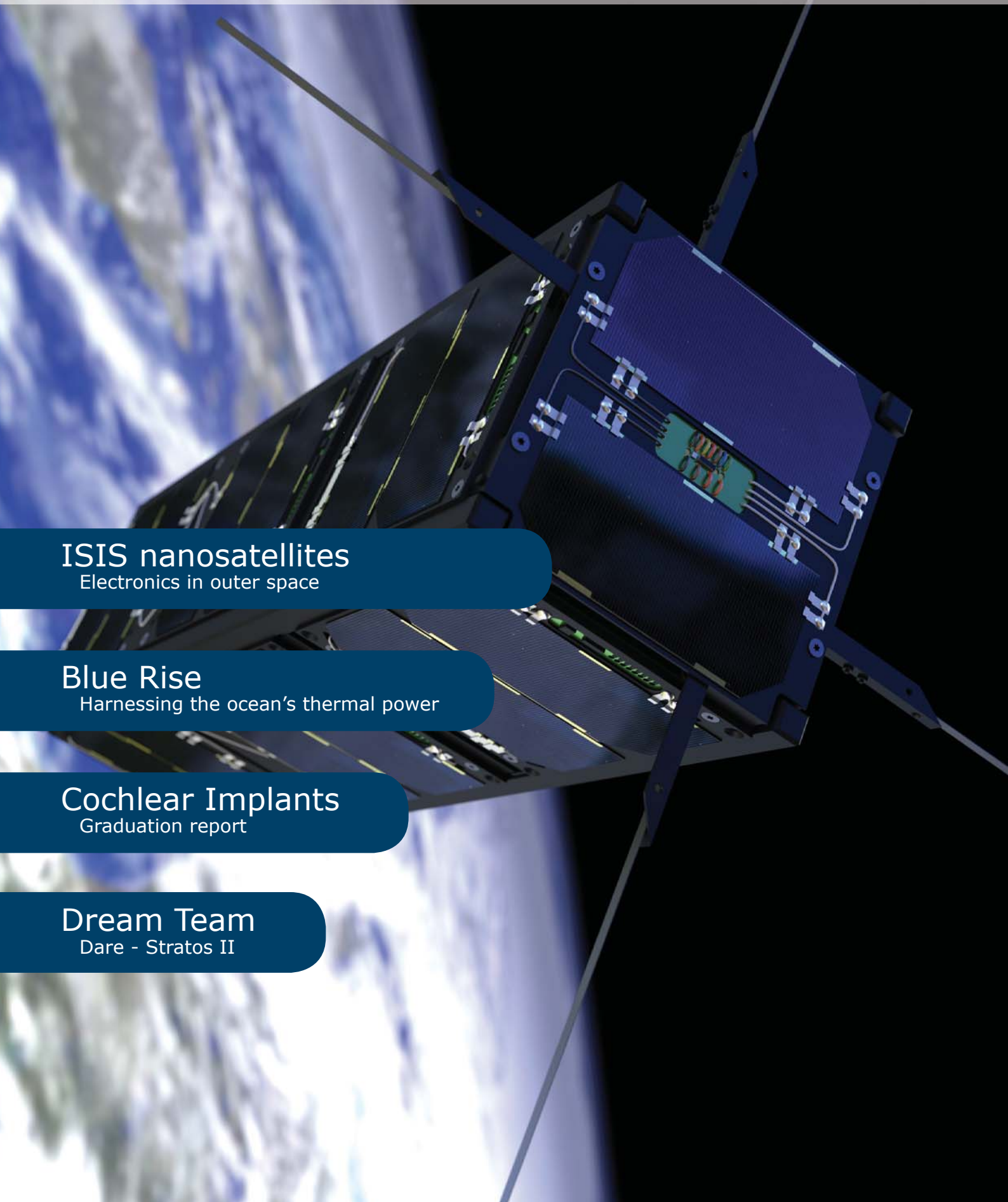
# MAXWELL

Magazine of the Electrotechnische Vereeniging

Edition 16.4
June 2013



## ISIS nanosatellites
Electronics in outer space

## Blue Rise
Harnessing the ocean's thermal power

## Cochlear Implants
Graduation report

## Dream Team
Dare - Stratos II

Electrotechnische Vereeniging

# Hulp nodig?

## Heb je nog ***eerstejaarsvakken*** open staan en wil jij het meeste halen uit de laatste herkansingweek...

...maar heb je tijdens de vakantie een duwtje in de goede richting nodig? Samen studeer je sterker!

In de periode van **29 juli tot 9 augustus** stelt de ETV extra studieruimte open in EWI, speciaal bedoeld voor EE-studenten om samen te studeren. Hier kunnen jullie zelf werken, overleggen en elkaars vragen beantwoorden. Spreek met elkaar af welk vak je gaat bestuderen, welke opgaven je voor die dag gaat maken en hoe laat je aanwezig bent. Zo heb je altijd een stuk achter de deur om aan het werk te gaan.

Voor de mensen die naast hun zelfstudie nog een laatste klap op de vuurpijl willen geven in de voorbereiding van hun herkansingen, zijn er ook studiemiddagen met extra hulp voor een bepaald vak. Zo kan je tot de aller laatste vraag beantwoord krijgen.

**De middagen voor studiehulp zijn van 13:45 tot 16:30**

Maandag 29 Juli
Electriciteit en Magnetisme

Woensdag 31 Juli
Digitale systemen

Vrijdag 2 Augustus
Meettechniek

Maandag 5 Augustus
Lineaire Schakelingen

Woensdag 7 Augustus
Electriciteit en Magnetisme

Vrijdag 9 Augustus
Kansrekening en statistiek

**Reminder:** Extra herkansing Lineaire Schakelingen

Ja, je leest het goed! Er is dit jaar in de herkansingweek tijdens de zomer een extra mogelijkheid om Lineaire Schakelingen te herkansen. Ook hiervoor is dus een studiehulp middag ingeplant! Vergeet niet om jezelf hiervoor, net als voor alle andere herkansingen, op tijd in te schrijven!

# From the board
## At the end of the year

We happen to be very sporty, sometimes!

Dear Reader,

As I am writing this the summer seems to be quite far away, according to the current weather, even though the end of this academic year is closing in fast. When this edition of the Maxwell is going to roll from the press, most of our students will be focussing the main portion of their time on the last exams of this year. And it is just a few more weeks until the summer vacation.

The fourth quarter has been a quite dynamic one. After yet another very successful 'MoTiBo', everyone had quickly found their place back in the classrooms and so did we in the boardroom. Well, except for Menno and Pascal who spend another week abroad. This time they represented Delft in Munich at the EESTEC congress. Their stories of this meeting were magnificent. Meanwhile in the Netherlands, the other board members organised once again an interesting board meeting with our predecessors.

The second and the third week of this period were a little short but the long weekends were more than worth it. Because were already busy with our work for the association, this allowed us for some more free time as well and we enjoyed this all very much.

At the third of may, the ETV joined the collective of the study association from the TU Delft to lay a wreath of flowers at the World War II monument. For this ceremony we had invited Paul van Woerkom who gave a short talk about the periods in which different Dutch students and professors had passed away through their work for the resistance. Also the vice principal from the TU Delft attended for a small thanks from the TU Delft to the associations and students in general for their interests in the commemoration.

In the fourth week we were proud to present the dies natalis week in which the committee had organised an awesome collection of activities to celebrate the associations anniversary. Traditionally the week started with the electronics auction and the dies reception but there were a few new things also. With principle of workshops in the morning our members learned to fold balloons and to practice sign language. Regardless of the weather we went surfing and played football as well. The highly anticipated cantus was a lot of fun and this year the dies-committee cooperated once again with the yearbook-committee for the loved "JaBoKaraoke." That evening the newest ETV yearbook was released and many people received a signed copy from the committee that attended in their best dress for the occasion. If you haven't picked one up yet, don't forget to walk by ETV desk to do so.

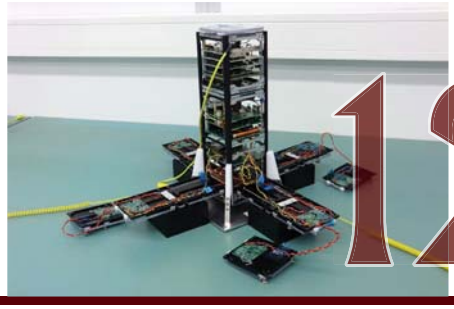
In the week of Pentecost, the ETV hosted an EESTEC workshop for which 12 European students came to Delft for eight days to get to know the city, the people and work on a TU Delft project. Together with the light version of what you probably know as the 'smart robot challenge' they were introduced to The Hague and Amsterdam and typical Dutch deep fried food.

As I am writing this, me and others are really looking forward to the "Sailicium" sailing weekend that one of our first-year committees organises next weekend. For now I will close with this, but since this my last opportunity to write for the Maxwell as a board member: I want to wish everyone a great summer vacation and I hope to see you all back next year.

On behalf of the dynamic, 141th board,

Derk-Jan Hulsinga

# Theme content



12

## ISIS Nanosatellites

Electronics in outer space

Language:

14

## Bluerise

Harnessing the ocean's thermal power

Language:

16

## Photo page

Geothermal power plant

Language:

18

## Dream team

Dare - Stratos II

Language:

**ETV MAGAZINE "MAXWELL"** Year 16 – edition 4 – June 2013 **PRINTING** DeltaHage B.V., Den Haag **NUMBER OF COPIES** 800 **EDITORS** Jeroen Ouweneel, Benjamin Gardiner, Ester Stienstra, Adriaan Taal, Isabelle Vlasman, Derk-Jan Hulsinga, Tobias Roest **CONTACT** Maxwell, p/a Electrotechnische Vereeniging, Mekelweg 4, 2628 CD Delft, phone: 015-2786189 or 015-2781989, e-mail: *Maxwell-ETV@tudelft.nl*, website: *www.etv.tudelft.nl* **CHANGE OF ADDRESS** Please send your changes to the address above, or use the website **ADVERTISEMENTS** KPN Consulting (p.8), Deerns (p.31), Lely (back) **SUBSCRIPTIONS** Non-members can receive the Maxwell four times a year, against a contribution of €10,- per year. For more information, please contact the Maxwell Committee.

# ... and more


- From the Board 3
  *An overview of the last quarter by the president of the ETV*
- Newsflash 6
  *Updates from the Electrical Engineering field*
- Exploring the researchgroups 9
  *Microsystems / MEMS technology*
- From IC design to costumer intimacy 20
  *ASML advertorial*
- Graduation report 22
  *Joost van Driel on Cochlear implants*
- ETV Activities 25
  *Excursies naar KEMA en Stedin*
- Dies report 26
  *Een verslag van de feestweek van de ETV*
- Tie before you Die 28
  *EESTEC workshop 2013*
- ETV Social activities 30
  *An overview of last quarter's social activities*



# Editorial

As you read this, you are sitting in the sun, enjoying some nice time off. Or at least this would be the ideal picture. Unfortunately you never know what the weather in the Netherlands does. And besides that some students still have to do a lot this summer in order to be allowed to continue their bachelor studies. For those freshmen there is a very nice program this summer, called BSAugustus. Where the ETV will open up a study room and some senior students will help you with all your questions. Good luck to all of you who still have to gain enough study points for BSA!

We as Maxwell committee had a great time making this edition again. Our theme this time is extreme environments. We look at applications in the ocean as well as in space. Besides the theme we also have the graduation report from old time committee member Joost van Driel, he tells us all about his research on cochlear implants. Also we visit another research group, this time we stay in our own study field. And off course a lot of reports of all the activities from this quarter are included. Not only the usual stuff has been done this quarter, but also the birthday of our beautiful society has been celebrated. All the traditional celebrations have been alternated with new activities, that might have been the first time of a new tradition, since some of them where very successful.

After all this fuzz we now have a whole summer to relax before a new board will be installed in September and a new and exciting year will start again. We wish you all a great summer and good luck with the re-exams in August.

*Ester Stienstra*

# Newsflash
## Updates from the EE field

**Author: Jeroen Ouweneel**

### Sensors, camera, action!

The Ishikawa Oku Laboratory (University of Tokyo) has been researching in the field of high-speed sensors, image processing and actuators for quite some year now – leading to several ingenious, useful and (perhaps mainly) fun-to-watch inventions. At the basis of these contraptions lies a parallel control system that is able to perform a full readout-processing-actuating cycle in a single millisecond.

The high update frequency of 1 kHz has an advantage: it eliminates the need for path-prediction of recorded objects, thereby saving valuable calculation time. It is enough to simply adjust the actuators based on the current and previous video frame.

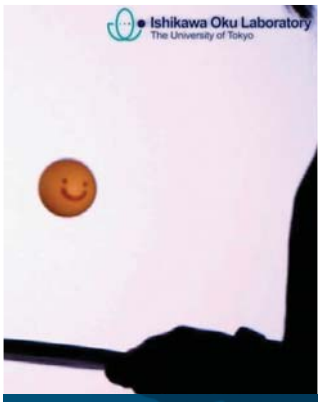
With this system, several setups have been made, most of which use a combination of a (full-HD) camera, a digital image projector and high-accuracy actuated mirrors. The possibilities seem endless: projecting a 'smartphone' from above on a piece of paper, or a dial pad on a hand (which, of course, follows the projected surface's every move) - or even projecting a smiley on a ping pong ball (called 'Lumipen'), as can be seen in the QR-codes movie.

Also in the movie, the same principle is used to keep the center of a camera perfectly focused on a ball in motion. Rather than the 'conventional' method of moving a camera to keep track of a target, two high-speed actuated mirrors are placed in fromt of the camera. This technique is currently being tested 'in the field' – imagine what a penalty would look like with the soccer ball perfectly in the center throughout the shot!

Other examples are a high-accuracy baseball swinger that never misses, and a rock-paper-scissors robot that always wins (by last-minute analyzing the human opponent's hand movement, and reacting accordingly).

Most of these contraptions may not seem very contributing to society, but when matured they may very well be employed for i.e. automating high-accuracy manufacturing tasks or improving delicate surgery.

Source: *http://www.k2.t.u-tokyo.ac.jp/*



Smiley projected on a ball

Check the Lumipen in action!

A human losing rock paper scissors to the robot - once again


The two actuated mirrors that keep camera focus on a subject

## New KALQ-tablet keyboard layout

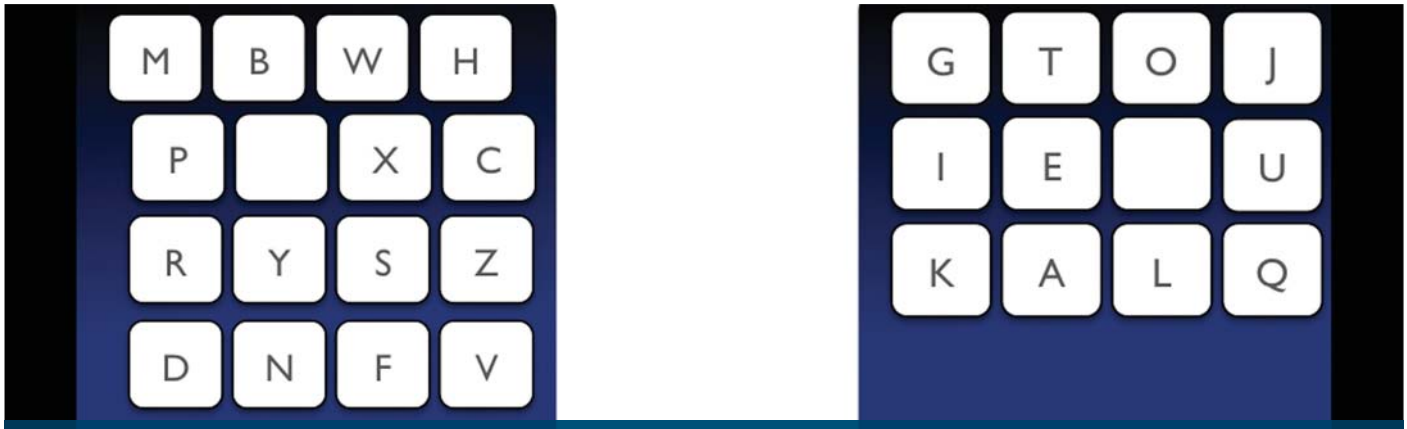
Typing on tablets is usually with the help of an on-screen, virtual querty keyboard. This is somewhat strange, as these devices are usually held with two hands - meaning only two thumbs remain for typing.

In an attempt to tackle this problem, researchers at the University of St Andrews came up with a new keyboard layout, kalled 'KALQ', which - according to research - can speedup tablet typing by an impressive 34 per cent.

The most important concept is avoiding long typing sequences with a single thumb, as this allows the user to already move to the next symbol while typing another.

With this, and a model for thumb movement, as a mathematical basis, the layout was optimized, with the pictured layout below as a result.

Source: *http://st-andrews.ac.uk*




The proposed new tablet keyboard 'KALQ' layout, which can alledgedly speed up typing by 34%

## Solar cell efficiency record broken once again!

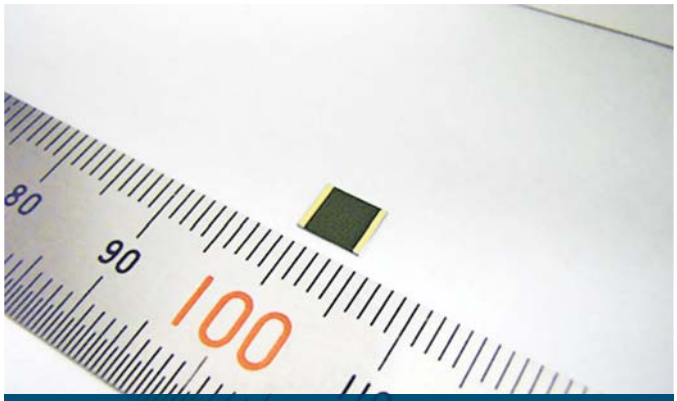
If there were a Guiness record for 'most broken record', solar cell efficiency would most certainly win. This time, Sharp claims the prize with 44.4% efficiency, as confirmed by the Fraunhofer Institute for Solar Energy Systems.

In order to achieve this efficiency, Sharp employed several techniques. First off, the cell is what is known as a 'concentrator triple-junction compound' solar cell. This means the cell is made of not one, but three different photo-absorption layers - which means a broader range of wavelengths can be converted to electricity. This had already led to a solar cell capable of converting 37.7 % of oncoming sunlight in late 2012.

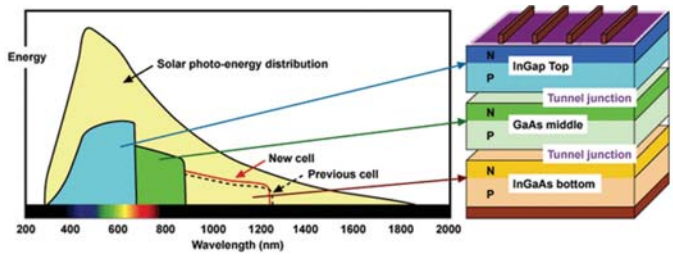
What gave the final push was the use of a Fresnel lens to focus sunlight of a larger surface to the solar cell below. Note that this is the 'concentrator' part of the above cell description -i.e. it is a separate 'class' of solar cells, with their own record.

Nowadays, these compound solar cells are only used on space satellites, but the goal of sharp is to mature their techniques far enough to make these kind of high-efficiency cells available 'on land'.

Source: *http://sharp-world.com*, *http://phys.org*




The record-holding compound solar-cell




Graph illustrating the three photo-absorption layers

# Uitgestudeerd, maar nog niet uitgeleerd?

KPN Consulting* zoekt:
Young Professionals Proces- & Projectmanagement
Young Professionals Techniek

## Wat ga je doen?

Het Young Professional traject van KPN Consulting duurt in totaal een jaar en is een goede mix van trainingen, cursussen en praktijkervaring bij de klant. Gedurende het traject maak je op een leuke en prettige manier kennis met het 'werkende' leven. Als YP start je met een uitgebreid en geheel verzorgd introductietraject van drie weken, waarna je direct inzetbaar bent. Tijdens dit traject krijg je verschillende vakinhoudelijke, business- en soft skills trainingen en workshops. In deze korte en intensieve periode leer je onze organisatie en je collega's goed kennen.

Alle kennis die je tijdens de introductie hebt opgedaan, kun je direct toepassen bij onze klanten. KPN Consulting werkt samen met de 400 grootste bedrijven van Nederland zoals Shell, Nuon, Rijkswaterstaat, NS en ING. Bovendien stippel je samen met een persoonlijke coach een carrièrepad uit aan de hand van jouw kennis, ervaring en ambitie. Gedurende het jaar volg je naast je projecten nog enkele trainingen. Ter afsluiting van het traject voer je samen met je mede YP-collega's een praktijkgerichte case op het gebied van techniek of proces- & projectmanagement uit, die je daarna presenteert aan onze directie.

Na het eerste jaar ontwikkel je je verder richting proces- & projectmanagement, service & performance management, techniek of architectuur. Je kunt daarbij een vliegende start maken door als High Potential door te stromen naar een vervolg opleidingstraject, waar je in korte tijd de kennis, kunde en ervaring opdoet voor de rest van je loopbaan. Dit geeft je de mogelijkheid om uit te groeien tot een gewaardeerde consultant die organisaties met concrete adviezen naar een hoger niveau tilt.

## Wat verwachten wij van jou?

- Afgeronde masteropleiding bij voorkeur in een bèta studierichting
- Goede beheersing van de Nederlandse taal in woord en geschrift
- Communicatief en sociaal vaardig
- Helikopterview, proactief, resultaatgericht en pragmatisch
- Je staat voor kwaliteit en je zet graag een stapje extra
- Affiniteit met IT

## Wat bieden wij?

Wij bieden jou een carrière bij de nummer 1 in ICT-consultancy met zeer goede primaire en secundaire arbeidsvoorwaarden. Veel belangrijker vinden wij het echter om jou de kans te bieden je te ontwikkelen, daarom denken we met je mee in een persoonlijk ontwikkelplan en heb je bij ons goede doorgroei- en opleidingsmogelijkheden.

## Interesse?

Reageer dan snel en stuur jouw motivatie en CV naar Mandy Klemann.
Voor meer informatie kun je contact opnemen per email via mandy.klemann@kpn.com
of telefonisch via 06-13444246 of bezoek onze website op www.kpn.com/consulting.

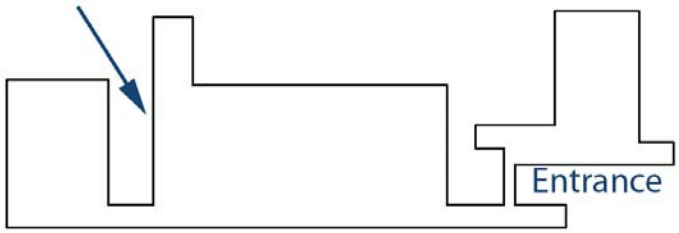
*KPN Consuling staat sinds 2012 in de top 25 van Great Place To Work.

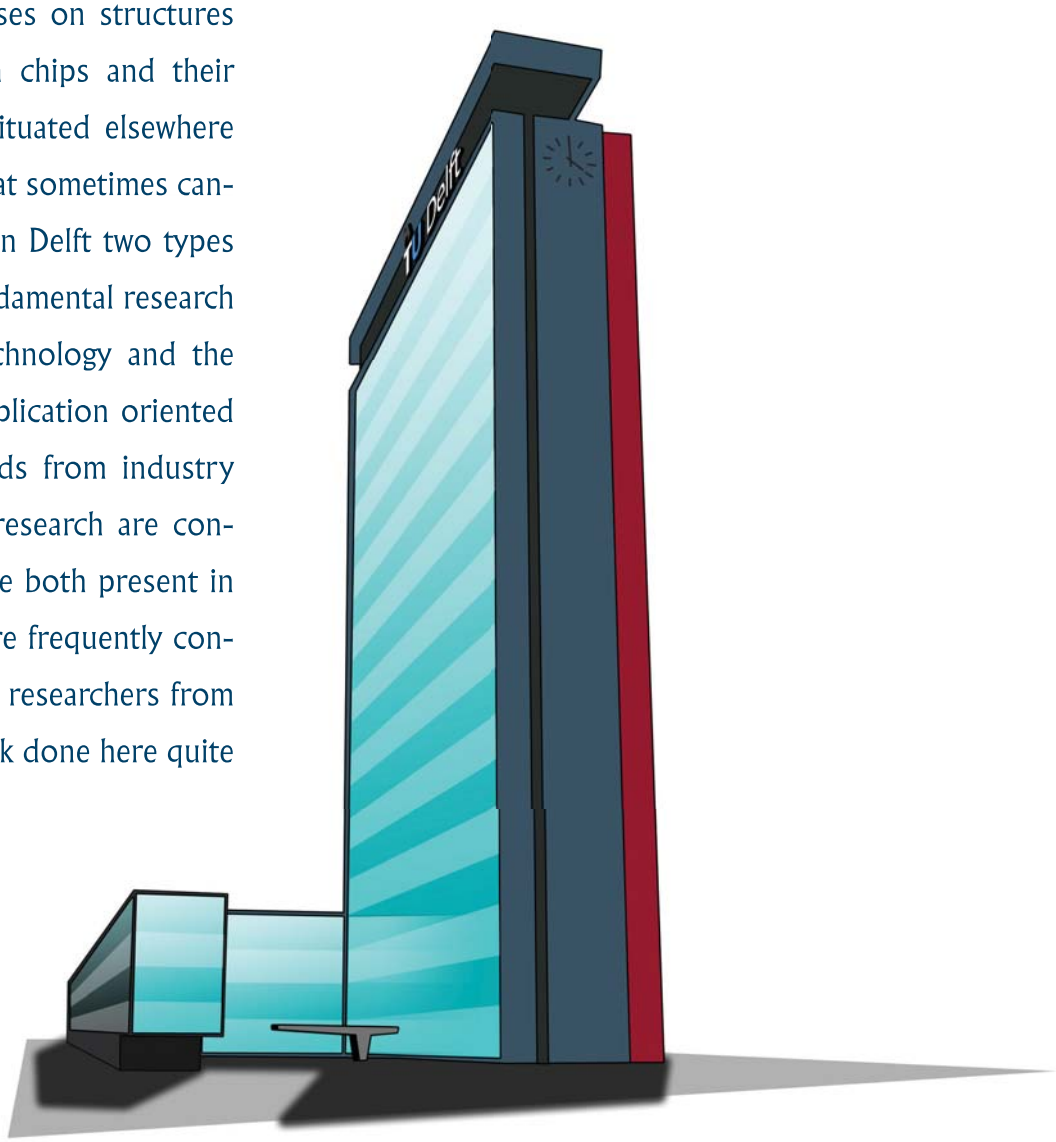
kpn consulting

# Exploring the research groups
## Microsystems / MEMS Technology

**Author: Ester Stienstra**

The last edition of this year we stay at our own faculty and visit a group that is part of our own study field. We visit Prof. Lina Sarro who  is part of the group Microsystems / MEMS Technology. MEMS stands for micro-electro-mechanical systems and is a research field that focuses on building very small mechanical structures on chips. Since the research group in Delft is closely involved in the DIMES laboratory, the group here focuses on structures that are compatible with silicon chips and their fabrication processes. Groups situated elsewhere often focus on other materials that sometimes cannot be integrated. In the group in Delft two types of research are done, a more fundamental research into material properties and technology and the type of research that is more application oriented and often is inspired by demands from industry or society. These two types of research are conducted side by side and often are both present in the same project. The projects are frequently conducted in close cooperation with researchers from other fields, which makes the work done here quite diverse.



The research done in the MEMS group is often a big puzzle. The big question is always how to come up with a device that both implements the desired functionality and fits into a silicon IC process. For every question addressed one or more solutions can be ticked off as not useful. The challenge is to find the optimum solution at the end. The structures that are made are three-dimensional (3D) structures that can a.o. move objects, transport heat or can sense if a particular chemical is present. The goal of the group is to develop a 'toolbox' that includes an amount of structures and devices that together can do whatever is demanded from the envisioned application. The parts in this toolbox are of course changing as the technology progresses.

## Materials

The main material of the chip is already defined as silicon, since this is the main material of the surrounding circuitry. But this does not mean that the entire MEMS device should also be made of silicon. New materials are explored to be able to improve structures functionality. One of the hardest things here is that the material should be compatible with silicon IC technology. Some materials simply cannot be used because they damage the silicon structure too much. Other materials are not compatible because to process them on an IC you need methods that will ruin other parts of your already processed chip.

Two new materials that are currently being explored are aluminum nitride and silicon carbide. Aluminum nitride will be processed as a final layer on the chip and can be used to make very sensitive resonators. These resonators than can be used to measure mass in very small amounts, which is of great interest for industry. Silicon carbide for MEMS is a very new research field, and DIMES is one of the few labs to process it. The good thing about this material is that it is very resistant against corrosion and temperature. The drawback is that the processing is more complex than for silicon. Therefore it is only used for very important parts, or it can be used as a protective thin-film layer that is put on top of part of the chip.

## Techniques

Most of the techniques that are used for making MEMS are techniques that are also used for normal IC fabrication. This is convenient since it means that the structure can be build up simultaneously with the rest of the IC which saves time. But sometimes structures need to be made in a way that is not compatible with the already existing IC processes. When this happens it can be a possibility to make the structure after the rest of the chip is fabricated. Research in this field focuses on making structures as compatible with IC fabrication as possible. This means improving current techniques, but also respond to developments in the IC fabrication research.

One of these new developments in IC techniques is the fabrication of flexible chips. With these techniques transistors and other devices are places on a flexible substrate. The challenge here is to adapt existing MEMS structures in such a way that they can be used on such a flexible substrate. One of the problems in this is that because of the substrate only low-temperature process steps can be used. Another interesting new development is the use of atomic layer deposition. With this technique a structure can be build layer by layer, where one layer has the depth of an atom. This is clearly an ideal technique if you want to build complex 3D structures, that then even can consist of a number of different materials. With this very accurate process you can even build nanopillars or tubes on a chip, that for instance can be interesting for gas sensing or nanofiltratiion. The problem here is that it is a very slow process, so it should be used for very thin layers or very small structures (a few tens of nm).

## Sensors

A sensor type that a lot of research is conducted on are gas sensors. This type of

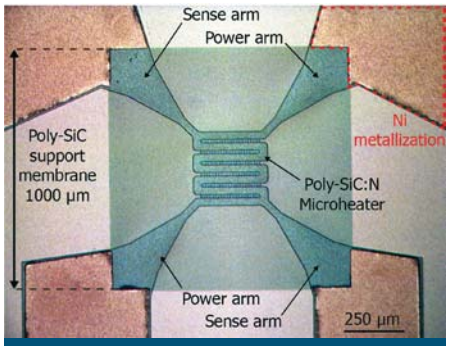


Fig. 1 Silicon Carbide microheater.

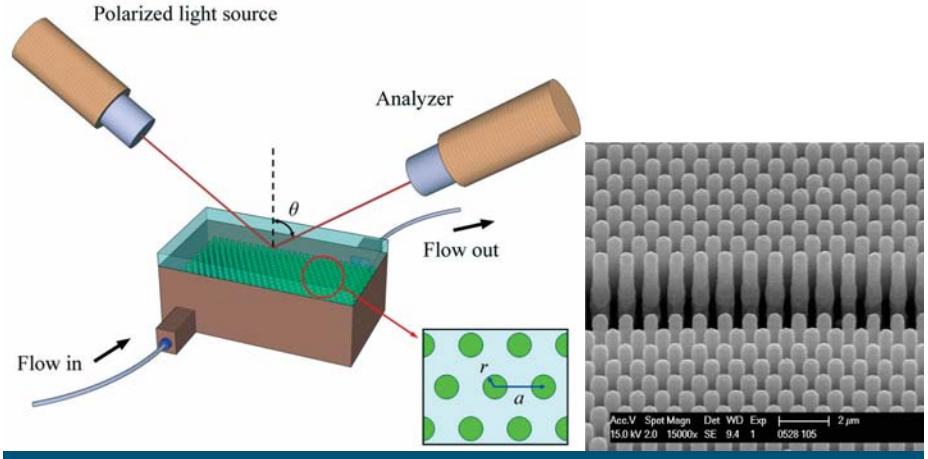


Fig. 2 ALD TiO2 nanopillars for PC liquid and gas sensing.

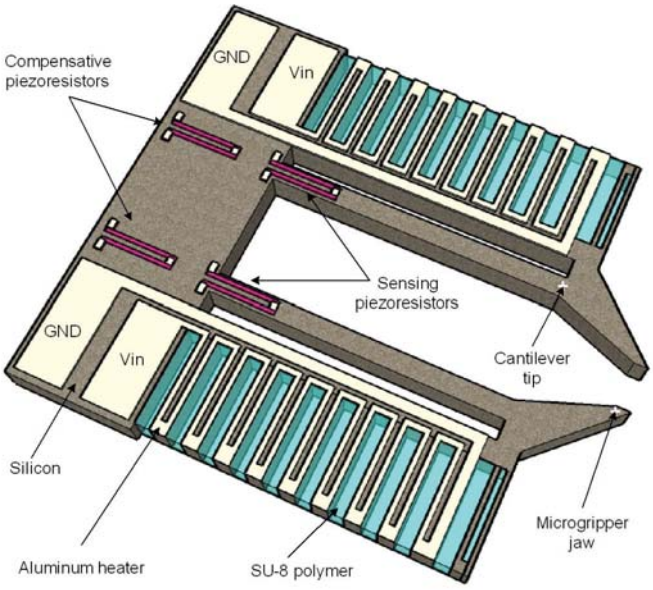



Fig. 3 Sensing microgripper.

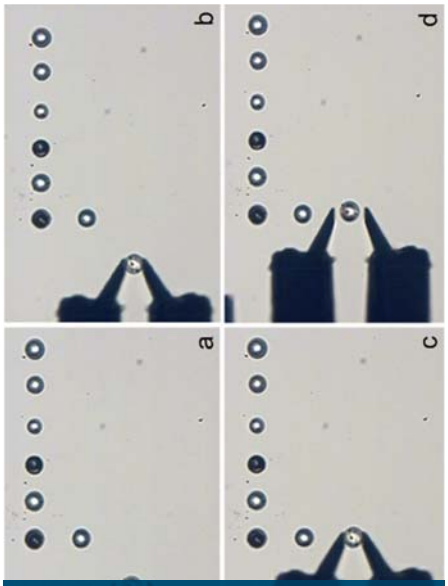



Fig. 4 Manipulating micro-glass-balls to form the letter L.

sensors is sought after by industry, but a lot of questions around them are still unanswered. The biggest issue is selectivity, as often a sensor is sensitive to multiple chemicals which can lead to unclear measurement results. The structure of such a sensor is always dependent on the chemical that needs to be measured, but unfortunately in reality a sensor is always placed in an environment with a mixture of gasses and often the device is also sensitive other gasses in the mixture. In order to solve this problem not only research in the MEMS field is needed, but also in the field of chemistry. Another project that involves chemistry are nanowires for biochemical applications, the biggest question here is how to put multiple of these wires on a silicon platform, in order to improve the sensor response

## Actuators

The counterpart of sensors are actuators, this are structures that perform an action based on the environment or on electrical signals. This can vary from a cantilever that is simply a switch to micro structures that act as a complete engine. Together with sensors actuators can be used to build chips that not only measure but also react to what they are measuring in order to change parameters in theire environment. Actuators that are studied, are structures that can move objects, or in case of flexible objects reshape them. When using MEMS to move lenses an optical structure can be build with an automatic focus function that is done by moving the lenses. Also research is done to build 3D silicon thermodynamic structures. These than can be used for heat management on a chip, which is becoming a bigger problem due to the shrinking of the component and wires on a chip.

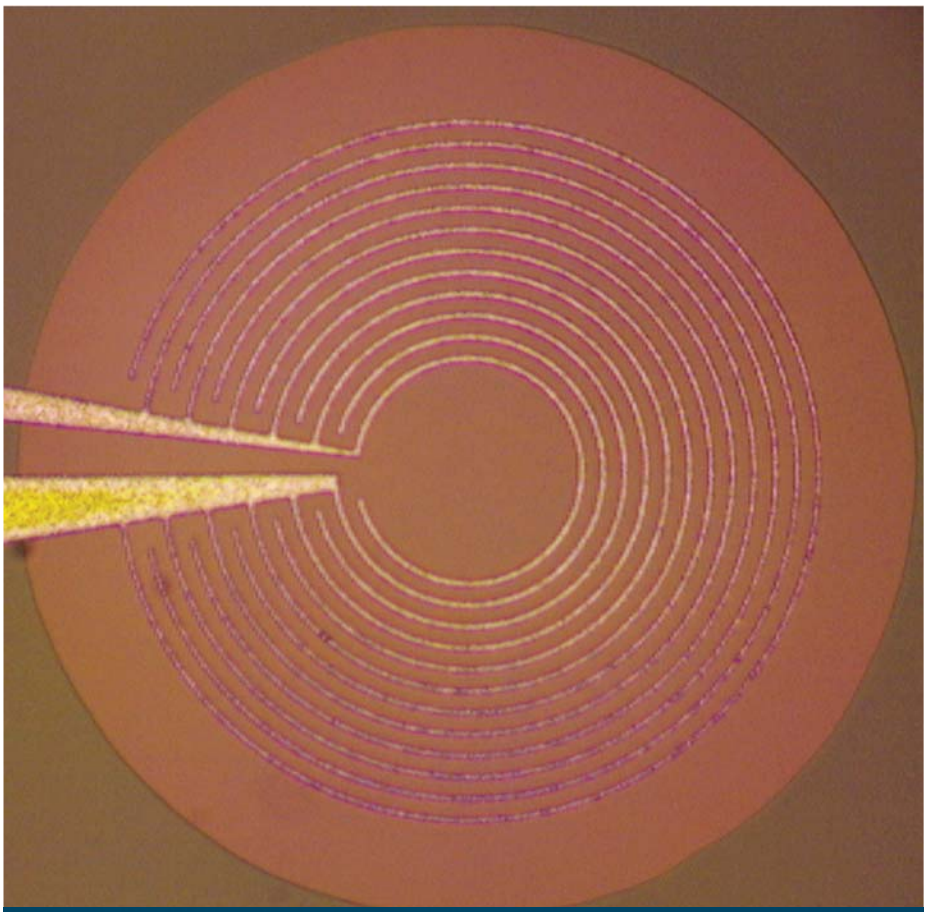


Fig. 5 Aluminum Nitride resonator for mass/particle sensing

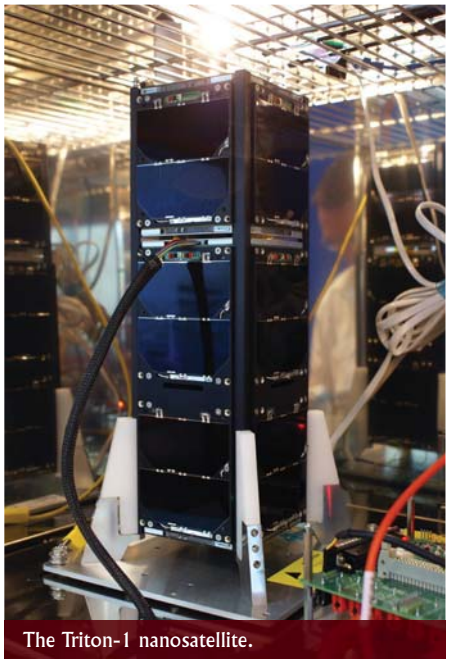
# ISIS nanosatellites
## Electronics in outer space

**Author: Waldemar Lubbers**

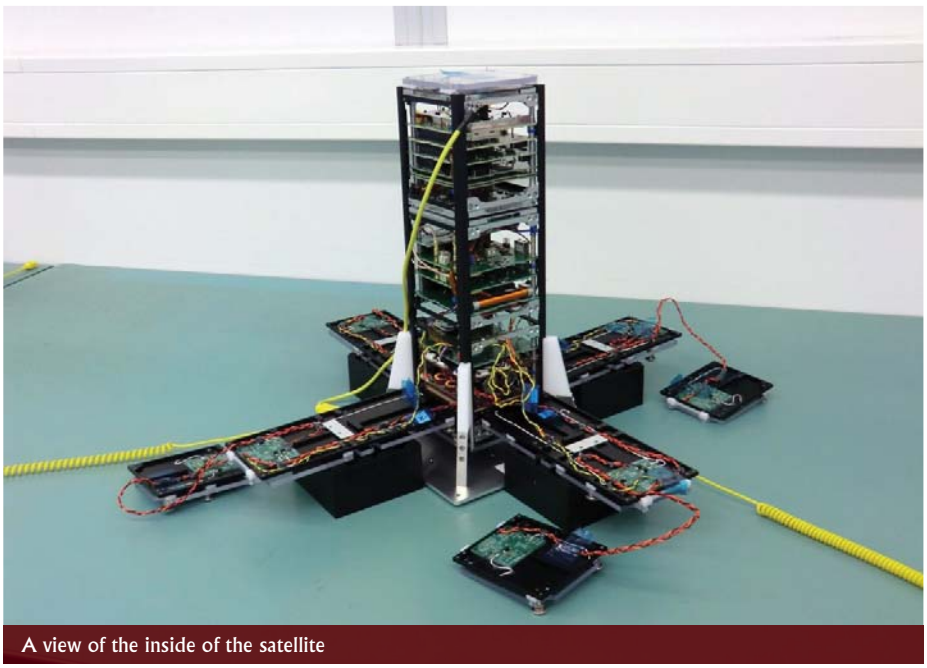
ISIS – Innovative Solutions In Space BV is a small space company in Delft, started as a spin-off from the Delfi-C3 satellite project from Delft University of Technology in 2006. Now, with more than 45 engineers, ISIS develops, launches and operates very small satellites, called nanosatellites, for a variety of applications. One of those applications is global ship tracking, for which ISIS has built a first demonstration satellite called 'Triton-1', waiting in ISIS' clean room for its journey to space. Space, an extreme environment, with vacuum conditions, temperature extremes from very cold to boiling hot and hostile radiation levels.

To best understand the possible effects of such an extreme environment on a satellite, imagine that you are the electronics system within a satellite. Your name is Triton-1, you were built in Delft and you just survived your hefty and shaky trip into space on a reliable, Russian rocket. Up there it is remarkably silent, since there is no air to propagate sound, only vacuum. Finally you have been deployed from the upper stage rocket body. Now you move with an incredible speed of 26000 kilometers per hour around the Earth at an altitude of 655 km, 300 km above the International Space Station. When you circle around the Earth with this speed it takes about 90 minutes to complete $2\varpi$ radians. It is alternating either hot when you're in the Sun, or very cold when you are in the shade of the Earth. This means that you will experience 17500 thermal cycles during your 3 years of operational lifetime. Next to that you will experience galactic cosmic rays and solar energetic particles from nearby and far away stars, pulsars and other cosmic objects. There are even micrometeorites and other debris flying there with other directions and speeds than you that threaten your life.

Ok, back to you, Triton-1. You have been silent during the rocket ride till now with all your systems shut down that can interfere with the communication systems and electronics on the rocket itself. Only a few timers are ticking to switch on your systems, first the power system, consisting of pre-charged batteries, solar cells,



The Triton-1 nanosatellite.



A view of the inside of the satellite

The satellite

regulators, switches and maximum power point trackers. Then the on-board computer (OBC) switches on. A little later the solar panels will be deployed by burning a wire and the spring mechanisms in the high efficiency solar cell panels will do their work. The same hot resistor wire burning system is used to deploy the antennas for V/UHF communication transceivers and the AIS receiving payload.

Deployed antennas mean that you can now communicate with the ground station. The flight plan software in the OBC contains pre-programmed test sequences that can be activated from the ground. After checking the systems and reporting back to the ground it is decided that the payload of the satellite can be switched on. The payload of a satellite determines the core functionality, such as communications, broadcasting, GPS, Earth observation or, in your case, receiving AIS signals. You have been put into this hostile environment for tracking ships at places where they cannot be received with ground based AIS receivers, i.e. in the middle of an ocean, far away from the shore. But at the altitude that you're at you will receive so many ship messages that they will collide, meaning that more than one ship has sent messages to you at the same time, so the signal you receive will have multiple overlaps.

But… You're a lucky satellite, the (electrical) engineers from ISIS engineered you very well, the best they could in your short development time. You are provided with a patented message decolliding algorithm that can decode even the AIS messages with multiple overlaps. You have semiconductors in your system with flight heritage and proven radiation hardness. Testing proved that you will survive the G-forces during the launch, thermal cycles and vacuum. Some of your systems are redundant, so that if one of the chains does not work anymore, it can switch over to another chain. You are soldered with Leaded solder so that you will not die because of Tin whiskers shorting your circuits. Your microcontrollers are programmed in such a way that if a part of the memory experiences a single event latch-up it switches over to another memory chip. Many reviews have been held to minimize the risks that you will experience. The deployment sequences, flight software and electronic systems have been tested over and over again. Simulations and tests show that you will not overheat nor freeze to death. All details should have been thought of.

*"You're a lucky satellite, the (electrical) engineers from ISIS engineered you very well"*

Now go, Triton-1, go, and do your job, for the years you have been designed for..

If you would like to have more information about ISIS, about Triton-1, or about the work of electrical engineers in the space industry, please feel free to contact ISIS.

Website: www.isispace.nl

Email: info@isispace.nl

# Bluerise

## Harnessing the ocean's thermal power

**Author: Berend Jan Kleute, co-founder of Bluerise**

Covering 70% of our globe, the oceans are the largest solar collectors on Earth. They have one of the world's largest renewable energy potentials. A principle called "Ocean Thermal Energy Conversion" (OTEC) can be used to unlock this potential and generate base-load "24/7" power.

Today's increasing need for clean, renewable energy has accelerated worldwide OTEC technology development. The US, Japan, France and the Netherlands are in the race to commercialize OTEC. Bluerise, a spin-off company from the TU Delft, has developed advanced OTEC technology and is currently scaling its technology to a 100kW OTEC pilot plant in the island of Curaçao. Soon OTEC will be part of the global energy mix.

### How does OTEC work?

The OTEC technology works by utilizing the naturally available temperature difference between warm surface water and deep seawater to drive a thermodynamic cycle and generate electricity. The principle is quite simple. The warm seawater at the surface is used to evaporate a working fluid, like ammonia. The vapor drives a turbine generator. The cold water brought up from the deeper ocean layer is then used to condense the vapor so it can be reused. This is a continuous electricity generating cycle, called the 'Organic Rankine Cycle' (Figure 1).

### How efficient is OTEC?

The efficiency of the cycle is strongly determined by the temperature differential. The bigger the difference, the higher the efficiency. Tropical waters are therefore particularly suited for OTEC. There the ocean surface temperature is about 26°C to 28°C and fairly constant year round. At about a thousand meter deep, the seawater is about 5 °C. The temperature difference therefore is just above 20 °C, bringing the theoretical efficiency, determined by the Carnot efficiency, to about 7 percent. Realistically, because of the required pumping power and sub optimal components, an efficiency of about 3.5 percent is achieved. This sounds low, however, some aspects of OTEC are significantly different than those of fossil fuel or nuclear energy plants. First of all, the energy source of OTEC is free - ocean water. Then, the energy source is available abundantly. And last, the source is renewable and is replenished as long as the sun shines.

### What is the potential of OTEC?

The potential of OTEC is vast. The latest report by the Intergovernmental Panel on Climate Change (IPCC) estimates the global potential that can be economically harnessed from the ocean without harming the natural ocean cycles to be between 5 and 10 Terawatts, more than two times our current global electricity demand.

In addition to electricity production, OTEC also offers the possibility of co-

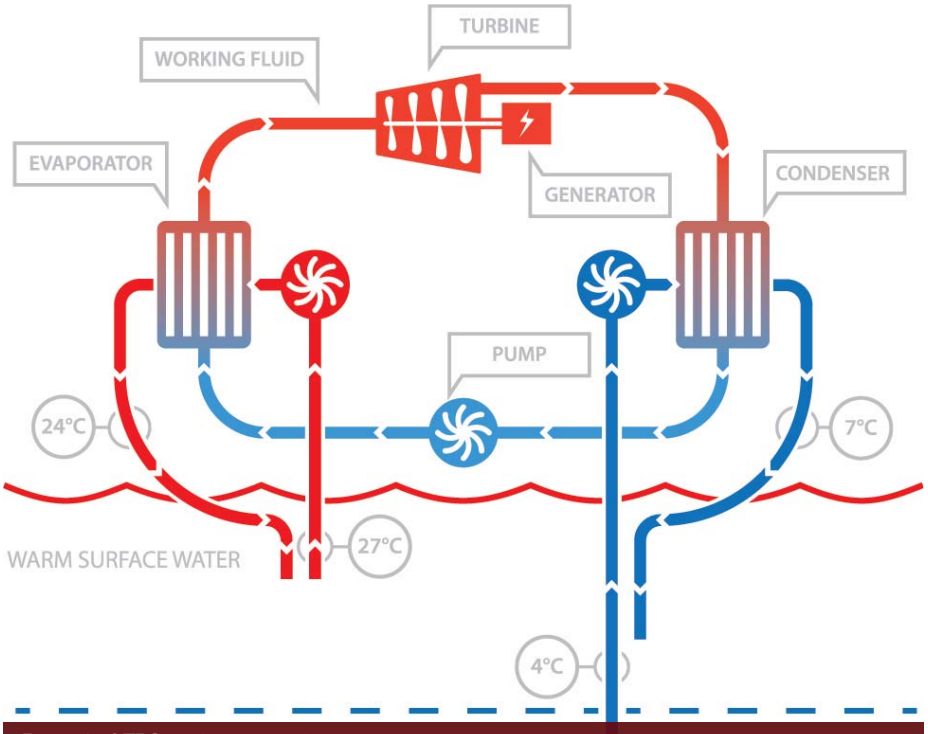



Figure 1: OTEC working principle

Figure 2: The first net energy producing 15kW OTEC demonstration plant in Hawaii, 1979

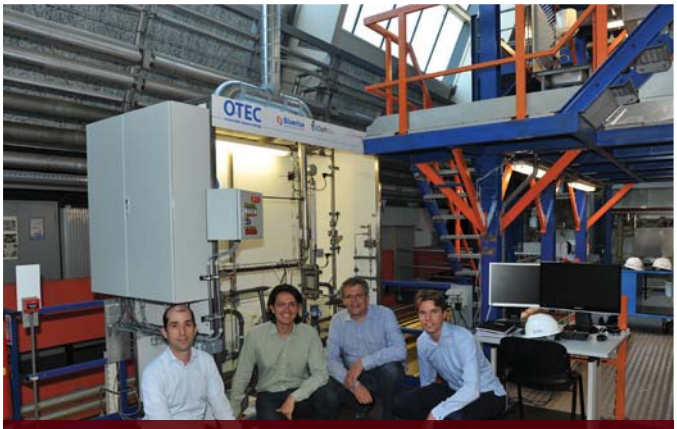



Figure 3: Bluerise founding team in front of OTEC advanced research prototype

generating other products, like clean drinking water and enhance agriculture and aquaculture production. Furthermore, the cold deep seawater can be used to efficiently cool buildings, saving up to 90% in energy consumption compared to conventional air-conditioning systems.

One of the main advantages when comparing OTEC to other renewable sources, such as wind and solar energy, is its baseload characteristic. It can produce constant electricity, day and night. This is a big advantage for remote regions, such as islands that typically have a small electricity network, not capable of handling a lot of intermittent power.

## What happened? And why will OTEC happen today?

OTEC has a long history, starting in 1881 when the French scientist Jacques-Arsene d'Arsonval thought it up. In the time that followed there have been several OTEC demonstration projects. One of them was mini-OTEC (figure 2) deployed in 1979, at the end of the oil crisis. Shortly after 1980, oil prices started to go down and interest in renewable energy faded. Up to today, OTEC has not yet proven itself commercially.

Since the 80's, a lot has changed. Not only does the world have to deal with an energy crisis, the greenhouse gas emissions created by burning fossil fuels are creating a climate crisis as well. Never has the need been greater to transition to a clean, renewable energy use. Last, OTEC technology matures to an economically viable level with improved know-how and experience available today in for example the offshore industry.

The market is developing rapidly. Multiple demonstration projects are under development worldwide. The company Lockheed Martin, a major defense contractor has announced to be committed to build a commercial 10MW OTEC installation. The same counts for DCNS, a major defense company in France.

## What's next? What role will NL and Bluerise play?

The Netherlands, being an international hub for offshore and maritime technologies, has a great opportunity to conquer a leading role in the renewable energy sector with OTEC.

Bluerise takes advantage of today's available expertise and is constantly improving its technology. Bluerise has developed an advanced OTEC cycle which is 10 – 20% more efficient, compared to current system designs, with a similar cost structure.

Bluerise is currently scaling its technology to one of the world's first OTEC power plants in the island of Curaçao. This 100kW pilot is scheduled to start in 2014 and will be installed for the Curaçao International Airport. It will be a showcase to the rest of the world of how OTEC could be implemented. We are working closely with motivated students. They get the opportunity to work on real projects, such as our test setup at TU Delft and our project in Curaçao. It may happen that you have to go to one of these beautiful tropical islands.

OTEC will prove to be a very attractive and essential part of the future energy mix and play an important role in cleaning the world's energy. The future will be green… and blue!

*For more information, hereby some relevant websites:*

www.otecnews.org

www.otec.tudelft.nl

www.bluerise.nl

# Geothermal Power Plant

## Generating energy from Earth's heat

Near the Krafla volcano in Iceland is the Krafla Geothermal power plant. The history of the Krafla power plant has been turbulent, starting from the onset when volcanic activity jeopardized the plant's existence just prior to its connection to the network.

The volcanic eruptions which ensued during the period between 1975 and 1984 caused corrosive vapor to enter the geothermal system which in turn altered the chemical properties of the steam supply, increasing its corrosiveness and destroying the supply lines. Despite these difficulties the first turbine was connected to the network in 1978.

As a result of the volcanic activities, the second turbine was not erected during the first phase as originally foreseen and the power plant was commissioned with only one of the two purchased units operating and only at approximately 10% capacity. In the following years, the amount of harnessed steam was gradually increased until the plant was operating at 100% capacity in the early 1990s.

At full capacity one turbine unit utilizes 55 kg/sec of saturated high pressure steam at 7.7 bar and 18 kg/sec of saturated low-pressure steam at 2.2 bar.

**Sources:** **http://assets.inhabitat.com/wp-content/blogs.dir/1/files/2013/03/Geothermal-Energy-Island-1.jpg**

**http://www.verkis.com/projects/geothermal/power-plants/nr/1628**

# Dream team
## DARE - Stratos II

**Authors: Geert Henk Visser and Christ Akkermans**

Delft Aerospace Rocket Engineering (DARE) is a student organization at the TU Delft which focuses on the design and production of rockets. The largest project within DARE is called Project Stratos. Within this project, students aim to design, build and launch a rocket to at least 50 kilometers altitude, whilst also servicing a multitude of payloads. After reaching the maximum altitude, the nosecone harboring all of the electronics and payloads is to descend back to Earth using a parachute. This Stratos II rocket is the successor to DARE's Stratos I rocket, launched in 2009, which set the European altitude record for amateur rocketry at 12.3 kilometer.

All of the electronics used to control the Stratos II rocket, as well as all other DARE rockets, are fully developed and built by DARE members. The basic functionality required to control a rocket could be summarized as a straight forward set of steps: igniting the engines, detecting launch and deploying a parachute. One could achieve these functions using a simple timer based controller. For most rockets however this method would not suffice.

### Electronics design

A significant challenge arises from making the electronics compliant with the extreme forces and vibrations associated with the launch of the rocket. An extra challenge for the electronics in the Stratos II rocket results from the space-like conditions at 50 kilometers altitude. In order to improve mission performance, an event driven system is more suitable than a simple timer based system. The Stratos II electronics are also to power the various payloads on board, store generated payload data and transmit telemetry data back to the ground station in real time.

The Stratos II flight computer will be equipped with a sensor kit containing an inertial measurement unit, magnetic field sensors, pressure sensors and temperature sensors. These sensors combined with an on-board simulation of the rocket, will allow the flight computers to propagate the rocket trajectory and attitude in real time. Using the output of the flight computers,

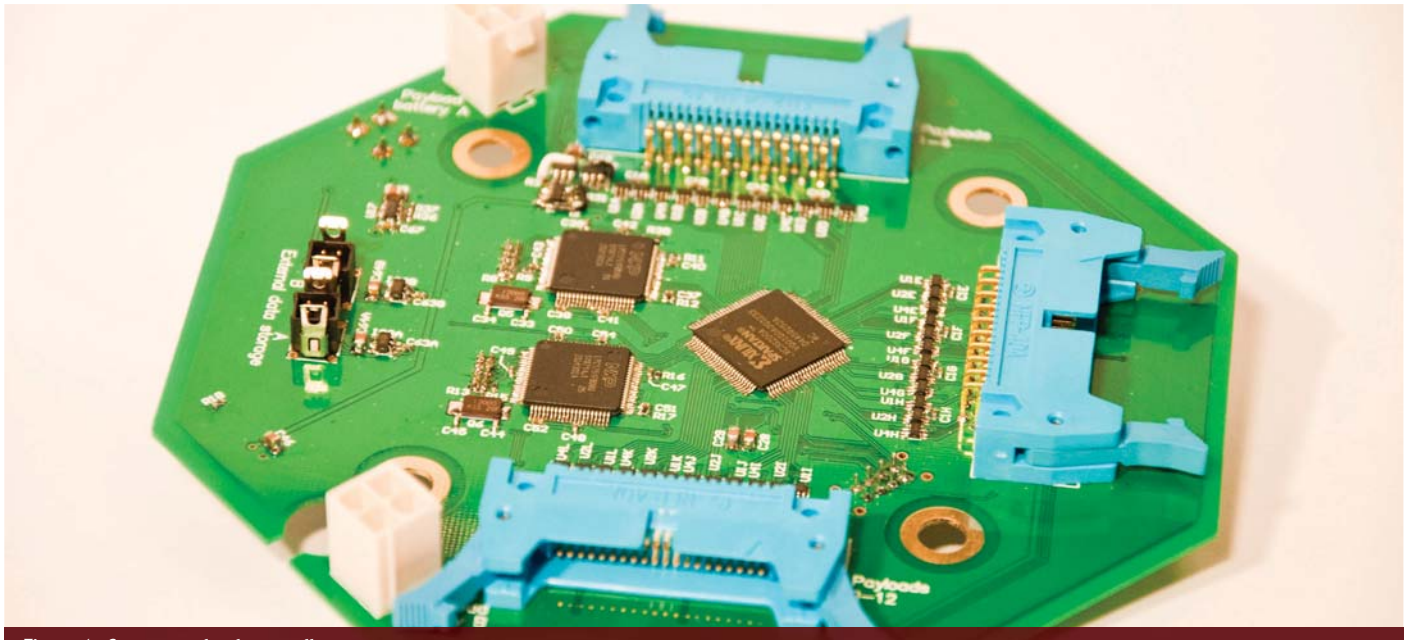


Figure 1: Stratos payload controller

actuation events can be timed where they are most effective. The exact moment of execution of these events is determined using a voting system between the two trajectory propagators and a main control unit, which employs a simpler timer based system.

## Payload controller

A photo of the flight version of the Stratos II payload controller board is visible in Figure 1. This board contains multiple micro-controllers and an FPGA tasked with routing the payload data to the various subsystems like the telemetry and data-storage. This board and the software running on it were fully developed in house. The physical design of the electronics package consists of multiple interconnected boards, where the mission critical boards are placed in a redundant configuration.

If you want to know more about DARE and Project Stratos or if you are interested in participating in one of DARE's projects, please visit our websites *dare.tudelft.nl* and *projectstratos.nl*, send an email to *info@dare.tudelft.nl* or subscribe to our Facebook page.


Figure 2: Dare Board members

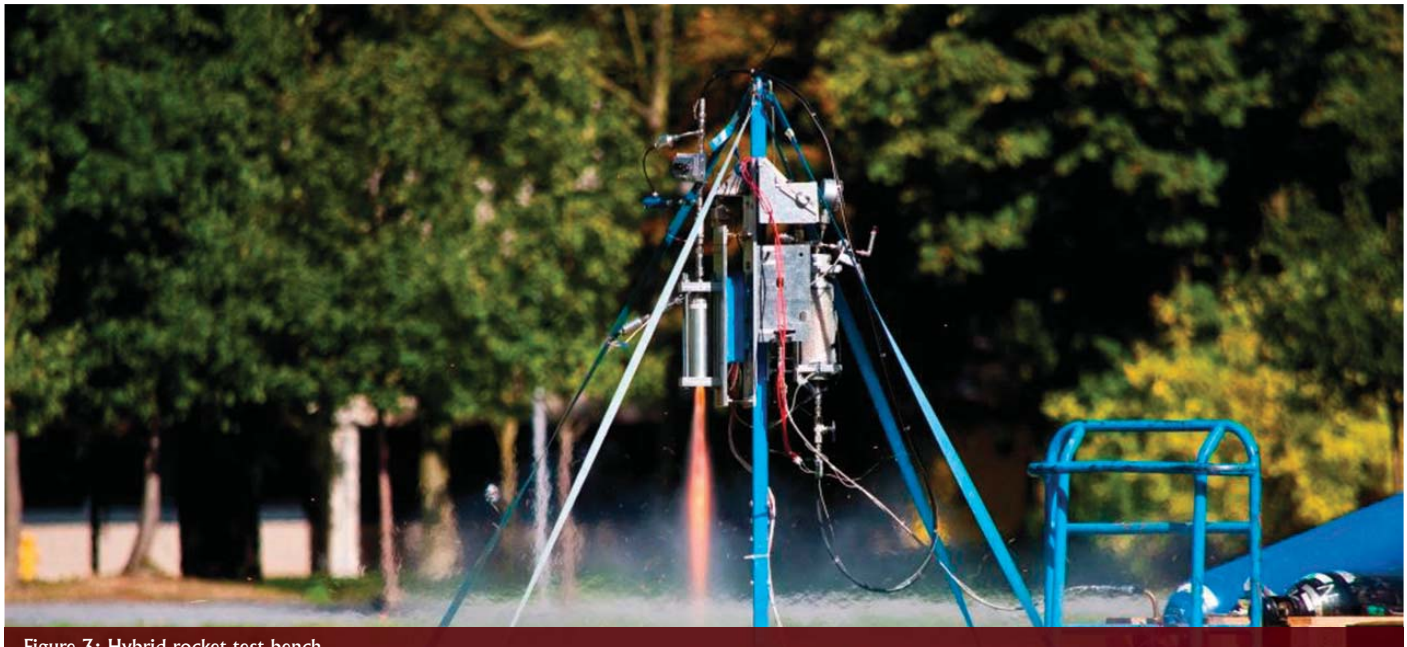


Figure 3: Hybrid rocket test bench

# From IC design to customer intimacy

## Former student Yide Zhu on his career at ASML

**Advertorial**

Somewhat of a decade ago, Yide Zhu moved from the metropolis of Shanghai to the Dutch city of Delft to study electronics. On Sunday, he got off the train and found himself in a (small) deserted town. "It was a culture shock. I expected to see the kind of ideal image of tulips and cows that I used to see on Chinese TV. What I saw, was altogether different." After a Dutch language course, Yide started his training and ultimately gained a Master's degree in microelectronics (Integrated Circuit design). It brought him his current position at ASML. Not in design, but as the spider in the web at the Application and Business Support department.

For those who are not familiar with ASML, here's a brief explanation. ASML in Veldhoven makes lithography machines for the production of computer chips. The company supplies all major chip manufacturers in the world - such such as Intel and Samsung - with products that defy the limits of what is scientifically possible. For instance, with the latest generation of machines, ASML is able to print lines and components less than 20 nanometres. That is like printing a complete novel of 500 pages on one centimetre of a human hair!

### Are you a man or a not?

Yide: "I did my master's internship at Philips Semiconductors (now NXP). There I worked on the design of 'novel' receivers, i.e. chips for mobile phones that receive and transmit data signals - such as GPS, 3G, and digital TV - to headphones and screens. It was both a fun and a difficult time. As a graduate, you're often left to your own device. Yes, you have theoretical knowledge, but in practice, things may sometimes be completely different. Internship supervisors have limited time so you're on your own. I have regularly told myself: Yide, are you a man or a mouse? You always have to be able to motivate yourself.

Yide Zhu

### More exciting

After my graduation I went to work in a small IC design house. But I felt trapped in the academic environment. At Philips I had discovered a new world. I wanted something more exciting, something that puts you right in the centre of the real world. At that time, ASML was looking for many engineers. So I sent them my resume and it didn't take long before I was called by a recruiter. The very first interview was immediately very interesting. I was impressed by the open and spontaneous atmosphere. The people at ASML are very accessible. All went very fast, a week later I was working for ASML!

### Many-sided job

Since 2008, I have been working at the Application and Business Support department. We advise our clients on and support them in the effective use of our machines. It is a profession with many aspects: troubleshooting, advising, marketing and sales. In fact, we occupy a position between Development and the customer. When ASML has a new product,

we usually introduce it in a pilot at the customer(s). We implement and monitor the entire process: testing and evaluating the results and analysing what benefits the product brings to the customer in terms of, for example, productivity, efficiency and quality.

## Across the world

For my work, I have to travel the world. The job I have is about people and the best results are achieved through face-to-face meetings. We call that customer intimacy. Your IQ and EQ are constantly put to the test. The point is that you have to be skilled at anticipating the customer's mindset. And you have to know how to deal with cultural differences. For instance, we have many customers in Asia, and that's when my roots stand in good stead. I also regularly go to the U.S. It is a multicultural environment and that is also reflected in my team. There are 8 nationalities in our team of 16 people.

## Brabant

Eindhoven is one of the reasons why I have chosen ASML. You celebrate carnival here! The first year I experienced carnival, I thought: hey, this is the best celebration ever! The Brabant culture is very easy-going, which quite appeals to me. You can just gas along with anyone. And that's also in the DNA of ASML.

The ASML laboratory

# Cochlear Implants
## Characterization of metals

**Author: Joost van Driel, MSc**

Hearing aids have been used for centuries, but not in the shape as we know them now. The absence of electricity before the 20th century resulted in passive or acoustic hearing aids. These speaking tubes and ear trumpets effectively increase the surface area of the external parts of the ear. The first electric hearing aids used carbon microphones, like the first telephones.

The quality and size were, however, very poor. Vacuum tubes did increase the quality dramatically, but the size actually increased too. Two separate batteries were needed to power both filaments. The transistor decreased the size and increased the quality and functionality. Some people do not benefit anymore from hearing aids and need electronics to take over some functions of the ear. Bone implanted hearing aids and cochlear implants are two products that have been used for some time now. Both of them bypass the external and middle ear by using implants and electronics.

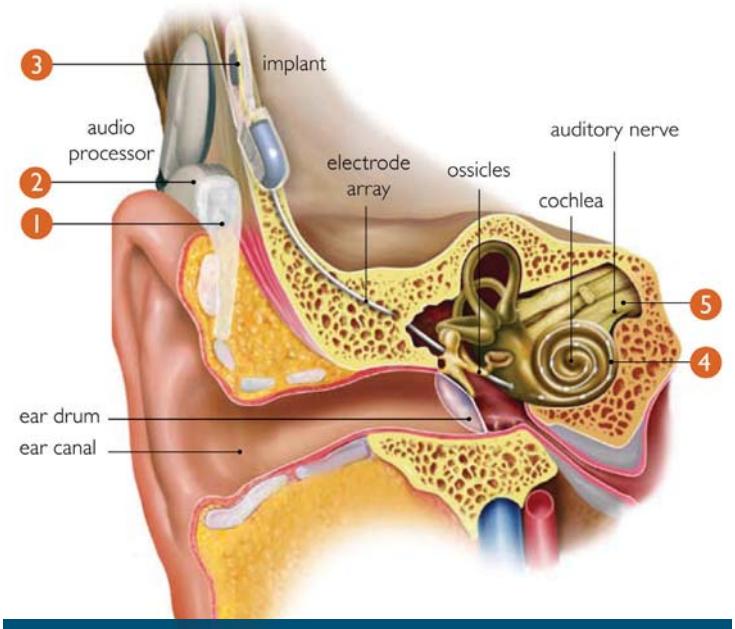



Figure 1: Overview of a Med-CI

Cochlear Implants (CI's) are implanted into the cochlea of the ear as shown in figure 1. These systems make deaf people hear again, if the nerves of the cochlea and auditory cortex are still intact. They are not just amplifying the sound, like in regular hearing aids as shown in figure 2. Current CI's consist of three parts: the first is the external sound processor, which is carried behind the ear and includes a microphone. The second consists of a part inside and outside the body, because the processed signals are sent wirelessly through the skin using coils. Just under the skin is the first implanted part of the CI, which contains the coils and circuitry for stimulating the electrodes. The third part is the electrode array that contains up to 32 electrodes made out of platinum electrodes, which is shown in figure 3. The electrodes are connected to platinum-iridium wires that are also connected to the stimulator circuitry.

CI's have been on the market since the 1980's and have improved a lot since their introduction. The first ones had only one electrode and the sound processor was very bulky. Also no wireless transmission through the skin was done. The current CI's are very small and can have a lot of functionalities, such as a waterproof, Bluetooth compatible, mp3-playing sound processor or a technique called current steering that uses multiple electrodes to stimulate nerves between the two electrodes. The quality of the current CI's is, however, still not good enough, because people using CI's cannot understand each other in a noisy environment. This is, among other things, due to the fact that the electrode arrays are created using pretty old-fashioned techniques. The electrodes are welded by hand to the wires and the coating is also applied manually. This is both expensive and limits the number of electrodes. New techniques need to be found to create these electrode array to accommodate more electrodes.

One of the candidates is the widely used technique that is used to produce chips, called CMOS-compatible techniques. This will give a lot of research topics and one of them is the characterization of metals on the electrode array. The electronic instrumentation department is developing a new electrode array that can be produced using CMOS-compatible techniques. One of the first problems is quite obvious, because the current CI's are flexible and most chips are rigid, due to the silicon.

Figure 2: A regular hearing aid


Figure 3: The AB HiFocus electrode array

## Polyimide

Polyimide is a solution to that, by removing the silicon and applying the flexible material. Another solution is to create a stiff probe that is implanted in the auditory nerve just outside of the cochlea, where the nerves are still organized on frequency. The nerves inside the cochlea are organized on frequency, due to the different resonance frequencies in the cochlea. The high frequencies are converted into electrical signals in the beginning of the cochlea, while low frequencies are converted close to the apex. A cross section of the cochlea is shown in figure 4.

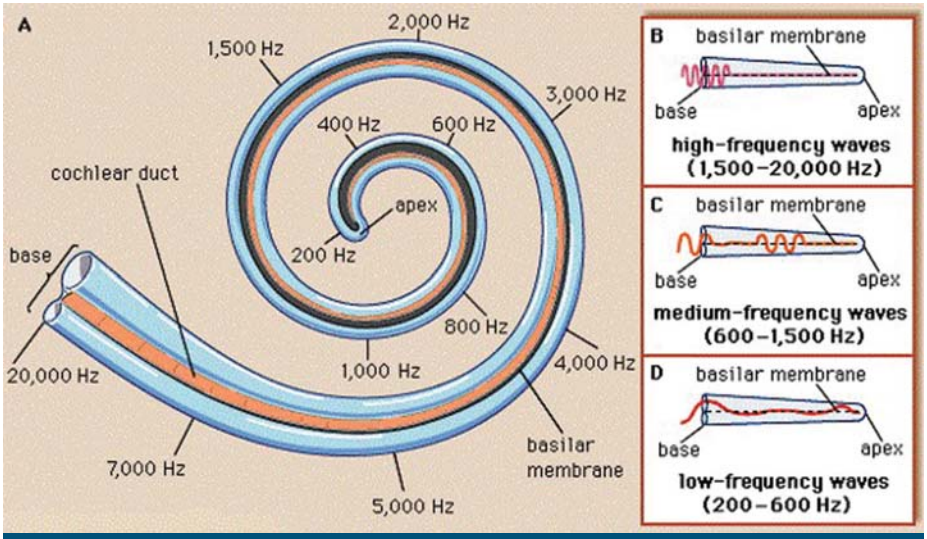



Figure 4: The tonotopic organisation of the cochlea

My part in this project was to investigate different metals that can be used as electrode and interconnect material. This metal needs to meet a lot of requirements, but they can be divided into some larger groups:

- Is the metal able to be processed using CMOS-compatible techniques?
- Is the metal able to withstand the harsh saline environment of the cochlea?
- Is the metal able to conduct the current from the stimulator circuitry (the implanted part just behind the ear) to the nerve endings in the cochlea?
- Can the metal be used as gate and interconnect material in transistors?

The first requirement already stops the already being used materials to be used. Platinum and platinum iridium are both not very suitable to be processed using CMOS-compatible techniques. It does introduce a material that is already used in pacemakers: Titanium Nitride (TiN). It is a material that has proven its usability as an electrode material. Its low reactiveness, high porousness (large geometric surface area) make it a very promising material for the new generation of CI's. My research was most focused on TiN, but Titanium (Ti) and Aluminium (Al) were taken as comparison materials. Al three of them are very suitable to be processed on a micron scale.

The second requirement focuses on the chemical reactions that can occur with the metal in the perilymph – the fluid inside the scala tympani in the cochlea. These reactions can occur without any external influence (corrosion) and can take a lot of time to occur. The lifetime of an implant has to be at least 25 years; happily, my thesis project didn't take that long. It did require some accelerated testing, but the contents of such tests were too chemical for my knowledge. Other tests that I could do involved the influence of charge on the chemical reactions. The addition of charge to the reactions could lead to the creation of unwanted materials like acids. The way to test this is by using a Cyclic Voltammetry setup. This will also show the extreme potentials that can be applied to the electrode site: the water window. The water itself will start to react with the charge beyond these extremes, a process better known as

electrolysis. These kind of measurements do require a very accurate test setup and this was not available to me. Tests that I could do did not indicate any damage to the metals, e.g. exposing the metals to a saline solution for at least a week.

## Electromigration

Tests and measurements that involve electricity are more for us electrical engineers. The charge that comes out of the stimulator circuitry needs to be delivered to the nerve endings, which will trigger an action potential, triggering the nerves. The first obvious measurement is to determine the impedance and calculate the resistivity. There is immediately a remarkable result: the TiN has a very high impedance, too high for the very long tracks of a CI. That is why a combination of the much less resistive Al has been made. The metal tracks need to carry current and when the dimensions of the track shrink, the current density increases dramatically. This can lead to the phenomenon called electromigration. The atoms of the metal will get dragged away from their original locations due to the electric field and the current density. This leads eventually to voids in the track. Results of the tests show that the softer Al is very susceptible to electromigration, while TiN did not show any signs of damage. The TiN-Al combination made this result very clear, because the TiN kept conducting while the Al underneath broke down. This is shown in figure 5. The current density was kept constant, while potential steps indicate that the current is going locally through the TiN.

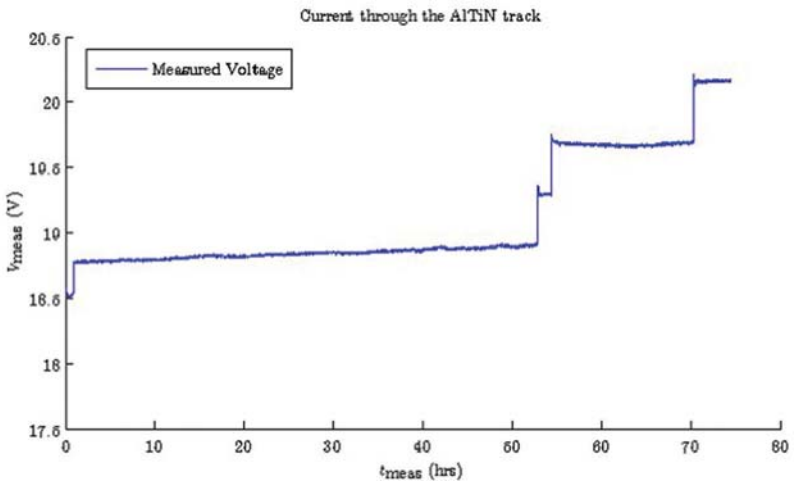
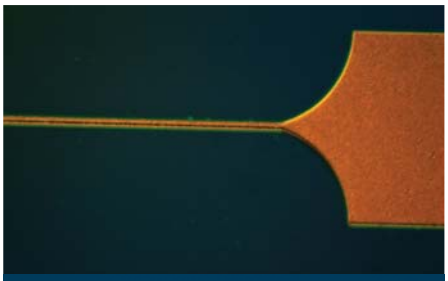



Figure 5: Electromigration through the Tin-Al combination

Other tests have been done regarding the self-heating and the amount of resistance change due to the self-heating (TCR). The amount of charge that needs to be delivered to the nerve endings needs to be accurate, so every resistance change needs to be modelled accurately. Also a model of a cross section of the electrode array has been made in Comsol to evaluate the electric field. I have held a presentation about this in Milan at the Comsol conference.



Microscope picture of the Tin-Al combination

*"The atoms of the metal will get dragged away from their original locations due to the electric field and the current density."*

The final objective was to create transistors using TiN. This feature could really make the difference and as it turned out, it is possible. With transistors on the electrode array it is possible to bring the stimulator circuitry close to the electrode sites. This will reduce the number of wires, because the communication to the circuitry will be digital that requires a low number tracks. The BiCMOS designed by Henk van Zeijl at Dimes was used to evaluate the properties of the different device types. I need to direct you to my thesis for the details, but again, the high resistivity of the TiN resulted in moderate quality NMOS, PMOS and npn transistors. It was possible to create an oscillator that created 25 MHz.

The high resistance of the TiN results in poor test and measurement results in favour of TiN. The addition of a low resistance material like Al does solve some of the problems, however, Al is a toxic material and even when it is completely covered with TiN, then it is unlikely that it will be allowed in the human body. There are, however, a lot of other materials that are suitable, so more research is needed for that. Also, a Cyclic Voltammetry needs to be done to characterize the electrode array.

# ETV activities
## Excursies naar KEMA en Stedin

### June 5th: Excursion KEMA

**Rik Wilmer**

Niet heel vaak krijgt een student kans het wekelijkste collegevolgen te onderbreken. Op 5 juni was echter een excursie naar DNV Kema gepland. Met twee volle busjes vertrokken wij om 9 uur wij naar DNV Kema in Arnhem. Na vijf kwartier kwamen we eindelijk aan in de mooie omgeving van het Business Park Arnhem.

We werden ontvangen met koffie en fris. Daarna kregen we een algemeen praatje over DNV Kema. (Het alom bekende KEMA-keurmerk bleek niet meer van Kema te zijn; het keurmerk is in 2009 verkocht.) Vervolgens werd onze kennis goed beproefd en kwam een hoogspanningsspecialist aan het woord.

Deze vertelde vrij diepgaand over uitdagingen die hij in zijn werk was tegengekomen en over projecten die hij heeft opgezet. Als tweede spreker was een kabelspecialist. Na uitgebreide analyse van een casus informeert hij klanten over kabelgebruik en -plaasting. Doordat bij onderbreking van hoge stromen er enorme krachten op paralelle geleiders komen te staan is het zeer belangrijk dat er niks of niemand geraakt wordt.

Als laatst kregen we een rondleiding over het terrein van DNV Kema, langs alle testhallen en de schakeltuin. Tot slot konden we nog napraten met onze gids en toen was het tijd om op huis aan te gaan. Om zeven uur waren we weer terug in Delft en konden we terugkijken op een geslaagde dag.

---

### May 8th: Excursion Stedin *by SSD*

**Erwin Visser**

Het SSD-Bestuur van dit jaar heeft op woensdag 8 mei 2013 een excursie naar Stedin georganiseerd. Als bestuurder van de ETV en als geïnteresseerde student op het gebied van Power Engineering ben ik mee gegaan met deze excursie.

De dag begon op het station van Delft. Vanaf daar zijn we met de trein naar station Rotterdam Blaak gegaan waar het regiokantoor van Stedin vrijwel naast staat. Hier kregen we een onder andere een uitleg over het netbeheersysteem en ook een rondleiding door de controle kamer, waar elke stroom, spanning, fase en power factor van het gehele midden- en laagspanningsnet onder het beheer van Stedin te zien is.

Ook was er een interessante presentatie over het zogeheten Self healing Network. Met dit principe hebben veel minder mensen last van een eventuele storing en worden storingen tevens sneller opgelost. Het is wel opmerkelijk dat het hier om een zeer eenvoudig principe gaat, maar dat er sinds kort pas een eerste bètaversie in het net is aangebracht. Deze zeer late doorvoering komt onder andere omdat je te maken hebt met een systeem dat tientallen jaren geleden is uitgerold en dat sindsdien eigenlijk geen downtime mag hebben.

Na de rondleiding en de presentaties konden we de systemen die het Self Healing Network realiseren met eigen ogen bezichtigen. Het gebouw van Stedin is namelijk onderdeel van de lus waar de bètaversie van dit systeem is geïmplementeerd. Vrijwel direct naast het gebouw is dus een transformatorhuisje waar we even een kijkje konden nemen. Het was hierbij erg belangrijk nergens naar te wijzen. Spanningen van ongeveer 6kV stonden hier namelijk op ongeïsoleerde leidingen en als je dat per ongeluk aanraakt kan dit schadelijk zijn voor de gezondheid.

Hierna was het tijd voor de lunch. Deze was voor ons verzorgd in een bus. Tijdens de lunch kregen we namelijk een kleine tour van Rotterdam naar Ypenburg langs allerlei projecten die onder andere met de hulp of onder begeleiding van Stedin zijn waargemaakt.

Eenmaal aangekomen in Ypenburg kregen we als laatste onderdeel een rondleiding door een relatief nieuw verdeelstation. Hier konden we onder andere de kabels bezichtigen die ervoor zorgen dat Ypenburg en groot deel van Den Haag van elektriciteit worden voorzien. Ook konden we een kijkje nemen bij de gigantische transformatoren die de inkomende 380 kV omzetten in een schamele spanning van 25 kV en 23 kV.

Met deze laatste bezichtiging was de excursie helaas afgelopen. De bus van Stedin zette de deelnemers die met de fiets naar het station waren gekomen netjes af bij station Delft en de overige deelnemers werden naar de faculteit EWI gebracht. Met een lekkere goede lunch en heel wat kennis en bezichtigingen rijker was het een zeer geslaagde dag.

# 107e Dies natalis
## Diesode: No Return

**Auteur: Ralph van Schelven**

Honderdenzeven jaar. Dat is een leeftijd die zeker gevierd mag worden. En dat is gebeurd. In de week van 13 tot 17 mei is de Vereniging ondergedompeld in een zee van paars, diodes en activiteiten. Een week waarvan geen terugkeer mogelijk is. De week van de 107e Dies Natalis. De week van DIESODE!

De week begon al goed. De commissie stond op maandagochtend in de pauze tussen colleges klaar om iedereen een lekkere pannenkoek aan te bieden. Dit waren natuurlijk niet zomaar pannenkoeken. De pannenkoeken waren helemaal in thema met diodes, DIES en ETV van poedersuiker. Terwijl iedereen genoot van een pannenkoekje stond de veiling al klaar en werd er naar de grote verscheidenheid van elektrogadgets gekeken. De geïnteresseerden moesten er snel bij zijn want het ging hard. Er werd heftig tegen elkaar opgeboden en de kopers konden hun nieuwe aankopen met een voldaan gevoel naar huis nemen. Traditiegetrouw is de maandag afgesloten met de Diesreceptie. Ereleden, afdelingen van EWI, oud-besturen, commissies, vriendinnen van het bestuur, ga zo maar door. Iedereen kwam het bestuur feliciteren met de verjaardag van de Vereniging. Na de receptie was het tijd voor het traditionele etentje bij Breintje Beer. Er werd lekker gesmuld van de spareribs en al gauw vlogen de botjes door de zaal. Na deze top dag was het duidelijk dat de week nog veel zal brengen.

De DIES was overal te vinden in deze week!

Dinsdag begon met een informatieve workshop: Ballonvouwen. De enige echte Ballonnenman, bekend van TV, kwam langs en leerde ons de fijne kneepjes van het vak. Spoedig werden er honden, beren en zwaarden gemaakt. Alle aanwezigen hadden het erg naar hun zin en de bestuurskamer werd na afloop een kleurrijke zee van ballonnendieren en hoeden. Zo sportief als we zijn bij de ETV kon een mooie sportactiviteit niet uitblijven. Deze dinsdag was het dan ook tijd om de strijd met de god van de zee aan te gaan en zijn golven te berijden als ware koningen. In werkelijkheid zag het er niet bij iedereen even triomfantelijk uit als verwacht, maar dat zal ongetwijfeld gelegen hebben aan de voorgaande worsteling met de wetsuits. Na de Noordzee compleet uitgespeeld te hebben werd het tijd voor ons om terug naar Delft te keren en onszelf los te laten op een prachtige barbecue. De barbecuekoningen vertoonden wederom hun kunsten met de tangen. Iedereen die er was zal kunnen beamen dat er vele engeltjes over tongen hebben gewandeld. Ondanks het slechte weer heeft de ETV er weer een gezellige avond van gemaakt. Benieuwd wat de volgende dag allemaal zal brengen gingen de aanwezigen met gevulde magen naar huis terwijl Van Wee zijn schoonmaak skills liet zien aan de commissie. Wederom een zeer geslaagde dag.

Twee zware, maar mooie, dagen achter de rug. Stoppen? Natuurlijk niet. De derde dag werd begonnen met een workshop gebarentaal. We hebben allemaal veel geleerd en geoefend. De aanwezig verbaasden zich er over hoe moeilijk dit was, en hebben vele handige woorden geleerd. Wie kan er nou door het leven zonder te weten wat bijvoorbeeld wedstrijdtafel, bestuurskamer of koning in gebarentaal is? Vanuit de workshop gingen we snel door de volgende activiteit. Karten. Met 18 nostalgische namen stapten we in de karts en scheurden we over het parkour van Raceplanet. Er werden top tijden gereden en de top vijf tijden van de maand werden gevuld met pokemon. Don't drink and drive. Doe dat lekker na elkaar. Op de woensdag avond ging de ETV naar de DSB voor een heuse cantus. Met zangbundels en plexen gewapend zaten de

Uit alle jaarlagen voegde mensen zich bij de commissie om even op krachten te komen

aanwezigen klaar om een avond te zingen en samen gezellig een biertje te drinken. De klassiekers als Piano man en Yesterday werden afgewisseld met de Elektro-liedjes en de sfeer zat er goed in. Uitgeput en met schorre kelen verlieten we de DSB en maakten we ons klaar voor donderdag.

Het bier van de cantus was inmiddels uit onze linkerhand verdwenen, maar op donderdagochtend hadden we zeker een soldeerbout in onze rechterhand. Het was weer tijd voor de meest elektro activiteit van de week: de klusstrijd. Vijf teams begonnen aan deze zware strijd, slechts vier van hen haalden de finish. Het resultaat van deze strijd mocht er dan ook wel wezen. Wapens, radios, originele dynamische dichttikjetsers en een nutteloos ronddraaiend ding werden gepresenteerd aan de jury. Trudi Middendorp, Joost van Driel en Xavier van Rijnsoever stonden voor een moeilijke keuze. De uiteindelijke winnaars werden in de /Pub bekend gemaakt en de Mieterse Majuskels konden hun geluk niet op. Gelukkig konden ze dat uiten in de vorm van het zingen van een liedje, maar niet voordat Abe de Verteller was uitgesproken. De Jaarboekcommissie had voor de luie mensen onder ons geregeld dat het boek werd voorgelezen. Aandachtig luisterend dwaalden de aanwezigen door de woorden en verhalen van de schrijvers. Abe maakte na een tijd van prachtige verhalen en quotes plaats voor de ETV'ers om zich te laten horen bij de jaarlijkse Jabokaraoke. Terwijl de commissie tot redactie van het 54e jaarboek der Electrotechnische Vereeniging niet stopte met het uitdelen en signeren van boeken schalden de stemmen van de andere ETV'ers door de zaal. Er werd tot diep in de nacht gezongen en gelachen. En het kan aan mij liggen, maar volgens mij werden we steeds beter.

*"De jaarboek-commissie had voor de luie mensen onder ons geregeld dat het boek werd voorgelezen"*

Dat we steeds beter werden kan ook door iets anders komen. Gelukkig stond er op vrijdag in de pauze een heerlijke uitbrakbrunch klaar. Met broodjes ETV en kroketten in de hand haalden mensen herinneringen op van de maandag en dinsdag die al zo lang geleden leken. Even lekker ontspannen en energie opdoen. Dit was ook wel nodig want er stond een tweede sportieve activiteit op het programma die middag: het ETVoetbaltoernooi. De sportievelingen onder ons deden met het bestuur en de commissie hun ding op het veld. De wedstrijden waren spannend en vermoeiend. Gelukkig waren er twee hele goede scheidsrechters aanwezig om de opgefokte spelers een beetje onder controle te houden. Helemaal uitgeput en met een aantal voetballen in de hand maakten we ons klaar voor alweer de laatste activiteit van de week. Het voelde als een thuis voor ons. Een veilige haven waar de dagen ten einde kwamen. Onze /Pub. Het was duidelijk dat de week zijn tol heeft geëist van de deelnemers. Ook de commissie had het zwaar achter de bar. Desalniettemin hebben we voor de laatste maal die week de bel van het E-kafee pas na middernacht geluid. De bel die het einde van de week betekende, maar niet het einde van de DIES…

# Tie before you Die
## EESTEC workshop 2013

**Auteur: Koen Emmer**

Het is 2e Pinksterdag, een vrije maandag. Even niks aan het hoofd, en terwijl het buiten weer oer-Hollands koud is, lig ik nog onder een warme deken. Genieten, tot een lange sessie uitslapen bruut wordt verstoord door een telefoontje. "Je EESTEC'er is gearriveerd" hoor ik. Ik weet meteen hoe laat het is; dat het stukje rust van zojuist het laatste beetje zal zijn voor de komende 8 dagen: de EESTEC-week is begonnen.

Zoals de meesten studenten uit Delft wel weten, is de studentencultuur van Delft een ideale omgeving om snel veel mensen te leren kennen. Toch is het soms lastig om in contact te komen met een echt stukje diversiteit, en zijn er bepaalde inzichten waarvoor je buiten de grenzen van ons land moet kijken om die te leren kennen.

Voor Elektrotechniek is dit waar EESTEC bij komt kijken. EESTEC is een internationale organisatie voor Electrical- en Computer Engineering studenten, bestaande uit verschillende Local Committees (LC's), die verschillende uitwisselingen en workshops aanbieden in eigen land. Ook de ETV biedt dit aan, onder de naam LC Delft. Eens per jaar organiseert dit orgaan een weekvullend programma, waar EESTECers uit het buitenland zich voor kunnen intekenen. Dit jaar viel de keuze op een workshop: 'Tie Another Day, A Challenge From Mars'.

De workshop zelf bestond uit vijf ochtenden en middagen waarin de EESTECers kennis maakten met de hardwarebeschrijvingstaal VHDL. Het doel was om een FPGA zodanig te programmeren dat de robot waar deze op bevestigd was een lijn kon volgen. Veel elektrostudenten zullen dit kennen als een project uit het eerste studiejaar. Ook maakten de EESTECers kennis met de werking achter zonnecellen en draadloze energieoverdracht. De meeste EESTECers waren met de verscheidene onderwerpen nauwelijks of niet bekend, en gingen zeer enthousiast te werk toen ze de mogelijkheden van VHDL inzagen. Zelfs degenen met ervaring in VHDL ontdekten dat er in de workshop gestreefd werd naar een veel hoger niveau dan waar zij zelf op zaten.

Men komt echter niet alleen naar Nederland om VHDL te leren, dat kan immers met iets meer moeite ook vanaf thuis. Naast verscheidene lunch- en borrellezingen, lag buiten het project vooral de focus op kennismaken met Delft, kennismaken met het Delftsche studentenleven, en het proeven van de Nederlandse cultuur. Dit is niet niks, en buiten de workshop om was het programma dan ook afgetopt met activiteiten als rondleidingen, bierproeverijen, borrels, uitstapjes naar andere steden en een aantal goede feestjes. Om een beter beeld te geven, volgt een korte samenvatting van de volledige week:

Overdag werkten de EESTEC'ers aan het Mars Rover project

Maandag was de aankomstdag. De EESTEC'ers kregen een host toegewezen, waar ze de rest van de week zouden overnachten. Toen iedereen zijn/haar spullen bij de host had achtergelaten, ging een deel van de EESTEC'ers bij hun host eten. Een ander deel verzamelde bij een dönertent. De weg hiernaartoe was typisch: op de fiets (sommige internationalen waren hier nog een beetje aan het stuntelen) met een regenbui waar je u tegen kon zeggen. Eenmaal aangekomen bij de dönertent stond een van de favoriete studentensnacks in een dampend bakje op hen te wachten, de kapsalon. Tenslotte kwamen alle EESTEC'ers bij elkaar in het speciaalbiercafé de Locus, waar ze al snel elkaar leerden kennen.

De volgende ochtend vond de Kick-off plaats. Na een rondleiding langs de highlights van EWI, begonnen de EESTECers zich te verdiepen in VHDL. Aan het eind van de middag werd het tijd om naar het centrum van Delft te verplaatsen, waar de EESTECers een rondleiding door Delft kregen. Onder andere de Beestenmarkt en het Prinsenhof kwamen hierbij aan bod. Vervolgens werd er gegeten op de

Delftsche Studenten Bond, was er een bierproeverij op de Koornbeurs, en werd de avond afgesloten bij het ETV-stamcafé, de Kobus Kuch (het was immers de derde dinsdag van de maand).

Woensdag was de eerste dag dat er vanaf 's ochtends vroeg tot het eind van de middag aan het project gewerkt werd. Een lange dag, die beloond werd met een goede hoeveelheid spareribs bij de Breintje Beer. Dit was de avond dat een bezoekje aan Leiden, aan het feest 'Boer zoekt Heidi', op het programma stond, en dat de EESTECers hier zin in hadden was duidelijk te merken. Aangekomen op Sociëteit Quintus, werd de avond gestart met Starko. Hoewel de meeste EESTECers geen idee hadden wat hij zong, gingen ze toch helemaal uit hun dak, en werd het een legendarische avond.

Het enthousiasme en energie van die avond, was donderdagochtend ver te zoeken, toen er weer 's ochtendsvroeg testjes uitgevoerd moesten worden in het PV-lab. Wakker blijven bij de borrellezing bleek een zware taak later op de middag, maar het onderwerp was interessant genoeg om de aandacht erbij te houden. Na een paar pinten genuttigd te hebben in de /Pub, verhuisden we snel naar buiten, om met alle EESTEC betrokkenen te barbecuen, tijdens een van de weinige zonnige namiddagen van de week. Vervolgens werd nog een kort bezoekje aan de Oude Jan gegund, gevolgd door een welverdiende avond rust, wat wel nodig was na woensdagnacht.

Vrijdag werd er weer volenthousiast geVHDL't, en begonnen de eerste robotjes lijnen te volgen. Wederom stond Kapsalon als avondeten op het programma, maar dit werd gecompenseerd door een zeer sjieke avond bij het Delftsch Studenten Corps, begeleid door een live bandje. Een verassend leuk feestje, heel anders dan degene van de woensdag daarvoor.

's Avonds verdiepte ze zich in het uitgaansleven van de gemiddelde ETV'er

*Wil jij ook op EESTEC? Vraag aan het LC Delft bestuur waar je heen kan!*

In het weekend werden andere steden aangedaan. Zaterdag was dit Den Haag, waarbij Madurodam, Sea Life in Scheveningen en een aantal Haagse higlights werden aangedaan. 's Avonds was er vooral aandacht voor de Champions League finale die deze dag gespeeld werd.

Zondag was het Open Monumenten Dag in Amsterdam, en na het proberen van de Hollandse Nieuwe, kregen we een rondleiding door het Andaz hotel, de oude bibliotheek van Amsterdam die Marcel Wanders compleet heeft geredesigned tot een modern hotel. Na deze rondleiding konden EESTECers vrij rondlopen, en gingen we uiteindelijk vlakbij het Rembrandtplein een hapje eten. Er was natuurlijk één ding dat men echt niet wilde missen: het Red Light District. Dus ook deze werd aangedaan, waarna een deel van de groep nog een Amsterdamse kroeg opzocht om tot laat door te gaan in de hoofdstad van Nederland.

Maandag was het helaas alweer de allerlaatste EESTEC-dag. De laatste robots waren werkend gekregen, en de week werd traditioneel afgesloten. Beginnend met een frituuravond in de /Pub, waar we EESTECers verbaasden met de typische Hollandse frituur. En dan tenslotte de internationaal bekende 'EESTEC International Party', waarbij elke EESTECer drank en hapjes uit eigen land meeneemt. Met dranken als Sangria, Raki, Ouzo en Vlek duurde het niet lang voor iedereen van het padje af lag. Met ook nog een jarige EESTECer was de feeststemming helemaal compleet. Tot diep in de nacht werd er genoten, maar helaas was het de volgende dag tijd om afscheid te nemen.

Terugkijkend op deze week was het een lange en zware week met weinig slaap. Maar wel een lange week barstensvol geweldige activiteiten die we voor geen goud hadden willen missen. De internationalen hebben erg veel geleerd, niet alleen van VHDL, maar vooral ook van onze cultuur, ons studentenleven. Maar uit alle conversaties hebben ook wij veel van hen kunnen leren, en is de motivatie om zelf naar het buitenland te gaan enorm vergroot. Onze dank gaat uit naar alle mensen die geholpen hebben, dan wel door een fiets af te staan tijdens deze week, dan wel door een of meerdere EESTECers een week in huis te nemen, dan wel door op welke andere manier dan ook een bijdrage geleverd te hebben. Wij vonden het in ieder geval fantastisch, en kunnen niet wachten tot volgend jaar!

# ETV Social Activities
## An overview of the fourth quarter

A good pile of yearbooks at the JaBokaraoke. Don't have one yet? Pick one up at the ETV

Congratulations to dr. ir. D. Djaraim on being Teacher of the Year of Electrical Engineering!

The "MoTiBo" at the beginning of the quarter was a great succes again

There were a lot of nice prices to win at the Dies lottery

*We're looking forward to the social activities next year!*

# Duurzaam transformeren

Beeld: OPL Architecten

Deerns

...brengt ideeën tot leven

Bijdragen aan een optimaal duurzame en comfortabele leef- en werkomgeving is de kern van onze missie. Dat doen we door de ontwikkeling en duurzame transformatie van innovatieve en energiezuinige gebouwconcepten zoals bij De Daalse Kwint in Utrecht.

Deerns is het grootste onafhankelijke adviesbureau op het gebied van installatietechniek in Nederland. Met projecten over de hele wereld en zestien vestigingen in Europa, Dubai en de Verenigde Staten is Deerns bovendien een toonaangevend internationaal bureau.

www.deerns.nl

# WANTED INNOVATIEVE ENGINEERS MET PASSIE!

## KIJK VOOR EEN BAAN OP WWW.LELYJOBS.COM

In het westen van het land is een van de meest innovatieve bedrijven van Nederland gevestigd. Wij zijn altijd op zoek naar enthousiaste en creatieve persoonlijkheden die onze ruwvoederproducten, melkwinningsproducten of voersystemen verder willen ontwikkelen. Ben jij een werktuigbouwkundig talent? Of heb jij een elektrotechnische of softwarematige achtergrond? Kijk dan op onze vacaturesite voor een interessante baan. Uiteraard ben je ook van harte welkom om eens 'in het westen' te komen kijken, om met eigen ogen te zien wat 'high-tech in agriculture' nu werkelijk inhoudt...

LELY

*innovators in agriculture*