, and I like to deal with a wide variety of topics. Therefore, I am currently working towards becoming an electronics architect. The electronics architect's scope is



Our anechoic chamber with antenna measurement setup.



A company trip to CERN that I organized.

an entire product or subsystem. One of the main challenges is to balance performance, cost, size, risk et cetera, in order to optimally fulfill a customer's requirements.

Growing into a new role is not done in a day. I do this by taking part in projects where there is the opportunity to do more than just designing. It is up to me to show the team that I can do more than designing antennas or electronics. Philips also offers a wide variety of courses, of which I am following the widely used Design for Six Sigma methodology.

Were my studies of any use?

I would say Electrical Engineering prepared me well for my job. It helps to specialize into one area (RF in my case). But to be able to look beyond the boundaries of my own work it also helped that I followed a wide variety of courses. Also some that weren't a lot of fun...

As an RF designer I do not work with Maxwell's equations regularly, but it certainly does help to have a firm grasp of them. This is especially true when you need to make a trade-off between cost, size and performance. For instance, do I advise the customer to add a second

(diversity) antenna to their product, or will the user also be satisfied without? To answer this, I need to quantify the added range by back-of-the-envelope calculations, and sometimes it asks for more complex propagation models.

Some personal advice

In short: always keep on learning! I would advise every student to try to find a place that provides a good and safe learning environment: somewhere where you can fail, as long as you learn from your failure. Then it is up to you to get out of your comfort zone and take up challenges, pushing the limits of your capabilities.

A job is more than its description. There will not (or at least should not) be a laid-out plan for what your days will look like. You have the largest influence in making your job ideal for you. Your studies have provided the tools to work with, but it is entirely up to you how you choose to apply them. You will have to raise your hand when you think you can contribute to solving a challenge your team is facing.

Lastly, who do you think keeps going to the gym: the person who thinks it is important, or the person who thinks it's fun? What about the person who does their job because it is important, or the one who thinks it's fun? If you enjoy your work, you will feel energized by it, be better at it, and you will develop yourself and the company. The ideal job, in my mind, is where fun and important work are mostly the same. And if you find after a while that a job doesn't work for you? You can always switch – no penalties involved. ■



Philips team changing course during the Race of the Classics for Young professionals.

Ethics in Technology Education

By: Jan Vleeshouwers

My previous article on Technology, about the thoughts of various European philosophers on technology and ethics, ended in a rather pessimistic tone regarding the possibility to educate morally responsible engineers. But it needs a follow-up, since current prospects are actually quite good. The point is that ethics education is much more a matter of practice than of knowing.

On the knowing side, people ask if we can develop an ethical framework to address the large problems of mankind: hunger, poverty, war, climate, pollution. This quest is overwhelming, and inevitably raises doubts if it will ever be possible to teach our young generations how to find a proper way to act in these issues. Even if you accept that no way will be perfect, if you approach teaching from this direction, pessimism is not a surprising result.

But that is the knowing side. The practice side is different. Our students are talented young people, eager to become technically proficient, but also aware of the world they live in. Our engineering education attaches to both: we teach technical knowledge and experience, and we also teach how technology interacts with humans, how engineering fits into an industrial society. You do not have to solve the world's problems, but you can contribute. Taking this practical, pragmatic perspective, our students' interests and attitudes provide ample room to address the question of developing 'good' technology.

How could we implement this in our curriculum, and in what phase? Oded Raz, researcher in the ECO group and chair of the Program Committee, says that in his experience, Electrical Engineering and Automotive Technology students are mainly focused on the technical topics when they enter university. Before anything else, their motive to choose a technical study is a fascination for



Johanna Höffkens



Oded Raz

technology. For that reason, addressing the context of technology in the bachelor is often somewhat cumbersome. But students are certainly interested in a wider, societal scope. In one bachelor course, Oded has taken up the role of a critical bystander who interrupts the teacher with questions. These regularly lead to a vivid exchange of views among the audience. And in the master phase, the topic resounds even more. In this phase, discussions on how to do research and how to balance interests of diverse parts of society find a responsive audience.

Discussion is a start, but in Johanna Höffkens' USE courses 'Responsible Innovation for the World' students actually create technology with the intention to make the world better. Johanna is researcher in the IE&IS department in the area of Responsible Innovation. She says that in designing this USE course she could use, build upon and weave together different trends and opportunities. One is her drive to work on a better world, which in a way is what Responsible Innovation stands for. Second is the Innovation Space concept,

which provides the environment to work on and realize concrete technology. Third is the Challenge-based Learning approach, which allows students to work on a real-life challenges. In her course, which lasts for three consecutive quarters, multidisciplinary student teams are supervised by public, private and non-profit partners. And fourth is a group of students who are motivated to go along with the ride.

Two of the students who are taking the course currently, Andrei Letinu and Erik Leonardo Visser, indicate that they are excited about working on a project with students from several disciplines, and with a company which is in search of an innovative product. But what made them decide to enter this course, was the aspect of responsibility and the idea of doing good, making good things. Previous projects had a concrete goal, which was good for a start, but in this project you also need to consider context, and they feel that this is a most relevant extension. Engineers must be fully aware of the fact that technology affects people, both good and bad. Technology is a double-edged sword.

[1] Connecthor 52, December 2020: see <https://thor.edu/storage/media/connecthors/52/file/1145/Connecthor-52-Vweb.pdf>

[2] See <https://www.cursor.tue.nl/en/opinion/oded-raz/a-useful-lesson/>

[3] See <https://studiegids.tue.nl/opleidingen/bachelor-college/use-leerlijnen/responsible-innovation-for-the-world/>.

[4] It brought her the Dutch 'Teacher of the Year' award. See <https://www.tue.nl/en/news/news-overview/23-06-2020-johanna-hoeffken-elected-dutch-teacher-of-the-year/>.



Erik Visser



Andrei Letinu

Erik and Andrei are unable to confirm Oded Raz's observation that students need time to widen their view; they both describe their own interest as much broader than just technical.

Johanna is convinced that students feel certainly involved in global developments: "Students both worry but are also excited about the future. They want and

are able to think about the impact they might make and want to learn how to contribute to responsible changes."

Education is at its best if it responds to this basis, connects it to societal and global challenges and opportunities we are facing, provides our students with the giant's shoulders to stand on, and dares them to be explicit in considerations and assumptions underlying their technological design. Of course, ethical questions are part of this, but embedded, not central. Approaching ethics education from the practical side is evidently promising, given the experiences described above. We shall not educate our engineers to be ethics experts. But we will educate new generations of engineers to be sensitive, active and equipped to critically address these problems. We'll confidently trust them to treat our world with care. ■

First year experiences

By: Various authors

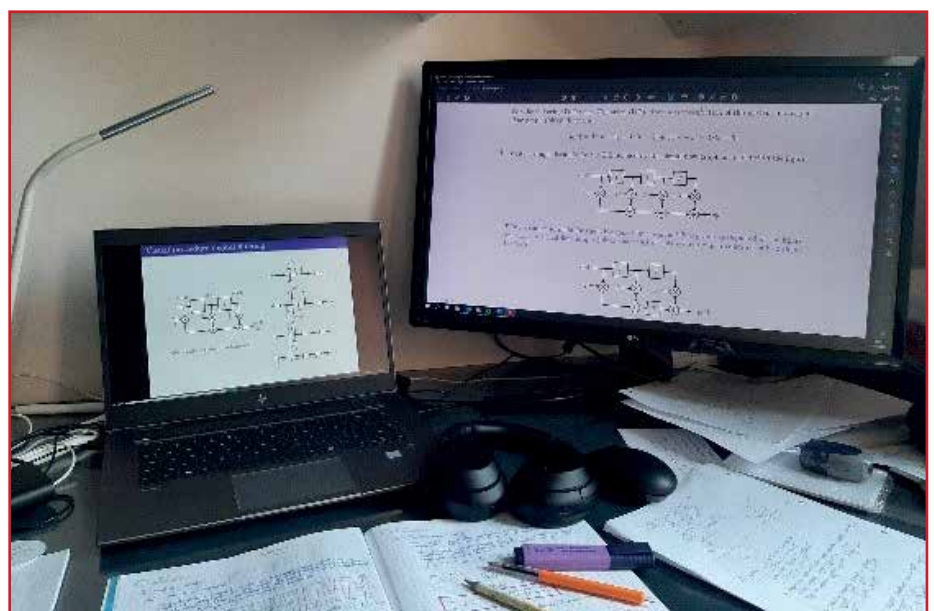
Once upon a time, there was a place called campus. They say it was a place full of life and joy where students could learn and enjoy life. There were sports and activities for every student, and not one day it was empty and quiet. Students were sitting with 200 of them in one big lecture hall almost every day. For group projects, they would go to this campus and work on it together. How weird is that!? And if students would eat or sleep during the lectures, the professor would notice and treat them with a snarky comment. I myself, have done both, but my professors never noticed me. On this so-called campus, there is even a place to get something to drink and socialize after class. I think they called it 'Walhalla' and that definitely sounds better than getting something from the fridge after the online class.

Weird to think that a year ago this was just normal. I would lie if I said that I didn't look forward to study in Eindhoven and enjoy student life. Because that is the only thing I could think about the last two years, I was tired of high school and ready for something new. When the COVID-19 situation began in March 2020, no one could have imagined that it would affect everything so drastically.

I hoped that maybe it would be over by September, but I was wrong. No lectures on campus for the first quartile. No new people to get to know during class, because there is no class. But I didn't give up, because the second quartile would be mine! I would have at least one lecture on campus every week and finally have some opportunities to make friends. But we got disappointed all over again. Another quartile without getting

to know new people. There is one thing that helped me though, I tried to go to campus every week and got to know my intro-parents better. That is my advice to other students: you are not alone in this situation, so don't give up on making friends, give it another chance.

- Anouk Nees ■



ASSOCIATION

It's 2021, almost a year into the pandemic and most people have somewhat gotten used to the current situation: we always carry a mask, stay 1.5 meters apart from each other and make sure we stock up on alcohol before 8 pm. However, the new standard of (mostly) online education is a continuous struggle, even for us first-years, who haven't experienced on-campus education in the first place.

Having finished high school in the pre-covid era, the fact that I'm being thrown in the deep end with online education has definitely been a challenge for me. With almost all lectures being (pre)-recorded, I was in charge of most of my schedule. I've never been a good planner, so efficiently using my days definitely wasn't and still isn't happening often. I'm learning, but slowly.

Then there's the problem of finding motivation and concentration when you're studying from home. As for many students, my places to sleep, relax and work are roughly the same, so the valid tip of separating study from home life is impossible to accomplish. An upside however: I can make tea without moving away from my desk, so I'm always



The most important thing at my desk, my kettle.

hydrated. Other than that though, I find myself easily distracted, and falling back into a comfy chair for a YouTube video is always very tempting.

A good solution for this can be to study with other people, which I try to do regularly. We have a first-years Discord and through there I also formed a smaller study group. Only talking through Discord though, I had no idea what those people looked like, so meeting on campus with them for the first time was

almost like going on a blind (study) date. In some regards, that was a funny situation, but then again, in normal times, I would've gotten to know them in person, and we would've been able to top off a long day of work in Het Walhalla.

Now, there's finally a speck of light on the horizon and I hope I can toast to a strange start of university with my fellow students soon.

- Eva Schreiber ■



My desk, at which I spend most of my time

My name is Jilles Tils, I'm 19 years old and I'm a first-year student. I am going to talk about my experience of studying as a first-year (also known as a 'sjaars' apparently). To start off, I enjoy that I can choose my own

schedule. As I can always turn the lecture on and off as I please, I basically have full control of when I start and when I end my studies. However, I am envious of people who got to experience their first year as a student in non-lockdown times, as I do

miss live lectures and sitting in a classroom with fellow students. And of course, missing out on all the partying around studying does make me extra jealous of previous first-years.

Although not going out to party does have its perks: I can for instance focus more on studying. I do have a lot of free time on my hands, and with this free time I can easily spend a lot of time with new friends that I made along the way. I usually spend my days working on assignments and playing video games with these friends. This of course results in spending a lot of time at my desk which can be seen on the included picture. Because I spend a lot of time with these people, I really got to know who they are without seeing them in real life. I am really looking forward to seeing them when the lockdown is over, and I am excited to have lectures from a professor who is not on my computer screen but who is actually standing in front of me!

- Jilles Tils ■

Studying during the COVID-19 pandemic has been one of the more strange and hectic times I have experienced. Although I have to stay home, there is so much going on.

I have had the experience to follow lectures both online and offline, since I stopped my study prematurely in February 2020. Having online lectures has been a tough challenge for me, since there are a lot of distractions at home.

However, there are a few advantages to studying at home. First of all, I can stay in my bed for an hour longer, because I don't have to travel to the university. I can also grab a bite to eat or something to drink anytime I want, and if something else comes up during a lecture, I can switch to that while keeping my

headphones on so I can still listen to the lecture that is given. This last part is both an advantage as well as a disadvantage, because I can easily get distracted while thinking "It's not a big deal, I can still hear what's going on in the lecture".

The biggest disadvantage of studying at home is definitely being in the same room every day, for the entire day. It gets a bit boring if you have to look at a screen for five days a week, and with my job involving computers, that makes it six days a week. This also means I try to make the most of my Sundays, trying to avoid electronic screens as much as possible.

All in all, I prefer having lectures at the university. Being in a lecture room has a different feeling than sitting in my own room, a feeling that promotes studying way more than my room does.

Speaking of my room, this is a picture of my desk. Normally it's a bit of a mess, with water bottles, paper, pens and books lying around. During the holidays, I've cleaned it, although I don't think it will last very long.

- Kevin van Dinter ■



My, for now, clean desk

We have a first-years Discord and through there I also formed a smaller study group. Only talking through Discord though, I had no idea what those people looked like, so meeting on campus with them for the first time was almost like going on a blind (study) date.

That is my advice to other students: you are not alone in this situation, so don't give up on making friends, give it another chance.

Puzzle

Answer to puzzle of last edition:

There were quite a few different answers, however not all as efficient or exact. The approach we were looking for (and which most of you got) went like this:

First, you turn both the hourglasses around. As soon as the 7-minute hourglass runs out, you turn it again. When the 11-minute hourglass runs out, you turn the 7-minute hourglass while it was still going. So, when the 7-minute

hourglass runs out again, 4 minutes have passed since turning it the last time, meaning you got to 15 minutes.

The winner of this puzzle is Maarten van Rossum! However due to the corona measures, you will receive your pie later.

New puzzle:

Time to get your math skills up to speed again! Here you see a 7x7-Kenken puzzle. The idea is that you fill all the boxes, but there are some rules:

- On each row and in each column the numbers 1 to 7 can only appear once.
- Within each cage, the number in the corner has to be made using the operator next to it.
- Within a cage, the same number can appear more than once (but only as long as it is not in the same row or column of course).

12+		3÷		56×		
	3-		4	10×	42×	
15+	13+	48×				
		7		10+		
	1-		11+	13+	6	6-
2÷	3-					
		5-		2-		6

Who are you?

By: Tom van Nunen

When working from home, it's important to keep the blood flowing and remind those muscles what their purpose is. Since I am not allowed to use the stairs in Flux anymore on a daily basis (which, as you can imagine, makes me really sad), I started making daily strolls and bike rides in the neighborhood. During one of those walks, I encountered the most intriguing thing.

As most of you will know, the Dutch government announced a total fireworks ban for the recent New Year's eve. Most citizens understand the need for this measure, but others are less happy. At least one person decided to display his disapproval by distributing stickers all around the neighborhood. The design was simple: a white circle with a red border, with text that translates loosely to 'ANTI FIREWORKS BAN!' To top it off, the letter 'I' of 'ANTI' had a little fuse above it, which made it look like an actual piece of firework. Simply brilliant.

My literature-loving side was immediately sparked by these three simple words, followed by an exclamation mark. Anti fireworks ban! First of all, I adore the fuse on the letter I. This kind of attention to detail always gets me. What I find interesting, though, is the double negative. Anti fireworks ban. If you would ask me to come up with a catchy phrase, the main purpose of which is to make a strong point in favor of a certain activity, something that convinces passers-by in the blink of an eye, I don't think the double negative will be the first thing that comes to mind. On the contrary, it makes the whole sticker rather confusing. I even have anecdotal evidence to support this statement: I showed the sticker to my brother, and it notably confused him. (Better luck next time?)

These kinds of thoughts run freely through my head during those regular strolls, and I love them. Diverting your thoughts from your everyday work can be so refreshing, and you can do it any time of the day you want, completely for free.



It didn't take long before the brain twists about these stickers brought back memories of another literary guerilla masterpiece I encountered a while back.

We were in a car on the highway exiting Eindhoven. After only a few minutes, there was a huge sign on the side of the road, and on it the text 'Eindhoven, what are we?' was graffitied. Whoa!

I don't know about you, but this immediately triggered deep and heavy philosophical thoughts in me. What are we? Not many questions cover our existence better than this one. Are we merely passengers on an endless car ride that eventually leads us into our grave? When we cross paths with someone else, do we need to worry about crashing our cars

of existence into one another? Can we change our car throughout our lives, or are we bound to it like destiny? Can we make additions to it or polish it? Do our children start in the back seat until they are old and wise enough to start driving their own car of life? I wonder whether or not the graffiti artist had the same thoughts when he decorated the sign with these words.

The only thing that I didn't like about the stickers, was the fact that someone put them on literally every outer door of our apartment building, and on all lamp posts around it. As I removed them, I just couldn't throw them away. That's why I hung them in our Christmas tree, for our limited amount of guests to enjoy as much as I did. ■

