

GLOW 2016 SCIENCETOUR TOUR ON THE CAMPUS WITH VARIOUS ELECTRICAL ENGINEERING PROJECTS

Internship **Chicago** | Summer schools | Thomas **Edison** | Transformation of **Potentiaal** to La Luna | **Column**

EDITORIAL

Connecthor

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ost of you are probably getting ready for a festive holiday season and are making yourselves ready for at least a week leave from the office. Hopefully this gives you some well-deserved time with family and friends, and some me-time. Time to sit down and relax. To look back at a year full of accomplishments and successes in your business and/or in your personal life. And as life is not always kind to us, we also look back at things that didn't go well or think of people that have left us much too soon.

In this December issue, you will find a touching story in memory of Ralph Otten, written by Twan Basten, Wim van Bokhoven and Jochen Jess. We would like to express our deepest sympathy and compassion to the family, friends, and ex-colleagues of Ralph, and we wish them strength in coping with the loss of their loved one.

Apart from this tragedy, this December edition brings you a wide range of student activities, such as internships abroad (Leuven and Chicago), summer schools in China, excursions to AME and ASML, a STORM behind the scenes story, a lunch lecture, and more.

We are also proud of the achievements of the people in our department and their work. We have a PDEng research article by Monica Llorens Revull, about a stabilized mode-locked laser. Libertario Demi wrote about his research on dynamic contrast-specific ultrasound tomography.

Two of many new staff members introduce themselves, Teun van de Biggelaar and Amritam Das.

Finally, the Connecthor editorial board has positions open for creative and enthusiastic (scientific) employees of the Department of Electrical Engineering who are interested in joining us to make the Connecthor magazine. Up for a new challenge? Please contact us! If you have ideas for upcoming editions, please contact us via connecthor@tue.nl.

We hope you enjoy reading this new edition. We wish you a prosperous and - most of all - a happy and healthy New Year!

The Connecthor editorial board



Team STORM back in Eindhoven In 80 days around the world. Read the story of team STORM on page 24!



From Potentiaal to La Luna Remember these stairs? Read about the transformation of Potentiaal on page 12.



Thor freshmen weekend The organization of the freshmen weekend tells about their experiences on page 14.



Internship abroad

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IDEPARTMENT

Managing academics: a balancing act

By: drs. Jolie van Wevelingen



Anaging academics is like herding cats.' This truism comes up sometimes when the faculty board is asked about its management and leadership philosophies, and it always annoys me. First of all, this truism is not true at all, and secondly, 'herding' strikes me as unnecessarily and needlessly derogatory.

Leading a university department has nothing to do with herding; it is primarily a balancing act, balancing all kinds of needs, each of which must be met simultaneously. It is all about striking a balance. Too little management and we would find ourselves in an Olbers' paradox organization: we would find obstacles in every direction we would want to be going. It'd be chaos. Part of a board's task is to get rid of clutter, shield out superfluous noise, provide some homeostasis for the organization and frankly, to give us some space. Too much management, on the other hand, and we would all end up in a waveguide. Sure, we would all be on the same wavelength - give or take a few harmonics - but we would also be moving, collectively, in the same direction and miss out every opportunity to explore the

roads less traveled, that is, the roads that are known to make all the difference once in a while, in science as well as in life. Read Frost's poem, The Road not Taken, and you'll know. Hence, a balancing act.

Let me give you an example. We would like to diversify our staff, in particular by increasing the number of female staff members. This is a somewhat sticky topic. Doing too little would have our department stay a male-dominated organization, as it has been for years, whereas doing too much would create all sorts of unwanted side effects, both for women and for the university. Recently TU/e has launched an initiative to strike a new balance on this issue. In order to increase the number of female staff, TU/e will further strengthen its WISE (Women in Science) network, e.g. through additional grants and tenure tracks. It is just one of the many incentives in this year's updated TU/e policy for scientific staff, 'Excellent people attract excellent people: the next generation'. The key point is that every high-potential scientist can further his/her career through 'development tracks'. If you would like to know more about these new

initiatives, just check out the 'Excellent people attract excellent people' policy file, that you will find on the TU/e website. This is stuff that you, as a Connecthor reader, will surely find relevant!

Switching from painting the big picture to noting something seemingly minor but important nevertheless, I would like to point out that there are not enough academic staff members participating in the Connecthor editorial board. If you are interested in joining the Connecthor ranks, please contact its editor in chief, Mrs. Pauline Hoen (P.E.R.Hoen@ tue.nl). Your help would be very much appreciated!

Jolie van Wevelingen Managing director

Photo: Bart van Overbeeke

From the President



Vou all probably know me by now. I am Lester, the new President of Thor. But it was not easy to come this far. There was a lot of preparation to this. Me and my fellow board members had to go through months of challenges to test if we were up to the task of becoming the new Board. There were definitely difficult moments, but there were also a lot of great and fun moments with the wonderful group I can now call my Board. The group consist of five young men, me included, and one young woman.

After these months we were finally ready for the task: becoming the Board of Thor. The annual General Members Meeting took place from October 10 to October 12. This was the last time that we had to present our policy to our members. When I was in front of the previous President of Thor I was completely on my own. He discharged himself as President of Thor and installed me as the new President of Thor. Then the spectacle began: many former Board members dove to the table and tried to grab everything. My fellow board members tried to secure as much as they could, but almost everything was gone. The only things I could secure were my medal,

the Mjölnir hammer and my one-liter tankard. After a lot of fuss everyone was seated (whether it was in a seat of a Board member or a seat in the GMM I will leave up to you). Some members helped me get a bit of control and my fellow Board members were helping me as much as they could. After a negotiation I got the five other medals back that I needed to install my fellow Board members. At this point I was not on my own anymore, my fellow Board members could help me. After I got everything back from our members I had to lead the GMM for the first time. It was a great feeling to sit there with the six of us. When everybody was sitting there in a row, I felt strong, like I could conquer the world. Leading the GMM was guite difficult at the beginning. We were with six people and I had to lead the remainder of the meeting, where a lot of people were present, but we made it through. We were the Board of Thor! All the other points that needed to go through the GMM after the installing of us as a Board were completed.

The evening was not over, we had to clean up everything and that was a lot. It was around 5 AM when we finished and at that

ASSOCIATIONI



time we were invited to have a drink with the barkeeper. At this time we were finally alone with the Board and the barkeeper. We talked and talked about the evening and everything around it, but the thing that was said the most was: "Guys, we are the new BOARD!".

At the time of the GMM, we were already running Thor for four weeks. These weeks were busy and tough, but do not get me wrong, it is great. It consist of a lot of serious things to handle during the day, preparing meetings, talking to the Department. I feel very proud to be the new President and Board of Thor. My Board is very motivated and therefore I am even more motivated. It will be a great year where we will learn a lot of new things, gain experience and – the most important thing – have fun.

"Veel gedonder!"

Lester Manders President of Thor

In Memoriam Em. prof. dr. ir. Ralph Otten



A life full of passion

On Friday 30 September 2016, former Director of Education of the Department of Electrical Engineering and former Chair of the Electronic Systems group Ralph Otten died in a tragic accident during a holiday in Georgia, the Caucasus.

Ralph graduated in 1971 from the ECB Research group at the Department of Electrical Engineering of the former Technische Hogeschool Eindhoven. After completing his study he was appointed scientific researcher in the newly formed research group Design Automation, chaired by Jochen Jess. This was the forerunner of the current Electronic Systems group. Ralph combined his PhD research with teaching in the Electrical Engineering curriculum and, in the early years, he studied medicine in Nijmegen. He obtained his doctoral degree in 1976 on the subject of iteration-free design.

In 1981 he was seconded to IBM Research in Yorktown Heights. He was responsible for the Yorktown Silicon Compiler (YSC), at that point in time the most advanced tool flow for designing digital circuits. During his time at IBM he remained in the employment of the TU and every year he returned to lecture for one trimester. Later, during a sabbatical year in 1996, he also

became a visiting professor at both Berkeley and Stanford universities. The years spent in the United States became very significant in Ralph's life. He made many scientific and industrial contacts, but in particular many close personal friendships originate from this period in his life.

In 1986, by royal appointment, Ralph became professor in Electrical Engineering at the TU in Delft. In Delft Ralph supervised many PhD students. There too, several close friendships were formed. In 2000 Ralph returned to the TU Eindhoven as Chair of the Electronic Systems group. He was instrumental in forming the group and laid the foundation for the group as it exists today. As Director of Education he had a significant influence on the current Electrical Engineering Bachelor and Master programs. He was very active in education and until his retirement in 2014 he was involved in teaching no fewer than nine courses.

In both the academic world and industry, his work has had an enormous impact on the automation of the design of electronic circuits. Ralph was the founder of slicing floorplan design, currently a standard step in all commercial design trajectories for digital circuits. Slicing floorplan design made crucial optimizations in circuit design feasible. His scientific contributions are diverse, ranging from algorithms for logic synthesis to a new representation of planar graphs and a theoretical analysis of the simulated annealing algorithm. Earlier this year Ralph received the ISPD Lifetime Achievement Award for "outstanding contributions made to the field of physical design automation".

Ralph's interests reached further than just Electrical Engineering. He had a broad interest in history, art, culture and religion. He was a passionate collector of books, music, and more. Verdi held a special place in his heart. He was also very keen on model building. In his garden, Castle Rommelstein is a veritable fairy tale with precisely replicated landscapes and fantasies. He loved the 'Burgundian' life, enjoyed good food and loved to cook. His collection of single malt whiskies is impressive. And he could talk for hours about football. Italy was his favorite country.

Despite his busy workload and many hobbies, Ralph always had time and attention for the people around him. Birthdays, Christmas and Sinterklaas were always extensively celebrated, often with a creative and educative accent. He was especially important to his godchildren and their parents whom he supervised as PhD students in Delft. His guidance and preparation for the first communion of his two youngest godchildren was very special.

Everything Ralph did, he did with passion. This applied to his hobbies, his research, his teaching and his friendships. Everything has been shared with love and pleasure with his wife Carla, whom he married in 1978. He did everything his own way. Always just a bit different than everyone else. He was creative and had strong visions. In Ralph we lose a great inspirational spirit. We wish Carla, his godchildren and their parents, family and friends much strength to overcome this great loss.

On behalf of the Electronic Systems group and the Department of Electrical Engineering,

Prof. dr. ir. Twan Basten, Chair Electronic Systems group Em. prof. dr. ir. Wim van Bokhoven, former Dean Dept. Electrical Engineering Em. prof. dr. ing. Jochen Jess, former Chair Electronic Systems group





ERC Starting Grant awarded to **Roland Tóth**

Roland Tóth, assistant professor in the Control Systems Group, has been awarded a Starting Grant of the European Research Council, for developing an advanced framework of automated modeling and control synthesis of nonlinear (linear parameter-varying) physical systems. The intended research is aimed at developing the required tools for off-shelf implementation of so-called LPV control in an industrial context, in particular in the domain of high-tech systems.

Every year, only a few young scientists receive this prestigious grant of 1.5 million EUR from the European Research Council.



Arrival STORM

On 2nd November STORM arrived in Eindhoven after a 80 days trip around the world on their selfmade electric motorcycle. They successfully showed the world that the future of mobility is electric by proving that it is already possible to drive 23 thousand kilometers on a motorcycle without local emissions. On pages 24 and 25 you can read more about their trip around the world.

Goodbye Manon

For several years, Manon Eijsvogel has been a valued team member of Connecthor editorial board. As Manon graduated and accepted a position as Technical Trainee at Alliander, she decided to step down from the editorial board after the June edition. We would like to thank Manon for he contributions to Connecthor and wish he a lot of success for her future career.



IEEExtreme , Sleep == false

Does 24 hours of programming sound like a good idea to you? At the annual global IEEEXtreme competition, this year taking place on 22 October, this is the challenge, and the IEEE Student Branch participated. From 2.00 in the night onwards, the teams tackled the problems. After 20 hours and a huge amount of snacks and coffee, the need for sleep started to kick in, and some of the teams packed their stuff to go home Some diehard contestants made the full 24 hours and got close to the top 100 of the world! The competition was a great success, thanks to the contestants and especially the proctors.

Elsevier: TU/e has best Electrical Engineering program of Netherlands

TU/e is the best university of technology in the Netherlands. That is the outcome of the annual 'Best Studies' survey by the publishing house Elsevier. The Eindhoven students (54.5%) are second to Wageningen University students (63.2%) as being most satisfied with their university. The students rated the Electrical Engineering program at TU/e as number 1. The University of Twente and the Delft University of Technology ranked number 2 and 3, respectively.

NEWS



Best Paper Award for Sofie Haesaert

Sofie Haesaert (PhD at the CS group) has received the Best Paper Award during the 13th International Conference on Oualitative Evaluation of Systems (OEST 2016), that was held in August in Quebec, Canada, for her paper "Verification of General Markov Decision Processes by Approximate Similarity Relations and Policy Refinement", co-authored by Alessandro Abate (Oxford) and Paul van den Hof (CS).

Sofie is in the final year of her PhD track. In her research she is building a bridge between advanced control theory and computer science.



Goodbye Hans Hegt

On Friday 24 June, dr.ir. Hans Hegt, Associate Professor of the Mixed-signal Microelectronics (MsM) research group, said goodbye to the TU/e by means of a well-attended reception at Grand Café De Zwarte Doos. After a period of 33 years of service, Hans will be enjoying his (early) retirement.

DEPARTMENT

Introducing...

i everyone. Please allow me to introduce myself: my name is Teun van den Biggelaar, I'm 25 years old and I was born and raised in a small village called Erp. In my free time I like to play (indoor) soccer, I sometimes take my racing bike for a ride and I love to do scuba diving. Next to sports, social activities are an important part of my life. Therefore, for example, I can (occasionally) be found in Het Walhalla as well.

As some of you already know, I started my In July 2016 I graduated, and I was searching study Electrical Engineering in 2009 at the TU/e. Next to studying, I've always been an



active member at our study association Thor. To only name a few activities: I've been board member of Thor in the year 2011-2012, I've organized an interesting and awesome study trip to Brazil in the summer of 2014, and during the move to Flux I was responsible for the new bar of Het Walhalla and the change from Bavaria to Jupiler. And next to that, you might also know me for being a bartender in Het Walhalla for 4.5 years.

for a new challenge. Eventually, I got offered a PhD position in an awesome project at the EM research group. In the coming four years, I will be exploring possibilities for efficient and low-cost antennas, which will hopefully help in enabling 5G communication systems. Although only a very small fraction of my time as a PhD Candidate has passed at this moment, I already came across exciting challenges and impressive technological highlights. I can only say that I'm looking forward to what's to come!



y name is Amritam Das and I was born in Kolkata, one of the largest city of India. It is generally called the city of joy for its vibrant life, cheerful people and mouth-watering cuisine. After schooling, I decided to study engineering and did my bachelor in Mechatronics Engineering in India. I finished my bachelor degree as a gold medalist and wanted to pursue a higher study abroad. Eindhoven University

of Technology is a renowned university in the field of mechatronics and was one of my dream destinations. I was awarded with an ALSP merit scholarship and decided to join the MSc program in Systems and Control. I have recently graduated and joined as a PhD scholar in the CS research group of the Electrical Engineering Department. My PhD research focuses on modeling and control of thermal systems in professional printers.

Mathematical descriptions of thermal or fluidic systems are generally formulated as an infinite-dimensional partial differential equation based system. Estimating such a largescale system and building control algorithms for it is a very challenging task from an implementational point of view. In my research I aim to develop a generic framework where such tasks become possible for real-time implementation, and improve overall printing performance.

In my leisure time, I love reading and playing guitar. Roots rock music is one of my favorite genres and I love playing to Dire Straits and The Eagles. Food is an inseparable part of Indian culture, which makes me an official 'foodie'. I love the combination of different spices in Indian food and enjoy cooking dinner with friends. After coming to Europe, traveling became an added bonus in my hobby. I like the idea of solo traveling and enjoying quality time by yourself. The last solo trip to Rome and Florence was a unique experience to discover a whole new perspective about the place and myself.

I am looking forward to spend the next four years of my life at this university. I am very excited to make new friends here and share experiences. After all, life is a journey with problems to solve, lessons to learn and most of all, experiences to enjoy.

Whose desk is this?

y name is John Snoeijs and I have been married to Esther for three years. Together we have two children (boys) aged 20 and 17. The eldest recently moved out and by coincidence his partner is also called Esther. My hobbies are tennis, music and I like to cook – particularly in the Burgundian style.

I joined the department of Electrical Engineering in 1988 with a short break from 1 April 2013 to 1 January 2016 when I was employed centrally (Dienst Interne Zaken) and worked at the Facility Services office of the Electrical Engineering (EE) and Applied Physics (AP) departments. I am happy to be back in service at EE and AP as it gives me the opportunity to get closer to my colleagues at both departments.

Over the years I have got to know almost all of the employees and most of the students at the EE department, and I am now well on the way to doing the same with AP. I really believe that these two departments fit well together and complement each other.

Before I started working in the Flux building, my colleague Berty Vonken and I were responsible for clearing out the old Electrical Engineering buildings for the move to Flux. This was an enormous task because the building was 50 years old and a lot of things had been collected over the years. We are not only talking about furniture and paperwork, but also components such as capacitors and transformers from the Impuls and Corona buildings. All this had to be done following the legal regulations for disposing of equipment. A careful selection was made and a strict deadline was set in place as the EE buildings had to be handed over empty and clean by 1 April 2015. On the last evening I worked on until 23.00 and then finally everything was cleared. It was an enormous challenge but I wouldn't want to have missed it for the world!

After this gigantic operation, I worked at the Mechanical Engineering department for six months at Facility Services. This was a hectic period but very enjoyable. I met many new John people





DEPARTMENT

Since 1 January 2016 I have been employed by the department of Electrical Engineering and started my role as Health and Safety Advisor (arboconsulent). On 1 April I started a training to become a safety expert and this involves writing a graduation thesis. The subject I have chosen is Cryogene liquids, and in particular the filling point in the Cascade building. I am currently interviewing the users and management involved.

The Health and Safety team consists of Tom Eijkemans, Eric van de Sande and myself. We are situated in Flux 0.154 together with our colleagues from Facility Services and ICT. As you may know my colleagues from Health and Safety are now making a Risk and Evaluation Inventory for EE and AP. My task at the moment is to support my colleagues, which involves setting up workplaces according to the health and safety rules, other assistance where needed and, of course, my study.

DECEMBER 2016 09

TECHNOLOGY

A Stabilized Mode-Locked Laser

By: Mònica Llorens Revull

irst of all, let me introduce myself. am Mònica Llorens, another member of the PDEng family that Nick Ilieskou mentioned in one of the articles in the June edition of Connecthor. I joined this family two years ago and the family is still growing with the arrival of new PDEngs. These two years were full of new experiences and good moments together. But of course, it was also full of responsibilities, such as finishing the project on time.

I was a PDEng trainee in the Photonic Integration (PhI) group, in the Electrical Engineering department at the Technical University of Eindhoven. One of the tasks of my project was to stabilize an optical frequency comb generated by a monolithic mode-locked semiconductor laser. The laser was designed and integrated in an indium phosphide (InP) photonic integrated circuit (PIC) chip. Thanks to this experience, I will start working for EFFECT Photonics BV located in Strijp S Eindhoven. It seems that I like to work with these devices and that I have built a certain connection to the city of Eindhoven. But let's talk about my project!

But let's talk about my project!

In recent years, intense research into how to generate ultra-fast optical pulses has been a topic of interest and explored many scientific and industrial applications. Medical,



metrology, spectroscopy as well as telecommunication applications, require a periodic pulse train with ultra-short pulse duration. Some of these applications make use of the high peak intensity of the pulse, while others prefer wide optical frequency combs (OFC). The optical spectrum of a periodic pulse train generated by a mode-locked laser (MLL) consists of an optical frequency comb with mode spacing between its optical lines equal to the repetition rate of the laser.

The techniques used in this work are the so-called passive and hybrid mode-locking techniques. These techniques use a saturable absorber section to create time slots on the signal generating periodic pulses with short pulse duration. The monolithic mode-locked semiconductor laser presented in this article was designed using a generic open-access active-passive technology platform. The InP PIC chip was fabricated in a multi-project wafer run using open-access passive-active photonic integration technology of OCLARO Technology UK.

This technology offers freedom in circuit design, i.e. one can choose the length of active and passive components of the circuit as well as the position where they are located depending on the requirements of each application. Moreover, these platforms are based on a collection of standard building blocks which allow one to design more complex circuits and integrate more devices on a single PIC chip. In terms of fabrication, another benefit of these platforms is that they allow the fabrication of several PIC chips in a multi-project wafer run, thus making largescale fabrication more feasible.

Although monolithic mode-locked semiconductor lasers seem to have a big market potential because of the large-scale manufacturing capability of InP PIC chips, it has been observed that these kinds of lasers offer low optical output power to the order of mere hundreds of µW. Moreover, these lasers still need to be frequency-stabilized. Experiments showed that an optical frequency comb generated by a mode-locked semiconductor laser can undergo variations in its spectrum due to amplitude and frequency noise.

The frequencies in the optical spectrum of the comb can vary. This can be described by two types of variation. The first is the instability of



the mode spacing of the comb. i.e. the mode spacing changes with time. The second is that the optical comb spectrum, as a whole, can suffer from frequency drift, i.e. the carrierenvelope offset (CEO) frequency of the optical frequency comb is drifting with respect to the intended position.

Since a number of scientific and industrial applications require stabilized frequency combs, interest into further research on the frequency stabilization of mode-locked semiconductor lasers has grown. An interesting and desirable result would be to find a method for frequency stabilizing an optical frequency comb generated by a monolithic modelocked semiconductor laser that is physically compact. We believe that by making use of the generic open-access active-passive technology for designing and fabricating InP PIC chips together with the method presented in this article, it is possible to achieve this goal.

The method presented in this article allows stabilization of the CEO frequency of an optical frequency comb down to a few MHz relative to a tunable single frequency laser. Our method allows the integration of all optical components required for the stabilized system on a single InP PIC chip and thus potentially offers the market faster and miniaturized devices at reduced cost. The main advantage is the independent control of the carrier-envelope offset frequency and the mode spacing of an OFC through the use of an electro-optic phase modulator intracavity while the laser is operating in a hybrid mode-locking regime.

The monolithic ring mode-locked semiconductor laser with 7.05 GHz repetition rate, shown in Figure 2, is working in the telecommunications wavelength range of C-band (1530-1565 nm) and was used to demonstrate the CEO frequency stabilization of an optical



. (FOPM)

frequency comb. The symmetrical laser cavity is 11.81 mm long, thus allowing a repetition rate of 7.05 GHz. The main components of the structure of a mode-locked laser are a gain section and a saturable absorber section.

In Figure 2 the semiconductor optical amplifier (SOA) sections are presented. Two of them are 455 um long, and the third, which is integrated in one of the MZI branches, is 750 µm long. A saturable absorber (SA) of 30 µm, six electrical isolation sections (ISO) of 30 µm and an electro-optic phase modulator (EOPM), which is integrated in the second branch of the intra-cavity filter, is 2200 µm. Two 2x2 multi-mode interference couplers (MMI) were used to couple the light in both directions of the ring.

As mentioned above, the two main components for a mode-locked semiconductor laser are a semiconductor optical amplifier and a saturable absorber. A balance between gain and absorption saturation makes it possible to correlate the phases of these modes and thus to generate a periodic pulse train at the laser output, the optical spectrum of which corresponds to an optical frequency comb. When the optical frequency comb is generated by the integration of a saturable absorber section inside the laser cavity, the technique is called passive mode-locking (PML).

To stabilize the mode spacing of an optical frequency comb, a stable electronic sinusoidal signal at a free-spectral range frequency of the laser cavity is applied to the saturable absorber. This technique is called hybrid mode-locking (HML). So for that, +21 dBm power of a stable electronic sinusoidal signal at 7.05 GHz was applied to the saturable absorber. To stabilize the CEO frequency of a monolithic mode-locked semiconductor laser, an electrical feedback control loop coming back to the laser has to be implemented that controls this offset. The principle of a basic frequency stabilization system consists of implementing an electric feedback loop and comparing the reference signal with a set value. Then, using electronics, the laser frequency is driven back to the locking point or to the so-called set value. In our case, a beat-tone is generated by mixing the output of a semiconductor ring-MLL and an external tunable continuous-wave (CW) single longitudinal mode laser.

The beat-tone together with a low-pass RF filter (SLP-1000+) and a gain detector (AD8302) were used to make a frequency-tovoltage conversion and thus to detect the free running direction of the optical comb. This technique can be interpreted as a variation of the side-of-fringe locking technique. Once the laser frequency is detected and converted to a voltage, an error signal is created and sent to a proportional-integral-derivative (PID) controller, a SRS model SIM960.



The corresponding amount of voltage generated at the output of the PID controller controls the electro-optic phase modulator. The EOPM is integrated inside the laser cavity which allows control of the carrier-envelope frequency of the optical comb. Figure 3 shows a simple schematic block diagram for stabilizing the CEO frequency of an optical frequency comb generated by a semiconductor ring-MLL. Optical components and optical paths are represented in red, electrical components and electrical paths in blue and the low-pass RF filter which was used as a frequency discriminator in green.

This method makes it possible to reduce the frequency drift of the CEO frequency of an optical frequency comb down to 50 MHz over 2 hours of measurement. A standard deviation of the output signal measured in the electrical domain was calculated to be 14.5 MHz when the CEO frequency was stabilized. It also demonstrated a reduction of the timing jitter of 30% when the laser is frequency stabilized.

The purpose of this work was to demonstrate that by using photonic integration generic technology it is possible to offer faster and miniaturized devices for frequency stabilization systems of monolithic mode-locked semiconductor lasers integrated in an InP PIC chip. For further information about my related work, take a look into the Final Design Project report called "Wavelength stabilized optical frequency comb laser". It will be published on TU/e library by October 2016. ■

IDEPARTMENT

The transformation of Potentiaal to La Luna



From old into the new

The transformation of the old Potentiaal into the new La Luna has been impressive. Before the new building was delivered in August 2016, we honor the achievements since 1963 when Potentiaal was delivered as a new building. Much valuable research has been carried out, leading or contributing to the invention of new technologies. Not forgetting the countless friendships formed, stimulating discussions over work, and the many students that have gone through Potentiaal to achieve greater things.

Since the relocation of the facilities there to Flux, the old landmark has been completely stripped and rebuilt over the course of thirteen months. Although only the external features such as the new shades and windows are visible, our recent excursion inside the building has unraveled the impressive metamorphosis. From the Connecthor editorial team; Lisa, Birgit, Mark, Jeroen, Chigo and Suzanne enjoyed the privilege of visiting the building whilst in the final phases of renovation.

1) The building company
2) The owner of the building



On a beautiful day in August we put helmets and safety shoes on and stepped into the adjourning Potentiaal building which was completely covered in scaffolding.

Our guides

Before been shown around, we were welcomed with coffee and briefed on safety procedures. The representatives of Dura Vermeer¹, Jordy Mintjes and Virgil Tas, and the representative of Camelot Europe², Inge Burgmans, together formed a team of enthusiastic guides who provided the opportunity to ask about the renovation work.

A big challenge

To demolish and refurbish such a huge building in a small period is always a big challenge due to the different factors at play. Firstly, the moment the work can start depends on several signatures, and this process can be late. As the delivery date is a deadline, the building time therefore is a fixed period. A second factor is the challenge in realizing the plans due to the weather



By: Suzanne Kuijlaars and Chigo Okonkwo. Pictures: Mark Legters and Chigo Okonkwo

> circumstances. A mild winter, as was the case. was not of much help because of the wind and rain, which in an open building is very unfavorable. When the wind is strong the cranes employed for the construction cannot be operated. Without the façade, the building covered and the roofing completed, the interior fixes cannot proceed. Purely due to its age, the roof on the old Potentiaal was bad and renovation of the roof in previous years was limited due to the building being occupied at the time. Before the new roof could be placed, a total of four weeks was spent to remove the old roof and reveal the skeletal structures. Constructing the new roof took another four weeks.

> After this process, the stairs leading to all fourteen floors were refurbished with new bannisters and carpets over a period of six weeks, and will be unrecognizable to those who marched down the stairs during the fire drills of the Potentiaal era.





Removing the litter was an enormous logistical operation. To facilitate this process it was decided to take the litter away through the back wall (north facing side). New materials were delivered through the front wall (south facing side). Several new materials were employed to bring the renovated building in line with state-of-the-art standards, employing novel building techniques such as the 441 prefabricated bathrooms and kitchens. These were literally lifted and placed into each apartment.

All of these activities occurred whilst guaranteeing a safe place to work for up to 150 men on site daily.

New technologies

New technologies are used in the refurbished building. The windows are sun-protected, the curtains are blinded, and there is a state-ofthe-art ventilation system. The plague of flies in the façade of Potentiaal was a problem that is now solved when the fronts of the building were knocked down. When renovating it is not compulsory to adhere to the building regulations stipulated for brand new buildings. However, the most recent regulations are applied to isolate against noise and insulate for low energy consumption. The connections of the heating and the electricity make part of the new floor, which creates a floor having a cross-section of 7 cm. The walls are highly isolated as well in order to make the apartments noise-proof. The waste pipes of the bathrooms lead through the meter cupboard which is also an advantage for the noise reduction.

Rooms can set individual temperature allowing better control. As the tenants occupying these rooms require state of the art wireless internet, the renovated building is connected to the TU/e network via optical fiber patch panels, with individual rooms connected to optical patch panels at the end of each floor. An amusing trivia by our guard revealed that a CCTV scans the pristine halls



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and the end corridors where the fire hoses are installed, targeting adventurous residents who may be tempted to tamper with the fire hoses.

When the building fully opens to students, visiting students and professors, it is expected that the highest energy label will be achieved.

Trivial facts and figures

There were 25 bags of concrete removed from each floor. 1 bag contains 1.000 kg.

The value of the project is 30 million euros. This is the construction and the land value. It is based on a leasehold of 50 years. The university can buy this all back after 50 years.

On 26 August 2016 441 apartments, of which nine are penthouses, were delivered, including the roof terrace which is available for all the inhabitants.



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IASSOCIATION

Thor Freshmen Weekend

By: Elwin Hameleers

ike every year Thor organizes a weekend for the freshmen to get to know each other. This weekend, called the ThEW (Thor Eerstejaars Weekend), typically is set in one of the first weekends of the new academic year and, as a Board member of Thor, this is one of the last activities you organize before you give the responsibility of the association to the next Board. The weekend is full of relaxing times around a campfire, joyful and musical times loving the taste of a few beers with your palls, and numerous other activities.

The goal of the ThEW for the first-year students is to get to know more students. During the Introduction week, most students only know their 'brothers' and 'sisters' (their fellow students with whom they were in an intro group), but during the ThEW they get to





know a lot more students of their year. It is not surprising that a lot of friendships are formed during this weekend. Next to that, these new members of Thor get to know the association a bit more. Next to the first year students, also a lot of older members drop by this weekend to show what Thor is all about and how much fun the association really is. For me, as one of the organizers of the event, it was mainly an exhausting weekend. I had to drive a lot from place A to B and had to make sure everything went according to the schedule. This, of course, failed from the very beginning, since some of the participants got lost on the way towards the camping place. Luckily I had my two fellow organizers, three Board members and three more awesome people to help making the weekend a success!

Opening of the Academic Year 2016

s is tradition, the new academic year was kicked off with one of the biggest TU/e parties of the year: the Opening of the Academic Year party. The TU/e went all-in, with famous artists like The Partysquad.

Like last year, Het Walhalla, in corporation with Van Der Waals, had the honor of organizing the complete distribution chain of beer and other drinks. To this goal we assembled about 120 volunteers in two shifts, 14 taps and 10.000 liters of beer. Traditionally, the TU/e gifted the first 1500 liters of beer to the students for free.

Of course this took a lot of preparation. Even though we could build on last years' experience, the planning of the event took about three months with a team of six people from Thor and Van Der Waals. We had to overcome problems like cooling of the beer (standard beer coolers don't quite match up to 1500 liters of beer in 27 minutes), getting the right people to the right place at the right time,

50L kegs of beer, which is the largest amount of beer Het Walhalla has ever sold in one evening.

We are proud that we managed to organize

120 volunteers in two shifts, 14 taps and 10.000 liters of beer

By: Stefan Molenschot

sales of tens of thousands of coins, electrical supplies for the equipment (for those interested: 15*230V/16A, just for the beer distribution) et cetera. The final score was 168 one of the biggest parties of the year (around 6000 attendees), with the cheapest beer of the year ($\in 0, 80$). I would like to thank everybody that helped make this possible, and I would like to invite you all to the party next year!

Internship abroad

After the summer holidays it was time to move to Belgium for my internship. At the University of Leuven I've been doing my internship for the past two months. Here I help on the development of measurement interfaces for different purposes. My main project includes sensor measurements on microbial electrolytic cells and in home sensors.

t the end of my first master year my internship period came closer. So, I had to choose a place to do my internship at. As my interests on the field of electronics are wide, I didn't really know where I wanted to go for an internship. Therefore I requested a list of possible places and projects in a range of 300km from home (I had not been living on my own yet, so I didn't want to go too far away). In this list of possibilities I saw the projects of the KU Leuven, which got my attention. These projects included the work on the field of microbacteria. I never had done anything on this topic before, and it sounded like quite a challenge. So without knowing anything about the university or the city of Leuven I applied to do my internship there.

Even though Leuven isn't too far away from Eindhoven, there are quite some differences. The KU Leuven originates from 1425, and all the departments are spread out over the city. This makes Leuven a real student city and it is mostly active during the work-week. Most of the buildings in the city and the buildings of the university have an historic value, which makes Leuven a beautiful place to live.

During my internship I am working at the department of Electronic Engineering at the KU Leuven, in the MICAS research group under guidance of prof. Verhelst. This group mainly works on new technologies for microand nanoelectronics. The project in which I am involved investigates the electrical





behavior of particular bacteria with promising applications in a circular economy. These bacteria convert carbon-rich wastewater into valuable organic chemicals. This process is accelerated by applying electrical current through these bacteria. At this moment the measurement equipment is very expensive and the experiments themselves are rather time-consuming. Next to this, the way these devices work is very static. The operator needs to find the optimal settings for his purposes manually. As most experiments easily take up to months, this is a very time-consuming process. In the research of the project in which I'm participating, the goal is to build a measurement device to have this process automated. The measurement equipment will be actively trying to find the optimal settings (current supply) for these bacteria to accelerate the process.

I am doing the master of Electronic Systems myself, which is quite different from the main topic of this project. In this project a lot of measurements and controlling is done by the use of a custom embedded platform. On this platform is a microprocessor that performs different experiments and records the response, which is where my part starts. My goal is to program this microprocessor

VARIA



in such a manner that the user can choose a curve which should be supplied to the bacteria, and a way to save the sensor data. The sensor data has to be well logged, so it can be used by users who don't have any experiences into the field of electronics. As most of the tests take days to months, these systems have to work very robust. In a process which might take months, the bacteria die when the environment is not right, so if there is something wrong with the way the microprocessor controls the environment, a few months of measurements and work is lost. This is a new experience for me since most of the tests and projects I did took at the most one hour per test.

The work in a multi-disciplinary team is a very interesting experience and gives me a lot of insight into different fields of work. Applying everything I learned during my bachelor and master so far is really interesting and challenging, especially, since it is used on a field I did not work on, and choosing the best solutions for the goals to be met. Choosing an internship outside of the University of Eindhoven is something I would really recommend to everyone, as you gain a lot of experiences when working outside a familiar environment.











4





























1 & 2. After intro party 3 & 4. Lunch lecture Alliander 5 & 6. TeaseLAN 7 - 9. kandi drink 10 & 11. Lunch lecture Arcadis 12 - 16. Constitutieborrel 17 & 18. OKTHORberfest 19 & 20 Exam training Calculus 21 & 22. TV-Deco 23 & 24. Exam training Electromagnetics 1

DEPARTMENT

Sino-Dutch Summer School

ino-Dutch Summer School is an international high level talent forum and summer school on semiconductor technologies. Qiang Liu, Bedilu Befekadu Adela and Dian Tresnawan from EM group, Zhe Chen from MSM group and Sasa Gazibegovic from Applied Physics department participated in this year's Sino-Dutch Summer School held in Fudan University from August 22 - 28, 2016.

Sino-Dutch Summer School

The International Summer School for IC Technology Exchange and High Talent was born in April 2012, by bilateral agreement between the Dutch Ministry of Economic Affairs, Agriculture and Innovation and the Municipality of Changzhou. The objective of the Summer School is to strengthen the collaboration between China and the Netherlands in the field of micro- and nanoelectronics. The first summer school was



school. The summer school includes technical lectures, soft skill training, a group assignment and a city tour.

Lectures

The summer school invited some experts from universities and industries, both from the Netherlands and China. They gave lectures on all aspects of microelectronics and emerging



By: Qiang Liu and Bedilu Befekadu Adela

an interesting panel discussion by people who own companies. Furthermore, prof. dr. ir. Jacob Fokkema from TU Delft gave an interesting talk about "The Joy of Knowing". He mentioned the paradox of learning, "you have to know what you do not know, and then start learning and experience the pleasure of knowing and the joy of understanding".

"You have to know what you do not know, and then start learning and experience the pleasure of knowing and the joy of understanding."

held on August 6-10, 2012 in Changzhou with "Solid State Lighting" as a theme. Since then, it has become a yearly event that takes place in China, where Electrical Engineering PhD students from famous Chinese universities meet with Electrical Engineering PhD students of the three universities of technology in the Netherlands. This year it took place in Fundan University in Shanghai from August 22-28, and from the Netherlands thirteen PhD students from the three technology universities participated in this year's summer

technologies. After the opening ceremony, Shaojun Wei from Tsinghua University and Kees Beenakker, gave keynote speeches about IC industry in China and micro- and nanoelectronics in the Netherlands, respectively. The lectures following the keynote speakers included the topics IC technology, fabrication processes, testable design and testing of integrated systems, MEMS technology and its application in IoT (Internet of Things) and energy-efficient SoC (System-on-Chip). It also included a lecture on startups and entrepreneurships that was followed by

Soft skill training

In addition to the technical lectures, the summer school included soft skill training. MoTiv Team from a training and coaching school for leadership and communication from TU Delft gave training on personal leadership, intercultural communication, communication skills, presentation skills, talent development and motivation, and personal coaching. The training was given for two hours a day for six days in total. Using Belbin tests, the MoTiv team helped the students





identify their role in a team, develop their strengths, manage their weaknesses. It was an important training, as it helped the students eliminate the cultural obstacle between Chinese and Dutch students. In addition to the training, it included a fun quiz. In the quiz three Chinese students participated in answering questions about China and the Netherlands, the culture of both countries, cuisines, festivals and so on.

Group assignment

As part of the summer school students had to do a group assignment on two different topics: a technical and a non-technical subject area. The 28 students were divided into four groups. Each group chose a chairman and secretary for the group discussion and prepared to present to the audience, that included all the professors and the summer school students. During preparation, each group got coaching from the MoTiv team and





some guidance on technical guestions from lecturers. Topics of the assignment included Von-Neumann architectures, advantages and disadvantages of the IC technology scaling, how to make the microelectronics industry more attractive to young people, and challenges to startups and how to build an entrepreneurship mentality.

City tour – Shanghai

We arrived in Shanghai on August 20, after an eleven-hour flight. We were eager to see this populous Chinese city and try some delicious Chinese cuisines, and so we started our tour from the first day without taking a rest. Shanghai, with a population size of 24 million, is one of China's most populous and modern cities. Being the most influential economic, cultural, scientific and technologic city in China, it offers a popular touristic sites for visitors. We visited many places, including the commercial place near temple named Yu

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Garden where we tried all kinds of traditional Chinese snacks and street foods, and walked around the traditional temple-kind of buildings. We also visited Bund, a famous touristic place in Shanghai. The Bund stretches one mile along the bank of the Huangpu River and from there you can see the Shanghai Tower, Shanghai World Financial Center and the Oriental Pearl Radio & TV Tower. Especially the night scene is extremely beautiful. As part of the Summer School, Fudan University also organized a city tour. On the second day of our arrival they took us to the Oriental Pearl Radio & TV Tower. It was the tallest structure in China from 1994 - 2007, before it was surpassed by the Shanghai World Financial Center. It is still the landmark building in Shanghai. We were able to see the whole city and the river from top of the tower. This place is so famous in Shanghai that it took us more than four hours waiting in a queue before we started our visit.



IVARIA

Chicago-style Internship

By: Julian Dobrovolsch

The world is a book and those who don't travel read only one page - I've been driven by these words all my life, so I decided to throw myself into the challenge of completing the master internship abroad. Living in a society where nearly everyone wants to experience the 'American dream', I thought this could be a perfect opportunity to check it out in person, and compare the European educational system with the American benchmark/standard. Due to the diverse experiences which one could have across the US, I'll just give you a taste of what I have discovered in Chicago. Tune in and check out my story below.

How to make it to America

Everything started last year when I walked into my first master program class. The beauty of the courses in the master program is that at the beginning of each course lecturers present the niche research of their department and discuss the kind of opportunities that follow. Each professor has a huge network of connections from different academic environments and research institutes. After some coffee talks with different lecturers I already knew that the USA is a hot trend right now, and that relevant academic progress is being conducted at different institutions! Therefore, I firmly made up my mind to go to the USA.

I first started to prioritize companies based on the type of internship I was interested in. Soon I realized that getting in touch with institutions by yourself was an impossible mission. Hence I decided to ask teachers to put me in contact with companies they had connections with. By sheer chance my current host company from the USA asked one of the department's lecturer for some internship candidates. I was humbled by the opportunity that was offered, and now, here I am in Chicago, Illinois at the Argonne National Laboratory, Transportation Technology R&D Center.

Chicago lifestyle

Chicago, also known as the windy city, is one of the top three cities in USA that one would want to live in. Its unique allure includes the world's top skyscrapers, as well as the riverwalks along the channel that split Chicago in three parts: North-East, South-East and West. The city is very ripe with diversity, and it is





home to big communities such as the Puerto Rican, Indian, Ukrainian and Polish, where you can encounter different lifestyles.

Yes, everything here is Chicago style. From hot-dogs, burgers and other American 'gourmet' food to beer, salsa dancing, jazz music and other ways of life. The city has a vast history of art culture and is packed with small exhibition centers and public sculptures. One of the most famous is the Cloud Gate Sculpture, situated in the heart of Chicago. As you walk down the streets you get a glimpse of American culture starting from 50s up to today. From wood-like houses to glossy and overwhelming marble towers. Of course, these ones are concentrated downtown, but surprisingly a big majority of them are just office buildings. Because of

that, there are not many good places to eat or just hang out, or to dance in a club. People prefer to escape from the hectic life and find the more down to earth environments of a terrace or bar just a bit outside the city loop. This way you have a mesmerizing view over the Chicago skyline in the evening.

Chicagoans are very welcoming, I guess this is actually part of the American culture. Independent of the location or people, they would welcome you with the classic "Hey, how are you doing today?" and unless you are anti-social you cannot avoid engaging with them in a random conversation. I have been experiencing this at my job, the bar, bank, shops, sporting games and even while on Uber rides. The city is also famous for its



comedy theater and its school of improvisation called The Second City. I have made up my mind to sign up and take one of the improvisation classes.

Interning at Argonne

Argonne National Laboratory is one of the few National Laboratories in the USA. Ironically it is run by the University of Chicago, which does not have any engineering departments. It is however part of the US Department of Energy (DOE), which means that all kinds of research in the sphere of energy is done solely at this laboratory. The campus is huge, it looks like a village from the inside. It has all the vital aspects of life, because it is situated 30 km away from the city. The wildlife is also guite diverse, white deer being the iconic emblem of Argonne. It is host to more than 4000 researchers and engineers, and accommodates many conferences and lectures on different top-notch engineering projects. I was quite impressed to learn that one of the most important tools in engineering, MATLAB, started its development at Argonne as a PhD project. Moreover, by next year Argonne will be the home of the most powerful supercom-

If you haven't been impressed by the company by now, I will tell you about my interaction with it. As I mentioned earlier, it was a warm welcome. The company organized a guided tour through the campus and provided lots of training to make you quickly familiar with the work you will be doing. In my department there were plenty of young students like me. I met people from all over the world and had really great experiences.

puter: Aurora.

The task I was assigned to is part of a big project which is conducted at the request of the DOE. I am part of the Transportation division, and my research topic is in the same area. The current trend in the automotive industry is focused on connected and automated cars, and guess what - that is exactly



a predictive controller that is able to reduce the fuel consumption by giving a route and information about that specific route. So far, I am half way through the project and I really enjoyed diving into the problem, conducting literature study and presenting information about my findings and strategy. The research group that I am part of is very dynamic. We hang out together in Chicago at clubs, we play games, we have potluck dinners and other social activities such as movies.

One particular aspect that I would like to point out is that the myth about Americans being workaholics is confirmed. They might not be as productive as the Dutch people, but their leisure time is pretty much proportional to the time they spend at work. The majority of them arrive at work around 9 a.m. and leave around 6 p.m.

Exploring the USA

the field that I am exploring. I have to design

The United States is a beautiful country but - oh God it IS huge. As an intern, Argonne provides several free days for travelling around the country. The most convenient way is by plane and the tickets for flights are pretty reasonable. In the first months of living in Chicago I visited most of its attractions. The West Coast was one of the travel



ownton Chicago skyline (view from Lincoln park)

VARIA

destinations I was interested in, and in particular San Francisco and the Silicon Valley area. After checking out some iconic attractions in San Francisco, I spent one full day wandering around the Google, Facebook and Tesla Motors campuses. Finally, I paid a visit to Stanford University and felt deeply impressed by it. During the Thanksgiving weekend break I planned my visit to New York and at the end of my internship I intend to check out Cuba.

Final impressions

Doing an internship abroad is definitely something that every student should experience. You get to learn a lot, meet amazing people and make lifetime memories. Chicago is a perfect destination for all of that, with plenty of job opportunities and experienced people to lead you in the right direction. I strongly believe that as a student you have to go out and explore new limits, and frankly, I am happy that I was one of them. See you later!



IASSOCIATION

Excursion AME

he excursion to Applied Micro Electronics, also called AME, was the highlight of September 28. AME is an independent developer and manufacturer of high quality electronic products. People from electrical, mechanical, software, and industrial engineering work together to develop a new demanded product for the customer. AME is also very interesting since this business is located at our city, Eindhoven.

We all went by bike to AME. After we arrived, we got a short presentation about AME and how it functions. It was extra interesting to



By: Quinty Peters

hear, because it was a fellow student of ours that gave the presentation. He talked about his work at AME and how he as student experiences his part-time job. It was also made clear to us that we also could apply for a parttime job at AME, which is very interesting and a great opportunity.

After the presentation we got a tour through the company. As usual when visiting such a company, everybody had to wear a coat and foot grounders. There was a lot to see. The guide told us about the process cycle step by step. We could see everything from a very close range. What I found exciting to see was the live-cam from which you could see the soldering process in a machine. All machines were made for very precise actions, which is logical of course, but it is still fascinating how mankind built such machines.

Having returned from the tour, an assignment was waiting for us to be made. The questions made you think about details which you have to take into account during the development of a new product. They were not quite easy,



almost nobody knew all the answers. Luckily, the questions were discussed afterwards so we were not left behind without answers.

Then it was time to just talk about AME and ask questions to the present employees while having a drink and some snacks. It was all open and friendly which was very fun. There was no real ending time so after the assignment everybody was free to leave whenever he or she wanted.

Excursion ASML

n Thursday the 13th of October, a group of Electrical Engineering students, including myself, visited ASML in Veldhoven. ASML is well-known as the world's largest developer and manufacturing of lithography machines. These machines combine research disciplines from several engineering fields, including Mechanical Engineering, Software Science, and of course Electrical Engineering.

The excursion day was specifically organised for Electrical Engineering students from all over the country. Besides the familiar faces from Eindhoven, there were students from the University of Twente, Delft University of Technology and the 'Hogeschool van Amsterdam'.

After a brief welcome and introduction, professor Hans Butler, who works both at ASML and at the Control Systems group at our university, took the stage to explain several By: Martijn de Kok

design choices in the development of the lithography machine. His presentation taught me several new and interesting things in only a short amount of time.

We were lucky to be the first group excursion to visit ASML's brand-new Experience Centre. This room was built to provide visitors a hands-on experience with the various machine parts on display, without having to enter the cleanroom. There was also a 3D film showing the operation of the wafer scanner and a 'surveillance camera'-style film that shows the fast-forwarded construction of a complete lithography machine.

Max Schoonderbeek, a TU/e Electrical Engineering graduate, gave us a short presentation about what a week at ASML was like. Afterwards we were given a tour through the various buildings, seeing the view from the top floor of ASML tower and the system of cleanrooms that runs through the various buildings. The buildings reminded me a lot of the TU/e: there was a very nice campus-like atmosphere.

After lunch we were given a case study to work on in small groups. The objective was to design a system that could detect and remove contaminations on the wafer stage. We presented our "search and destroy" system concept to the other groups, who in turn presented their own ideas. What was really interesting to hear afterwards: ASML engineers had already attempted most of our suggestions!

The day was concluded with a drink with all the participants. I enjoyed talking with our fellow students from other universities, and one particular ASML engineer who was noticeably enthusiastic about his job. All in all, I think I can safely say that all of us had a great time during the excursion.

Icons of EE: Thomas Alva Edison

Uring the late 80s of the 19th century there was a battle between two engineering companies called 'The War of Currents'. Most engineers will have heard about this battle for the standard in electricity networks, and the outcome of this completion did have a huge impact on the way we work with electricity. One of the two competing companies was the company of Thomas Alva Edison, one of the greatest inventors from his time with over 1000 patents to his name. But how did he become one of the greatest inventors? What was his role in the war of currents? And what is his contribution to today's engineering?

Thomas Edison was born in 1847 as the seventh and last child of Samuel Ogden Edison and Nancy Matthews Elliot. As a young boy Edison developed a hearing problem, which led to partial deafness during his whole lifetime. The cause of this problem, told by Edison himself, was that he was picked up by the ears by a train conductor to prevent him from falling off the train. Expert however doubt the story of Edison because the partial deafness was running through his family blood. Another remarkable thing about his life is that he did not go to school at all. As a young child he was taught by his mother at home, while at a later age he educated himself by reading books about science, art and natural philosophy.



Edison's first light bulb

The beginning of Thomas's famous career was at the age of twelve as a newspaper boy at the railway station of Port Huron. One of the talents of Edison was very soon visible while he started selling a new paper, which he wrote with four assistants, next to the papers he had to sell. This talent for being a business man eventually led him to found fourteen companies during his lifetime, including General Electric, which is still a huge company nowadays.

One of the inventions Thomas Edison is credited for is the invention of the evanescent light bulb in 1879. This is however not totally fair because he was not the real inventor of the light bulb at all. The first light bulb was invented by Humphrey Davy, which was working in the electrical and chemical part of science, in 1806, way before the birth of Thomas. While he was not the real inventor of the light bulb, his light bulb does have a huge impact on the way we live and work today (especially in the region of Eindhoven). Thomas found a way to make a light bulb which could be made so inexpensive, due to the fact that he used carbon as a filament, that it could be a commercial product.

A good example to see this invention in relation with the way we live now in the region of Eindhoven is the foundation of Philips in 1891. In the first years the company was

TECHNOLOGY

By: Matthijs van Oort



producing light bulbs based on the light bulb of Edison with carbon filament. This in its turn led to an enormous technical impulse in the region of Eindhoven.

Besides the light bulb, Thomas Edison is also well known for his contribution to the war of currents. During the war of currents, Edison's company called Edison General Electric (which eventually became General Electric) competed with Westinghouse Electric (which employed the famous engineer Nikola Tesla). According to Thomas, a low-voltage DC grid would be much safer than an AC grid which needs a higher voltage. To strengthen his statement, Edison designed an electric chair for performing an execution based on AC voltage. This invention supported the, at that time, rising public furor over a series of deathly accidents with AC high-voltage lines. This however did not compensate for the cheap production of the AC grid.

Overall, the inventions of Thomas Edison do influence the way we live and work nowadays. Maybe he did not do all the inventions himself, but he did find a market fit for the inventions with his entrepreneurial skills. And although he did not win the war of currents due to the hard competition with AC voltage companies, he really did have an influence on the way we look at power grids today.

IVARIA

STORM, around the world

By: Maarten Slenter

ugust 14. After months of working on the motorcycle and barely seeing my friends (sorry guys!), we finally left for our tour around the world. First stop, Munich! We hadn't really been able to test the motorcycle yet, aside from a single day driving around the Netherlands. Soon, we found out why test time is so important. On the very first day, the motorcycle broke down, due to a software error on my part. Starting off the thing that you have been working towards for two years, that'll put everyone in a bad mood. Our second motorcycle was still having issues with a current measurement, which meant we couldn't use that one either. In order to fix the motorcycle, four people from our team, including me, spent the whole night replacing parts and making sure this mistake could not happen again. We returned to the hostel around 6 AM. There I experienced something new to me: not being able to sleep because of stress. About two or three hours later, we gathered the whole team and prepared to leave for Vienna. Fairly certain that we had fixed the problem, we set off with high hopes for Vienna. Imagine how I, how we, felt when on the second day, the motorcycle broke down again ...

Both times, it was the inverter that was damaged and had to (partly) be replaced. The inverter is the name for the power electronics that convert the DC power from the batteries into AC power for use in the three-phase away. We've seen Iran, where our ladies had

motor. Since this is a very complicated piece of electronics, we bought a complete solution from a company called Unitek, located near Stuttgart. On our second day we went from Munich to Vienna, meaning we would pass by relatively close to Unitek, allowing us to send one of our vans with a motorcycle to the manufacturer in order to ask their help in determining what went wrong.

To allow the split-off van to catch up, we soon decided to stay in Vienna for an extra day. We had a back-up day planned in Istanbul, which meant we had to move everything, charging locations, sleeping locations, events, that was planned between Vienna and Istanbul. Luckily, in Vienna, we had a great workshop available to us from the local URE. Also, the Dutch ambassador there was kind enough to provide us with not one, but two delicious dinners at his residence. All of this meant that after two days and another almost sleepless night, we finally had two working motorcycles. The STORM World Tour could now finally start.

Of course, we have still had plenty of setbacks, plenty of problems (no, challenges!). But most of all, we have had at least one working motorcycle. With this motorcycle, we have crossed through all of Asia. We've seen Turkey, where slowly the western civilization that we're all so used to started fading













to wear head-scarfs, the toilets weren't seats anymore and the traffic laws were more like... guidelines. We've seen Turkmenistan, which had a whole city, Ashgabat, built specifically to impress foreigners. We've seen Uzbekistan, where on the day of our arrival, the president died, causing a three-day period of national mourning, cancelling all our events. We've seen Kazachstan, a country which we couldn't enter for about eight hours because the Internet at the border wasn't working. We've seen Kyrgyzstan, the most beautiful country during our trip, located for a large part in the Himalayas. And finally, we've seen China, where the roads returned to acceptable conditions (no more playing mini-games of "dodge-the-hole" while driving 100 km/h) but other drivers' skills took a turn for the worst.

And now, after surviving the whole of Europe and Asia without a scratch (well almost, that accident with the taxi doesn't count), we've already been in two accidents in our first week North-America. No one got hurt and we weren't to blame for either accident (I swear!), but clearly, our adventures are not over yet.



Lunch lecture Sioux

Eindhoven University of Technology, where he specialized in low-noise analog electronics and signal processing. At Philips CFT he was leader of the Sensors and Measurement Technology group. In 1997 he joined FEI where he was involved with image and data acquisition and analysis. As an electronic systems architect he was responsible for the Small Dual Beam generation of FEI instruments. In 2015 he joined Sioux



Sioux pizza lunch at the lunchlecture

ees Kooijman graduated (1986) at Embedded Systems and is acting as system architect in various projects such as the Phenom desktop electron microscope.

> During the lecture Kees highlighted the electronic design challenges at Phenom-World. Phenom-World is a leading global supplier of desktop scanning electron microscopes and imaging solutions for submicron scale applications. Sioux contributes to the multidisciplinary Phenom project with experience in technical software, mechatronics, electronics, industrial mathematics and remote solutions. The electronic design, especially in the high voltage generation (up to 30,000 Volts) for the new electron source, appears to be quite tricky. Costs, physical volume, reliability, ultralow noise and stability where main themes in the work at Sioux.

A traditional "requirements-design-realization" process is hardly applicable because of hard-to-formulate requirements and many technical unknowns. Rather vague customer requirements like "make it as good (cheap, small) as possible" make it even harder to follow a traditional V-model. As mentioned by Kees, pizzas, gyrators, beer crates and magic

VARIA & ADVERTORIALI

By: Martine Dubling (Sioux)



liquids appear to be valuable ingredients in this process where creativity, ownership and perseverance of the Sioux engineers are severely challenged.

High voltage design comes with many hurdles like excessive stress on components and undesirable side effects like ionization and flash-overs. To tackle these, fundamental studies, proof-of-concepts and experimental work are typical activities before the actual product design can start. A hands-on attitude is indispensable for this type of electronic design work but also illustrates why it is fun to work at Sioux.

ADVERTORIAL

The ideal side job for an awesome company

Esmee Huismans studies Electrical Engineering at the TU/e and was President of the Thor Electrical Engineering Student Union. Esmee: "I was on the Thor Board for a year. That was a really nice experience. I had the opportunity to work on acquiring other skills and get to know a lot of people. Nevertheless, I am happy that I am back hitting the books."

hanks to her executive year, Esmee developed a large network amongst EE students. A network that she can put to good use in her role as ASML campus promoter. Esmee: "The previous campus promoter for the Electrical Engineering, Mathematics and Information Technology faculties went off to do an internship, and he envisioned me as his successor. He said: 'You know a lot of people, have a good speaking style and know how to convey a message.' So that's how I came to know ASML and guickly took over the reigns. It's an ideal side job for me!"

A great employer

Most Eindhoven technology students are likely familiar with ASML. But what may be less well-known is that ASML supplies all the big chip producers in the world. Samsung, Intel and TSMC, among others, use the innovative lithography technology to make the smallest possible and most powerful integrated circuits. Esmee: "ASML is well-known in Eindhoven and is also seen as an appealing employer. Now that I've spent a few days at me instead of just knocking on ASML's door.

By: Esmee Huismans



the company, I can fully confirm this. The atmosphere is very open, people of all levels comfortably converse with each other and you can go in all sorts of directions with your (technical) career. It's an awesome company with a very positive vibe!"

Accessible intermediary

So much for the company endorsement. But what does Esmee do for students? Esmee: "I am really an intermediary. It's a lot easier and more accessible for students to approach

ASML

Be part of progress

I help interested parties with questions and can tell them a lot about possibilities for an internship, graduation project or job openings. I also provide the required feedback to ASML. For example, if activities have been organised, such as a presentation, company visit or scholarship, then I let ASML know how the student came across and what can be improved, if necessary.

Recommendation

Esmee: "I wholly recommend that anyone who is in the technology field get to know ASML. The company is enjoying unprecedented achievements. It is incredibly difficult to advance in the chip market. To make chips that are even smaller and can do even more. Nevertheless, ASML always manages to get ahead of the game. They build gigantic, complex machines to allow them to work in nanometres. I think it's one of the most challenging work environments for technically oriented people."

Want to know more?

You may recognise Esmee from her time with Thor or from the lecture hall. Do you have more questions about ASML? Then contact Esmee - she will be glad to help. You can also email her at: esmeehuismans@gmail.com

www.workingatasml.com/students

Towards Dynamic Contrast Specific Ultrasound Tomography

It all started with an observation

We began this study from the observation of unexpected artifacts in contrast-specific imaging [Mischi et al, International Contrast Ultrasound Symposium 2007]. These artifacts affect standard dynamic contrast-enhanced ultrasound imaging (D-CEUS), and limit D-CEUS application in contexts where accurate localization and quantification of ultrasound contrast agents (UCA) concentration are crucial.

In essence, D-CEUS is an imaging technique where diagnostic ultrasound is used in combination with intravascular contrast agents, typically gas-filled microbubbles encapsulated in a lipid shell. To distinguish UCA echo signals from tissue, the nonlinear response of UCAs to ultrasound is usually exploited. Microbubbles respond in fact to insonification oscillating, not just at the (fundamental) frequency of the applied ultrasound field, but also at the second harmonic frequency, as well as at higher harmonics, sub-harmonic, superharmonics, and ultra-harmonic frequencies.

Based on these harmonic components, a variety of contrast-specific imaging techniques have been developed in the past years, and are clinically available.

However, tissue itself induces the formation of harmonic components as a consequence of the cumulative nonlinear distortion that occurs during ultrasound propagation through tissue, further deteriorating the image quality.

Moreover, the observed artifacts, which appear to be caused by nonlinear propagation of ultrasound through microbubbles, affect standard DCE-US imaging techniques, leading to possible tissue misclassification, misinterpretation of bubble concentrations, and image quality reduction.

Eureka!

Studying these artefacts in search of solutions we got inspired, and investigating the phenomena involved in the interaction



between UCA and ultrasound a new marker for UCA with great potential for imaging was then discovered [Demi et al, Journal of the Acoustical Society of America 2014].

We have now obtained exciting results, which prove the applicability of this marker to dynamic contrast-specific ultrasound tomography (DCS-UST), and named this new imaging modality "cumulative phased delay imaging" (CPDI).

CPDI is based on the different physical phenomena behind nonlinear propagation of ultrasound in tissue and UCA, producing a different delay accumulation between the second harmonic (2H) and fundamental (F0) component of the ultrasound field. In particular, a positive delay between 2H and F0 is a marker specific to UCA, as opposed to variations in harmonic amplitude (exploited for echo imaging), speed of sound, and attenuation (exploited for ultrasound tomography). CPDI has already shown capable of detecting and imaging UCA concentrations when working at pressure regimes $(0.05 \le MI \le 0.2)$ and frequencies (2.5-3 MHz) of interest for clinical applications.

Getting noticed

The first CPDI images were presented at the 20th European Symposium on Ultrasound Contrast Imaging in 2015, and were awarded with the best poster award prize for the category New Directions.

Also, a recent paper on CPDI was awarded 'featured article' by Physics in Medicine and Biology, and selected to appear in the European society for radiotherapy and oncology (ESTRO) newsletter in the section Editor's Picks: Highlight Radiotherapy Physics Papers.

In October 2016, our most recent paper on CPDI, titled "Towards Dynamic Contrast Specific Ultrasound Tomography", was published on Nature Scientific Reports. In this paper, we report on the first study demonstrating the ability of CPDI to image and quantify ultrasound contrast agent (UCA) kinetics. This aspect was crucial to evaluate as to understand the clinical relevance of this new imaging modality. In fact, by analysis of the UCA kinetics one could infer on the properties of the vascular structure the microbubbles are flowing through, ultimately behind

By: Libertario Demi



able to detect angiogenesis, a key process in cancer growth, and hence detect and localize cancer.

The research performed at the Biomedical Diagnostics Group on contrast ultrasound dispersion imaging (CUDI) is a perfect example of advanced signal processing techniques which may be applied to D-CEUS data with the final goal of detecting and localizing cancer [Sloun et al, Medical Image Analysis 2016].

The future ahead

In particular, the research on CPDI has great potential in the field of breast cancer diagnostics.

In fact, nowadays the only breast cancer screening method that has proved effective is mammography. Unfortunately, mammography is patient-unfriendly, costly, and false positives are common. Abnormal mammograms require further examinations using additional mammograms, X-ray CT, ultrasound, MRI and often biopsies. Moreover, the use of ionizing radiation in mammography and X-ray CT is accompanied by the risk of inducing DNA mutations that spur cells to grow into tumors.

In this context, a radiation-free technique that combines the diagnostic value of D-CEUS imaging with the advantages of computed tomography would represent a revolution in breast cancer care. This is indeed what CPDI enables: the development of dynamic contrast-specific ultrasound tomography (DCS-UST).

When imaging the breast, DCS-UST will allow for a more practical, faster, and less operatordependent imaging procedure compared to standard echo-contrast, while preserving accurate imaging of contrast kinetics, providing access to the whole 3D breast vasculature, and ultimately adding important features to multi-parametric ultrasound tomography of the breast.

A summer in Sichuan!

By: Bram Hooimeijer

A hundred students spread over four cities following a seven week program filled with business, culture and academics in China. That's what the Netherlands Asia Honours Summer School (NAHSS) is all about! This summer, my trip went to Chengdu, the capital of the Sichuan province in southwest China. A trip I'll never forget!

fter our flight we first stop for lunch, which is also our first taste of Chinese culture. There are no courses and you do not have your own dish, everybody shares dishes which are put in the middle of the table. The food in Sichuan is fantastic, especially if you like spicy. Yet, you get used to spicy, or have to, anyway. Out on the road, you note the many high apartment buildings, built in groups of five to ten identical buildings to cope with fast growth of the cities. Shops and small restaurants can be found all over the university guarters, as well as outside the campus. Notable are of course the street vendors, selling everything ranging from pig noses to rabbit heads: all Chinese delicacies. Shops are open until far in the night and there is always something happening outside. It's a different world, and very nice!

We stay in Chengdu for five weeks, which allows us to get accustomed to the Chinese life: morning classes cover Chinese language, afternoon classes cover Chinese history and politics. No bread for lunch here, so during the lunch break we look for new small restaurants, exploring all sorts of meals. Both our classes were very enjoyable, and after a week I was already able to use some Chinese when ordering food or taking a taxi. In Chengdu, few people speak English, which makes learning Chinese quite rewarding.



What I found most remarkable in Chinese culture, is the atmosphere in the parks. During the morning, people get together to do yoga or tai chi. In the afternoon, people get together to dance. The large groups of people dancing outside make a happy sight. However, when you stand by and watch, you are always urged to join in. In the weekends people do sports like badminton, or even make music together. Best part is, everybody can join in at any moment!

With our classes finished, we have the weekend off for ourselves. Together with four others, we try to use every weekend to explore as many places as possible. The weekend after our exams, we get on the bus in the early morning for a ten-hour trip to Kangding, a small city west of Chengdu. From there, we fetch the last taxi which takes the five of us – yes, that's four in the



back – through the mountains. The taxi trip takes another three hours but is absolutely phenomenal. Even though the altitude is 4000m there are grasslands everywhere, with gentle hills divided by creeks. Along the way we find nomads, Buddhist flags, sculptures, monasteries, temples and monks. In the end we reach Tagong, where we finish the day with a Yak burger. The Tibetan village is small and has only three streets, a very sharp contrast with a city like Chengdu.

The serenity of the grasslands and the town are delightful. After a breakfast with yakyoghurt we set out into the grasslands, towards a large monastery. As we walk down the valley we find Tibetans on their motors, driving from the town towards the monastery. Their English is excellent and they like western tourists. It is a delight to find Tibetan culture as well as Chinese in this corner of Sichuan.

Once we reached the monastery, one of the monks guides me through the temple, as long as we have taken off our shoes. Multiple Buddhist sculptures fill the hall, together with pictures of the different Dalai lamas. It is an incredible place to be. In front of every statue, the monk stops, and shows me the customs of his religion. He enjoys our interest and afterwards invites us for tea. Living in only a small shack outside the temples, his hospitality is amazing. Only a few days later, we leave the barren grasslands for the busy Shanghai.

The NAHSS is a yearly summer school open for all second- and third-year bachelor students, and includes a multidisciplinary project as well. More information can be found at http://bachelor.nahss.nl/, on which the new program will appear, probably, in December.

IEEE Congres

n Wednesday 17th of August it was finally time for the biannual IEEE Region 8 Student & Young Professional Congress. From all over Region 8 (Europe, Africa and the Middle East) Student Branch boards and members flocked to the beautiful city of Regensburg, Germany, for five days of meeting wonderful people, networking and attending interesting workshops. From the IEEE SB Eindhoven we went with the whole board: Steven, Jeanine, Marco and me.

Here you can see some impressions of what it was like. Most of the pictures are from the most fun night, the multicultural evening on Saturday. Everybody dresses up in his or her cultural outfit and brings typical food and drinks from his/her country. Obviously we dressed up in orange and brought 'jenever', Schrobbeler and 'oranjebitter' as drinks. For food we brought 'stroopwafels' and 'drop'. It was an awesome experience and I hope to bring a visit again to a later edition.













Here, I am making my own rice bread by smashing cook rice to dough. The result was delicious!



A typical Chinese façade we saw in Chongqing, another big city in southwest China.

VARIAI

By: Frank Boerman





DECEMBER 2016 29

IPUZZLE

Puzzle



Objective / Rules

- Complete the grid with the digits 1 to 9 in such a way that the four numbers around each diamond shape add to 20.
- Each diamond uses a different way to add to 20, i.e. if there is already 1 + 3 + 7 + 9, then there will not be another using the digits 1, 3, 7 and 9 (in any order).
- The same digit isn't allowed to touch, even diagonally.
- Please send your answer to connecthor@ thor.edu before 12 January.

Winner previous puzzle

The winner of the previous puzzle is Douwe de Vries.





Looking down on us

ur world has come to a point where we actually have companies offering pedestrian crossing lights that are built into the floor, so people notice them when they're walking around whilst they're busy doing stuff on their smartphone. Right after this news hit me, I instantly started thinking of a person whom I admire a lot. I'm talking about a man that presented a truly controversial idea that was, obviously but regrettably, not accepted by the general public for a quite some time. Let's just put it out there: one of my biggest idols is Charles Darwin.

Despite that I think everyone has heard of Darwin, I would still like to take the opportunity to outline his most famous book, published 157 years ago: On the Origin of Species. Written in such a way that it was comprehensible for non-specialists, it attracted a wide public, which in turn started a lot of discussion. It took about 70 years until his ideas were really accepted as the underlying concept of life sciences.

In his book, Darwin poses quite a number of statements, of which my favorite is undoubtedly the process of natural selection. As biologist Ernst Mayr puts it, individuals less suited to the environment are less likely to survive and less likely to reproduce; individuals more suited to the environment are more likely to survive and more likely to reproduce and leave their heritable traits to future generations, which produces the process of natural selection.

Organisms seem to adapt themselves to their environment, although this is in fact a passive activity; they are not actively adapting but rather the individuals with the most preferable (random) genetic mutations turn out to survive. Think for example of a group of bears, living in an area with lots of snow. If the one bear just happens to have a lighter colored skin than the others, that one is less likely to be noticed by a prey and will thus have a better chance of catching that prey. The other bears will catch less food and, harsh as it sounds, more of them will starve.

It seems like Darwin's theory only applied to species that lived long ago. Swimming creatures developed into land creatures, polar bears developed from other kinds of bears and humans developed from apes (which



does not mean that we are apes). It feels like the current set of organisms is somehow fixed.

Perhaps the species that's changing the most, is us, humans. Our life expectancy has been increasing slowly for millennia already, but really sky-rocketed in the last two centuries, during which it more than doubled. Why is that? Are we adapting to our environment at such a rapid pace? Are we suited to the environment so well? I think it's exactly the other way around: we've made the environment suit us. Advancements in for example hygiene, shelter, medicine and food made that our natural causes of death became less of a threat. Turns out we're really good at keeping dangers away from us.

In this context I find it more than remarkable that the number of selfie-related deaths outnumbers the number of fatal shark



By: Tom van Nunen

attacks by at least one order of magnitude. Don't think of me as some kind of sadist, but it almost sounds funny. With all our inventions we've brought ourselves to this point, where we take our safety for granted, where our technologies have made us so unaware of dangers that we don't know how to handle them anymore. Apparently, some of us need pedestrian traffic lights built into the floor because they don't understand that looking down to a smartphone screen is not a safe way of participating in everyday traffic.

It almost sounds as if Darwin is making a small return. For decades, we've been adapting our environment for our own benefit, and now our smartphones are trying to distract us; to make us less suited for the environment. Never stop thinking, always pay attention, and you'll be more likely to survive and more likely to reproduce and leave your heritable traits to future generations.

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