MAXWELL

Magazine of the Electrotechnische Vereeniging

Freshmen introduction weekend

A photomontage

Hybrid container cranes

An energy management system

Edition 13.1

November 2009

Hier invoegen: pagina2ASML.pdf

From the Board

This is the first time I write for the Maxwell as president of the ETV – and I can tell you it's a good feeling! We've had a great start as the Board with many inaugural receptions of other study associations, members coming to the desk to buy new books, and lots of active freshmen enjoying the atmosphere (and the coffee) in the boardroom in their breaks. As you might already know, there are a lot more freshmen than last year, which is of course a positive development. The international students have also had a good start. One of our first activities this year was the international barbeque with Christiaan Huygens, behind the faculty building. It was a pleasant evening with plenty of opportunities to get to know each other. Dutch and International students still don't have much contact; mostly there are two communities and we would like to offer the possibility of meeting each other during our activities.

We, the Board, won't be studying this year. But we are still learning. Learning how to be the head of an association full of traditions and ancient behaviors but also full of new ideas and new input from people wanting to participate. This quarter we have spent a lot of time learning about what people think about the ETV and what they expect from us. This isn't a simple issue. Some people only want the books they need for their courses to be delivered on time. Of course we strive to make this happen – but sometimes it's simply not possible. Other people are interested in social activities, doing fun things with their friends is an important issue for most students. The ETV can make this easier by organising social activities for its members, to allow them to integrate in an informal way. However, there are also members who want to broaden their knowledge about companies they are likely to work at when they have got their degrees. These members would like to see more lunch lectures and ask about excursions at our desk. But complaints about courses, lectures or university facilities can also be a reason to contact the ETV. We participate in lots of faculty bodies and meetings and in most cases know how to address the issues raised. So if you do have a complaint, don't hesitate to contact us!

Have you already told us what kind of member you are? We want you to tell us about your needs and wishes; we are here for you as an Electrical Engineering student. So we invite you to drop by for a free cup of coffee in the Boardroom, or just have a friendly conversation at the desk in the hall!

On behalf of the inviting board,

Imke Zimmerling, President

Editorial

AT THE TIME OF WRITING, WE ARE IN THE MIDDLE OF THE FIRST EXAM PERIOD OF THIS COLLEGE YEAR. THE MAXWELL, HOWEVER, DOESN'T MAKE ITSELF, SO INSTEAD OF LEARNING FOR THE EXAMS, ME AND A COUPLE OF OTHER COMMITTEE-MEMBERS ARE STILL HARD AT WORK COMPLETING THIS MAGAZINE.

WITH THE NEW COLLEGE YEAR, A LOT OF THINGS HAVE CHANGED FOR THE COMMITTEE AND, FOR THAT MATTER, THE ETV. FOR INSTANCE, THREE COMMITTEE MEMBERS DECIDED TO LEAVE, AFTER HAVING CONTRIBUTED TO MANY YEARS OF MAXWELLS. I'D LIKE TO THANK THEM FOR MAKING SURE THAT THE MAXWELLS WERE FILLED WITH INTERESTING ARTICLES EVERY TIME. IN ADDITION, TWO OF LAST YEAR'S NEW COMMITTEE MEMBERS DECIDED TO LAY DOWN THEIR STUDY AND OTHER ACTIVITIES FOR ONE YEAR, JOINING THE BOARD OF THE ETV.

THIS MEANT THAT ONLY ONE MEMBER WAS LEFT AFTER MAXWELL 12.4. LUCKILY, FOUR ENTHUSIASTIC NEW MEMBERS, INCLUDING MYSELF, WERE MORE THEN WILLING TO TAKE ON THE JOB OF MAKING THE MAXWELL, SO THE CONTINUITY OF THIS MAGAZINE SHOULD AGAIN BE SAFE FOR A WHILE.

AS YOU PROBABLY HAVE NOTICED, WE CONTINUED THE NEW STYLE OF THE COVER. WE TRY TO UPDATE THE STYLE OF THE CONTENTS AS WELL, MAKING THE ARTICLES MORE INTERESTING AND READABLE.

LIKE I SAID, MANY THINGS HAVE CHANGED AS OF THIS COLLEGE YEAR. WE ARE THEREFORE VERY PROUD TO PRESENT YOU WITH THIS YEAR'S FIRST MAXWELL. IN THIS EDITION, YOU WILL FIND REPORTS OF TWO OF THE MORE IMPORTANT ACTIVITIES OF THE ETV: THE INTRODUCTION WEEKEND FOR THE FRESHMEN ELECTRICAL ENGINEERING AND THE ELECTRIP, A SHORT STUDY TOUR TO VIENNA. THOSE LOOKING FOR MORE SERIOUS STUFF CAN LEAF THROUGH TO PAGES 18 OR 26 FOR A REPORT ON A MASTER THESIS OR AN ARTICLE ON PHILIPS' IMPROVED WAY OF ADMINISTERING MEDICINES. AS YOU CAN SEE, MORE THAN ENOUGH CONTENT FOR EVERY READER. AS FOR ME, IT'S TIME TO DIVE INTO THE BOOKS AGAIN AND TRY TO FINISH MY FIRST SEMESTER WITH GOOD RESULTS...

JEROEN OUWENEEL, EDITOR

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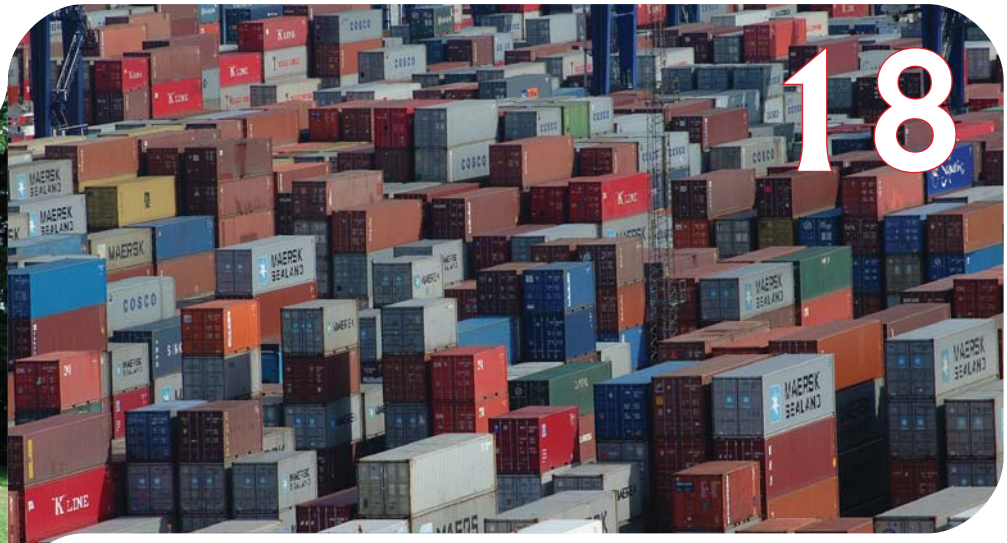
ETV MAGAZINE "MAXWELL" Year 13 – edition 1 – November 2009 **PRINTING** Thieme Media Services, Delft **NUMBER OF COPIES** 900 **EDITORS** Ben Allen, Joost van Driel, Stephan Groot, Maarten Kastelein, Jeroen Ouweneel, Imke Zimmerling, Joost van Zwieten **CONTACT** Maxwell, p/a Electrotechnische Vereeniging, Mekelweg 4, 2628 CD Delft, phone: 015-2786189 or 015-2781989, fax: 015-27 81002, 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. Alumni can change their address via the Alumni Office website: www.alumni.tudelft.nl. **ADVERTISEMENTS** ASML (p.2), Frames (p.31), Siemens (p.32), Technolution (p.16 & p.17) **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.

Hybrid Container Cranes

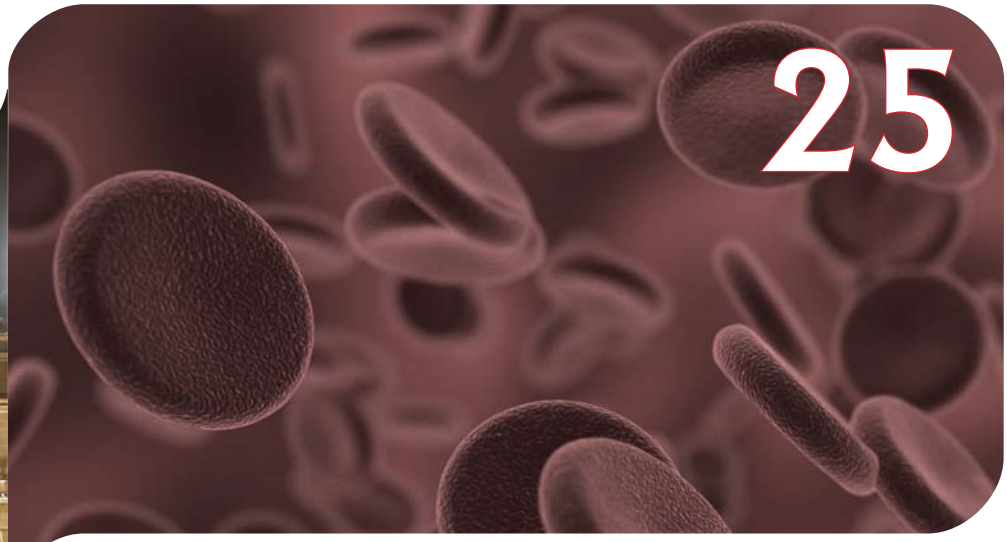
Steven Mulder explains about his master thesis project: an energy management strategy for hybrid container cranes.



unique photoreport of the Fheshmen Introduction weekend is included.

Hitting the right spot

Image-guided drug delivery. These four words could one day revolutionize the way diseases like cancer and cardiovascular disease are treated. For patients, it could change lives: more effective treatment, lower systemic toxicity and new drug possibilities.



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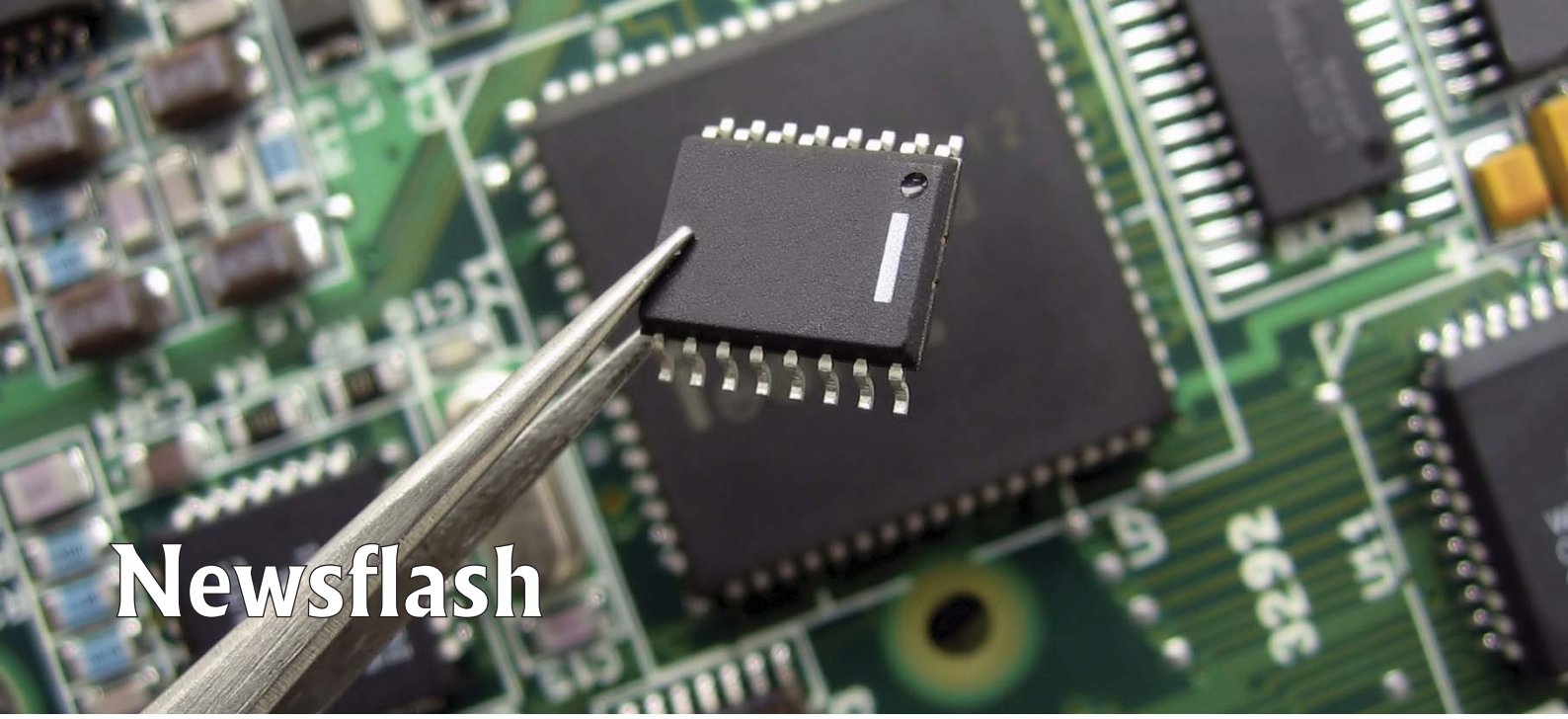


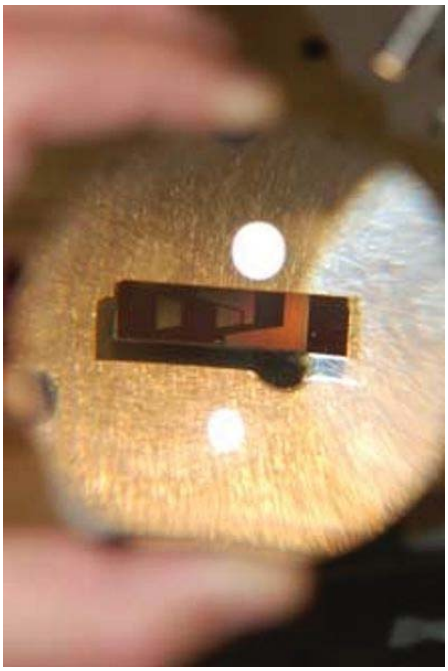
Newsflash

Time lens speeds optical data

Researchers at Cornell University have developed a simple silicon device for speeding up optical data. The device incorporates a silicon chip called a "time lens," lengths of optical fiber, and a laser. It splits up a data stream encoded at 10 gigabits per second, puts it back together and outputs the same data at 270 gigabits per second. Speeding up optical data transmission usually requires a lot of energy and bulky, expensive optics. The new system is energy efficient and is integrated on a compact silicon chip. It could be used to move vast quantities of data at fast speeds over the Internet or on optical chips inside computers.

The new device could be a critical step in the development of practical optical chips. As electronics speed up, "power consumption is becoming a more constraining issue, especially at chip level," says Keren Bergman, professor of electrical engineering at Columbia University, who was not involved with the research. "You can't have your laptop run faster without it getting hotter" and consuming more energy, says Bergman. Electronics have an upper limit of about 100 gigahertz. Optical chips could make computers run faster without generating waste heat, but because of the nature of light -photons don't like to interact- it takes a lot of energy to create speedy optical signals.

The new ultrafast modulator gets around this problem because it can compress data encoded with conventional equipment to ultrahigh speeds. The Cornell device is called a "time telescope." While an ordinary lens changes the spatial form of a light wave, a time lens stretches it out or compresses it over time. Brian Kolner, now a professor of applied science and electrical and computer engineering at the University of California, Davis, laid the theoretical groundwork for the time lens in 1988 while working at Hewlett-Packard. He made one in the early 1990s, but it required an expensive crystal modulator that took a lot of energy. The Cornell work, Kolner says, is "a sensible engineering step forward to reduce the proofs of principle to a useful practice."



The wave guiding chip, called a time lens

Here's how the Cornell system works. First, a signal is encoded on laser light using a conventional modulator. The light signal is then coupled into the Cornell chip through an optical-fiber coil, which carries it onto a nanoscale-patterned silicon waveguide. Just as a guitar chord is made up of notes from different strings, the signal is made up of different frequencies of light. While on the chip, the signal interacts with light from a laser, causing it to split into these component frequencies. The light travels through another length of cable onto another nanoscale-patterned silicon waveguide, where it interacts with light from the same laser. In the process, the signal is put back together, but with its phase altered. It then leaves the chip by means of another length of optical fiber, at a rate of 270 gigabits per second.

Katherine Bourzac, www.technologyreview.com

Robots smarter by asking help

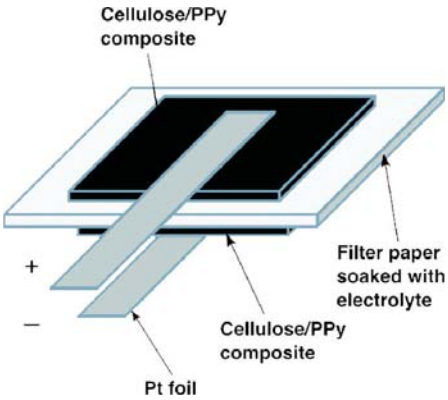
ASKING someone for help is second nature for humans, and now it could help robots overcome one of the thorniest problems in artificial intelligence. That's the thinking behind a project at Willow Garage, a robotics company in Palo Alto, California. Researchers there are training a robot to ask humans to identify objects it doesn't recognise. If successful, it could be an important step in developing machines capable of operating with consistent autonomy. Object recognition has long troubled AI researchers. While computers can be taught to recognise simple objects, such as pens or mugs, they often make mistakes when the lighting conditions or viewing angle change. This makes it difficult to create robots that can navigate safely around buildings and interact with objects, a problem Willow Garage encountered when building its Personal Robot 2 (PR2). Where AI struggles, humans excel, finding this sort of recognition task almost effortless. So Alex Sorokin, a computer scientist at the University of Illinois at Urbana-Champaign, who collaborates with Willow Garage, decided to take advantage of this by building a system that allows PR2 to ask humans for help.The system uses Amazon's Mechanical Turk, an online marketplace which pairs up workers with employers that have simple tasks they need completing. The robot takes a photo of the object it doesn't recognise and sends it to Mechanical Turk. Workers can then use Sorokin's software to draw an outline around an object in the image and attach a name to it, getting paid between 3 and 15 cents for each image they process. In initial tests, the robot moved through Willow Garage's offices, sending images to be processed every few seconds. Labelled images started coming back a few minutes later. The accuracy rate was only 80 per cent, but Sorokin says this can be improved by paying other workers to verify that the responses are valid. Sorokin believes his system will help robots learn about new environments. A cleaning robot, for example, could spend its first week in a new building taking pictures and having people label them, helping it to build up a model of the space and the objects it contained. If it got stuck, it could always ask for help again.

Jim Giles, www.newscientist.com

Paper battery may power electronics in clothing and packaging material

Imagine a gift wrapped in paper you really do treasure and want to carefully fold and save. That's because the wrapping paper lights up with words like "Happy Birthday" or "Happy Holidays," thanks to a built in battery — an amazing battery made out of paper. That's one potential application of a new battery made of cellulose, the stuff of paper, being described in the October 14 issue of ACS' Nano Letters, a monthly journal.

Albert Mihranyan and colleagues note in the report that scientists are trying to develop light, ecofriendly, inexpensive batteries consisting entirely of nonmetal parts. The most promising materials include so-called conductive polymers or "plastic electronics." One conductive polymer, polypyrrole (PPy), shows promise, but was often regarded as too inefficient for commercial batteries. The scientists realized, however, that by coating PPy on a large surface area substrate and carefully tailoring the thickness of the PPy coating, both the charging capacity and the charging (discharging) rates can be drastically improved. The secret behind the performance of this battery is the presence of the homogeneous, uninterrupted, nanothin coating — about 1/50,000th the thickness of a human hair — of PPy on individual cellulose fibers which in turn can be molded into paper sheets of exceptionally high internal porosity. It was special cellulose, extracted from a certain species of green algae, with 100 times the surface area of cellulose found in paper. That surface area was key to allowing the new device to hold and discharge electricity very efficiently.



Concept for a paper battery

The innovative design of the battery cell was surprisingly simple yet very elegant since both of the electrodes consist of identical pieces of the composite paper separated by an ordinary filter paper soaked with sodium chloride serving as the electrolyte. The potential difference is solely due to differences between the oxidized and reduced forms of the functional PPy layer. The battery recharged faster than conventional rechargeable batteries and appears well-suited for applications involving flexible electronics, such as clothing and packaging, the scientists say. Alternatively, low-cost very large energy storage devices having electrodes of several square yards in size could potentially be made in the future.

American Chemical Society

Activities of the Electrotechnische Vereeniging

TU Delft Electrical Engineering First Years Excursion

Author: Robbert Noordzij

On the 11th of September, all first year students were gathered in one of the larger lecture rooms of the EWI building. Since the day planning had changed from an excursion into an "incursie", the students were not going out to some electrical engineering in the wild. Companies like Siemens and Technolution had agreed to come to Delft.

Yes!Delft was the first to speak about their successful way of putting students with their own company on the market. Yes!Delft has done this by helping them to find funds for inventions. One of these success stories is that of two student who invented a fast charging battery. They started under the wings of Yes!Delft, but are now fully self supporting.

Sustainable Energy is a hot topic on the TU Delft, so it is not a strange idea to invite Siemens. Siemens is a company, which has been investing in sustainable energy, like wind energy, since late 1900. The head of sales gave us an inside look in the production and transportation of windmills and how electric cars can become the new power source of the future.

Technolution showed a few of their wonderful technical inventions, like the harden software for RTL(Z to generate these well known AEX tickers at the bottom of the screen.

The commissioner External Relationships thanks Wouter Robers from Epyon by giving him a bottle of whine and a yearbook

At the end of the day, a student told the first years about an amazing and unbelievable future: windmills without moving part: the EWICON. It sounds as impossible as it actually is. He succeeded in generating a small amount of power, however, to generate the small droplets needed he actually used up more energy than generated. As long as this problem is not solved, this 'windmill' won't disturb our landscape.

Lunch Lecture by Siemens

Author: Ben Allen

On a cold, rainy Tuesday in September the ETV received a distinguished guest, in the form of Jan Langedijk, who graduated from the TU Delft in 1982, and was a member of the ETV's 'Sterkstroomdispuut'. The audience, a 60-strong congregation of EE students, enjoyed yet another tasty lunch.

In 1905 Siemens introduced a vehicle aimed specifically at women: the electric car. Unfortunately for Siemens, the technology was not yet mature enough to be viable, and development of the electric car was halted.

Fast forward a century, and we find ourselves in need of alternative fuels for our cars, and the electric automobile has become interesting once again. Today, an estimated 300 000 hybrid cars are on our roads, and Siemens predicts that by 2020 over 15% of vehicles on the road will be either hybrid or electrically driven.

The solution that Siemens proposes for charging these vehicles is that instead

The view of Siemens on electric cars on the smart grid

of increasing the capacity of the grid to charge vehicles quickly, they propose to charge your car slowly, when the grid has redundant power available.

This comes with the problem of load balancing. The solution: add a control unit, which Siemens' calls a "Smart Box", to the charging set-up, that takes a number of parameters and manages the charging process. You could tell the charger you want your vehicle to be 100% charged at the beginning of the day, and it chooses when to charge based upon the load on the grid.

Electrically powered vehicles are still the prospect of times to come. Combustion engines must be phased out slowly while electric cars become affordable and readily available. Charging these vehicles is a delicate process that should be approached in such a way as to require a minimal change of the current power grid configuration – the "Smart Box" is Siemens' answer to this.

SSD Excursion to the Princess Amalia offshore windfarm

Author: Menno de Haas

On Tuesday September 22 the 'Sterkstroomdispuut der ETV' organized an excursion to the Princess Amalia offshore windfarm near IJmuiden.

In the morning 40 students gathered at the EEMCS faculty in order to depart by bus. Arrived in IJmuiden, several presentations were held by Auke Wiersma from Stedin about the company Stedin and the windfarm itself. Around 1 PM the message was spread that, unfortunately, the wave height had increased since the morning and we were therefore discouraged to enter the sea. Fortunately we organized a backup plan to Futureland, an information center about the Maasvlakte 2, which is a huge industrial area near Rotterdam under construction. After all, everyone enjoyed the day and returned home just slightly disappointed.

Stedin offered the Sterkstroomdispuut another opportunity to visit the windfarm during spring next year! At that time the probability on good weather conditions is higher and the excursion to the windfarm will hopefully succeed.»

Auke Wiersma from Stedin is just about to start his presentation

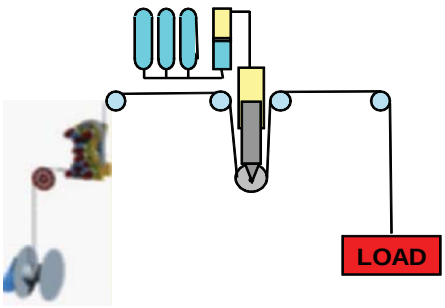
Lunch Lecture "Huisman applied electrical power distributions"

Author: Corné van Eeden

On October 13, Andre Delrue, employee of the Dutch company Huisman Equipment, gave a lunch lecture about power distribution in the lifting and drilling equipment developed by Huisman in Schiedam. Delrue has graduated from Delft in 2007 at the Electrical Power Processing group.

Huisman was founded in 1929 and is nowadays a company developing various offshore equipment like cranes, pipe laying equipment and drilling equipment. Next to Schiedam the company has factories / yards in Czech, China and Brazil.

Since Andre Delrue's background is in electrical power engineering, he has worked on various projects in power distribution on the various cranes. Those cranes – which are very large compared to their onshore counterparts – are used to lift various equipment offshore. Winches are used to store and pull the steel cables for hoisting. Often some kind of heave compensation is needed, to compensate for the movement of the the crane barge compared to the seabed, due to waves. This is for example needed when something has to be lowered on that seabed or on a fixed platform. If no compensation is applied, the device being lifted by the crane would bounce every time the crane barge is going down due to the swell.



Traction winch and storage winch with heave compensation

To do heave compensation, a remarkably large amount of power is needed during a short time (e.g. 5 seconds). Heave compensation can be done in several ways, the basis of all methods being the cable shortened and lengthened periodically. A classic way is to use some hydraulic piston with a pulley on the end, which pushes the line every time.

Other methods are also applied. For example, one could also partly wind and unwind the winding drum. This causes a periodically changing power demand: at one time instant power is being delivered to the drum motor via some power electronic inverter, and at a second time instant the power delivery reverses from drum motor to the ship's grid or is dissipated in seawater cooled resistor banks. Both AC and DC grids are used on sea going ships. Most grids on ships do not allow infeed from braking motors, or simply have no demand at the instant the power is being delivered by the braking motor. Various solutions have been found to smooth the power demand. One could for example use a winch like a fly wheel and accelerate or brake it to store energy. A novel solution to this problem of energy loss has been found in the form of capacitor banks.

Capacitor banks temporary store the generated energy and release it a few seconds later when power is needed to accelerate the winding drum. In this way the power demand is smoothed. A capacitor bank consists e.g. of 860 2.6V 1500 F (!) capacitors and a 50 kW DC/DC converter). Larger compensating systems of four times the previous mentioned sizes have also been built and are currently in use in a vessel used to dump stones on the seabed. The capacitor bank system performs well.

A huge crane for pipelaying purpouses

Andre Delrue has shown one example of the way electrical power engineering is used in current practice, which has proven to be interesting. After about 45 min and a good lunch and lunch lecture, all attendees went their own way again.

Educational Announcements

This academic year has started with a huge increase of freshmen. In order to accommodate the 99 freshmen, the timetable was altered significantly and a new lecture room was created while the students were enjoying their holidays. Below you can find some more education announcements

Author: Frank Teunisse, Commissioner of Education

LECTURER OF THE YEAR

Dr.ir. Gerard Janssen has been chosen as lecturer of the year. He has been chosen because of his efforts to stimulate students to follow his lectures and his great work behind the scenes in, for example, the exam committee and the committee that is preparing the new bachelor program. In reaction to his appointment as lecturer of the year Gerard Janssen will give a special lecture on the 26th of November about sound systems.

STUDY GUIDES

From this year on study guides are no longer freely available at the service desk and no longer contain an agenda. However, study guides can be ordered for free on blackboard (go to MyStudentInfo then click on "Order Readers online"). Samples are available for perusal at the ETV desk.

SUBSCRIPTION FOR EXAMS

Some confusion existed about the subscription for the exams. The official examination rules have been changed to: (translated) "The registration for participation in a written exam happens by putting data in the exam registration system, at least 14 days (not working days) before the beginning of the exam period. The last two weeks of a period will be regarded to be the exam period." Currently registration can be done 14 days before a particular exam (and not the whole period). However, this change will only take effect when the new registration system comes into operation and not all of the details are certain yet. The new system will not become in operation before the beginning of the 3rd quarter.

NEW TIME TABLE SYSTEM

As all students probably have noticed the TU introduced a new time table systems (http://roosters.tudelft.nl or http://timetables.tudelft.nl). In the beginning of the academic year, unfortunately, the system failed and a lot of students had troubles in finding their time table. Furthermore, the new system currently lacks a decent vcal exportation function. Fortunately one of our active members built a vCal generator, which is available on http://roosters.electrotechnischevereeniging.nl/.

EOW '09

This year there was an Electrical Engineering Welcoming Weekend (EOW), like every year, to teach the upcoming students about the faculty EWI and the student association ETV. The main goal of the EOW, however, is to get the freshmen to know each other and to create suiting mentor groups on the last day. The 27th EOW with the theme "Buisje, stroompje, feestje" was filled with both fun and informative activities.

Everyone gathered to listen to the introduction held by the president of the 137th ETV board (Thijs van Leeuwen), the dean (prof.dr. D. Lenstra), and the president of the 27th EOW committee (Tobias Dekker).

This was the 'place to be' for nice stories about Delft, the campus and the faculty itself.

The game called Stock Exchange (Beursspel) developed a hold up at the Monsterboard division.

Students will do anything to earn some EValuta Even if they have to carry someone outside for some fresh air.

Another game called the Exchange game (Ruilspel) took care of our shortage of more or less useless junk. Afterwards all the junk had to be carried off the beach, off course.

The evening came and quite a lot empty stomachs had to be filled. Fortunately we were prepared with a grill and a Michel Vermulst to provide everyone with food.

Later on everyone could compete in the beer relay to show off their magnificent beer drinking skills.

> > >

Needless to say, all the students respected the hard working EOW committee for their great efforts and time and therefore brought presents.

The morning exercises took care of the sleepyheads.

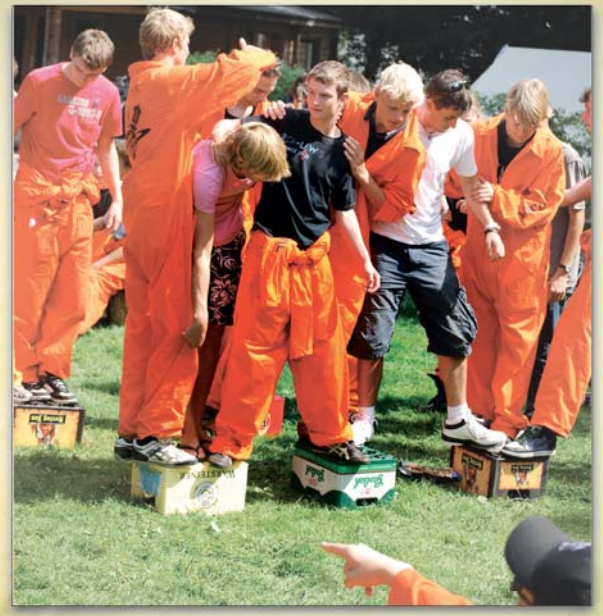
As a reward, the upcoming students were taught the so-called Elektro-moves to add to their lacking dance moves database.

The upcoming board was traditionally covered with all kinds of foods and fluids to make them look even more appealing.

Buisje Stroompje Feestje

Author: Jasper Boot

Most students interpreted the word applause the wrong way and clapped like seals. A old exercise for them was to move themselves like seals.



The students competed in the beer crates race as mentor groups against each other. Surprisingly enough the best group didn't always win the match.

Also the peanut butter race was held this year and covered half of the bodies of the freshmen with a nice layer of peanut butter. It's definitely a fun game to watch!

Ending this year's EOW with a group photo wasn't as easy as we thought, but the result is great nevertheless!

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Hybrid Container Cranes

An Energy Managament Strategy

Author: Steven Mulder MSc.

Somehow, container cranes have managed to work their way into every major project I have performed during my studies. My final bachelor's project at Electrical Engineering—"IPP" for intimi—involved creating the electrical instrumentation for the simulator crane of the department of Transport and Logistics. After this project, I made the jump from Electrical Engineering to Systems and Control. At the end of the first year, I was confronted with anti-sway control for a container crane for a practical assignment. It seems inevitable that the subject of my final thesis also has to do with container cranes. In this article I will give a brief overview of my graduation project for Systems & Control, performed at Siemens Cranes in The Hague under supervision of professor Hellendoorn.

Due to the advent of hybrid cars, energy management strategies have been a popular research subject in recent years. The challenge in energy management is making the best use of the limited amount of energy that is stored in the hybrid systems' secondary power source—the battery pack. This secondary source should make sure that the primary combustion engine runs in its most efficient working point as much as possible. What makes improving the energy management strategy so interesting is that it only changes the software of the system, so no additional hardware costs are necessary, while the overall fuel efficiency can improve significantly. In the case of Siemens' Hybrid ECO-RTG crane, the newly designed strategy could save terminal operators literally hundreds of thousands of dollars.

Container shipping

Within a container terminal there are a number of different types of cranes in operation. The most well-known are the giant ship-to-shore (STS) cranes, that have to load or unload container ships as quickly as possible, usually with multiple cranes working on a single ship. The containers are transported to the stacking yard behind the STS cranes. The containers are stored here before they are transferred onto trucks or trains that transport them over land. They are stacked into neat rows for the most efficient use of space and time. This stacking is often done by rubber-tired gantry (RTG) cranes, which are the subject of my graduation project.

RTG cranes straddle multiple lanes of stacked containers (see fig. 2), and can move 20 or 40 ft long containers weighing up to 65 t. The cranes are driven by an operator who is seated in a control cabin on the trolley at the top of the crane. As the name suggests, rubber-tired gantry cranes have rubber tires that enable them to move from one line of stacked containers to another.

Siemens Hybrid ECO-RTG

Most cranes in container terminals are connected to a fixed electrical power grid. RTG cranes are an exception to this rule, because they have to be able to move around and switch from one stack lane

to another, making it difficult to connect them to a fixed grid. There are projects to fit yards with conducting rails to remove this problem, but this limits mobility and is not practical in a lot of cases. Therefore RTG cranes are traditionally equipped with a large diesel generator set (GenSet), which provides the crane's electric motors with the necessary power. The problem is that this GenSet consumes a lot of fuel during operation.

To tackle the problem of the high fuel costs of RTG cranes, Siemens developed an energy saving solution, the Hybrid ECO-RTG. This hybrid crane is able to temporarily store regenerated energy and reuse it later on. Container cranes are an especially interesting application for hybrid systems, because there is a very large amount of "free" energy available: every time a container is lowered, the crane's electric motors can regenerate the potential energy that is released. Thanks to all this regenerated energy the Hybrid ECO-RTG can achieve incredible fuel efficiency, far better than hybrid cars—which can only regenerate energy during braking.

The regenerated energy is stored in an ultracapacitor bank which forms a secondary power source for the crane. Ultracapacitors are a type of capacitors with very high energy density thanks to very porous carbon electrodes and special double-layer dielectric material. They are also known as supercapacitors or double-layer capacitors. There are of course other storage technologies such as batteries (Li-ion or lead-acid) or flywheels, but Siemens has chosen for ultracapacitors because of the relatively high cycle lifetime of this technology.

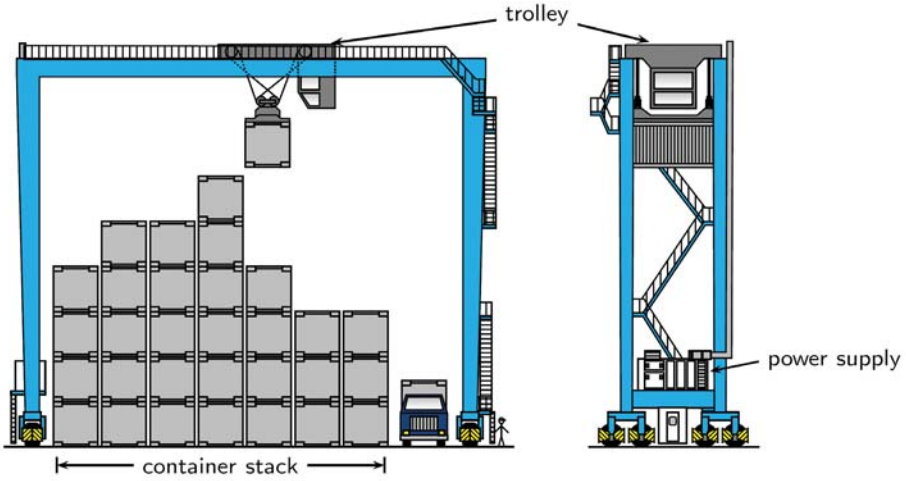


Figure 1: Front and side view of a rubber-tired gantry (RTG) crane

Energy management strategies

The main contribution of my thesis is the design of a new energy management strategy for the Hybrid ECO-RTG. This is the control policy that governs the use of the regenerated energy that is stored in the ultracapacitors, see Fig. 3. The overall efficiency of the crane can be optimized by using a strategy that makes smart decisions about when and how to use the GenSet and the ultracapacitors. This is summed up by the following formal thesis goal: "To improve the energy management strategy of the Siemens Hybrid ECO-RTG crane in order to enhance its fuel economy".

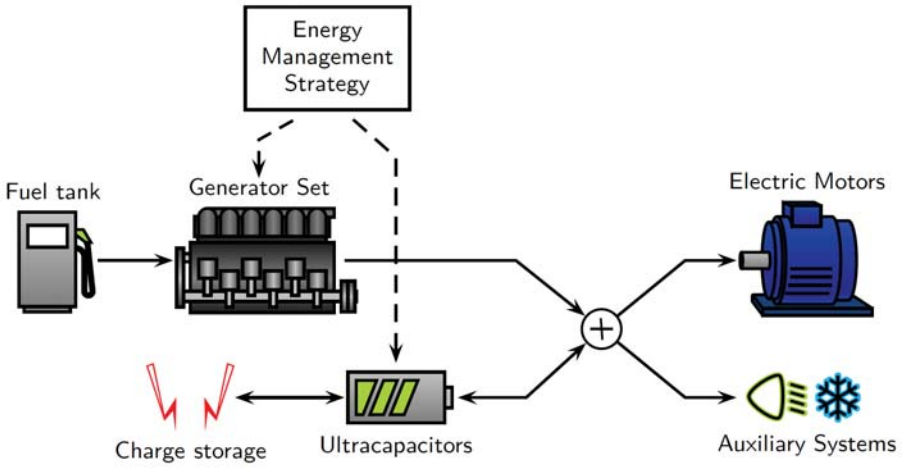


Figure 2: Power system of the Hybrid ECO-RTG

Design of the new strategy

The goal of the energy management strategy is to minimize the fuel consumption of the Hybrid ECO-RTG crane during operation. The most straightforward way to save fuel is by turning off the GenSet engine and only using the ultracapacitors to power the crane. Unfortunately the energy storage capacity of the ultracapacitors is not big enough for this simple strategy, so it is necessary to use the GenSet at least part of the time when the crane is in operation. The challenge is to use the GenSet as efficiently as possible, by selecting the best time to turn the GenSet on and off, and by using it in its most efficient operating range.

It is important for the strategy to know in what working point the GenSet and the ultracapacitors function most efficiently. Measurements show that the GenSet is most efficient in the region 150–200 kW, close to the rated power of the GenSet. The performance rapidly deteriorates for lower and higher power delivery, this is typical behavior for combustion engines. The energy management strategy must try to keep the engine running »

inside this region as much as possible. For the ultracapacitors, most losses are due to internal heating, as well as some losses during DC/DC conversion. For the most efficient use of the ultracapacitors, the energy management strategy should avoid delivering large peaks of power with them.

Selecting the best time to shut the GenSet engine off and to turn it back on again presents the strategy with another crucial dilemma. This can be compared to the automatic stop/start mechanism in some modern cars: when a car spends two minutes idling in front of an opened bridge, it is best to turn the engine off and save fuel; on the other hand, when the car is in a traffic jam, it would be disadvantageous for the fuel consumption to switch off the engine every time it came to a stop. The same decision of when to switch the engine on and off has to be made for the Hybrid ECO-RTG crane, when it is in between moving two containers.

It is theoretically possible to calculate the optimal solution to the fuel consumption problem. There might even be multiple optimal solutions for a given power demand. The difficulty lies in the fact that optimal solution has to be found in real time, so there is limited calculation time available. Furthermore, the exact power demand is not known in advance. The crane software does not know the locations where the containers have to be picked up or released, or even the weight of the container is unknown until it is picked up.

Even more importantly, the software also does not know when the crane is going to start a move or when it going to be idle for some time. This is crucial in trying to decide when best to switch the GenSet engine off. Because of the lack of knowledge about the upcoming power demand, the energy management strategy has to react on the real-time power demand and also has to try to anticipate what will happen in the next two minutes—the average duration of a typical move.

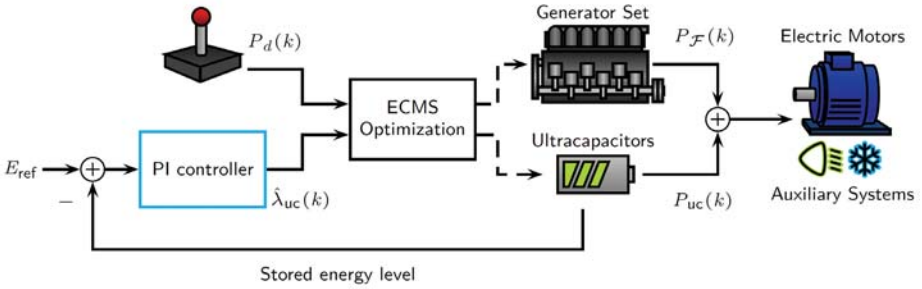


Figure 3: Block scheme of first weighting solution, using SOC feedback.

Equivalent Consumption Minimization

There are many different ways to approach the design of an energy management system. This ranges from basic if/then/else systems to complex strategies that use principles from game theory. A relatively simple approach that has proven to be very successful for automotive application is known as Equivalent Consumption Minimization Strategy (ECMS).

The general idea behind ECMS is the fact that all the energy that the ultracapacitors supply to the crane has to be balanced in the future by energy that is stored back in the ultracapacitors, either using regenerated energy or using excess power from the GenSet. Recharging the ultracapacitors adds to the fuel cost, so the power that the ultracapacitors supply can be expressed in terms of its "equivalent fuel cost".

Basically, ECMS considers the power from the ultracapacitors not as "free energy" as it would seem from the original objective function, but it will cost some fuel in the future. The argument is the same when energy is stored instead of spent: storing energy right now will save fuel in the future. The energy management system should try to minimize the GenSet fuel consumption, but also take into account the equivalent fuel cost of using the ultracapacitors.

The notion of equivalent consumption reduces the complexity of the problem enormously: there is no need to take the future power demand into account, because the power flowing in and out of the ultracapacitors is automatically balanced. Unfortunately, it also presents a new challenge: how to define the equivalent fuel cost of discharging the ultracapacitors?

A sensible definition of the equivalent fuel cost simply the ultracapacitor power multiplied by a weighting factor λ_{uc}. The choice for this weight is crucial: when the ultracapacitors are heavily weighted, the strategy will be too conservative, and use the GenSet too much. On the other hand, if the weight is too small, the strategy will be too aggressive and the ultracapacitor storage will become drained. Therefore, estimating the weight is extremely important for optimal behavior of the new strategy.

Curiously enough, there was little information available about how to make a proper choice for the weight λ_{uc}. Most researchers seemed content to use their strategies in a simulation environment, where you can use knowledge about the power demand during a certain time period in order to find the perfect weight for this time period. In real life this information is not available, so a different approach was required for Siemens to use this system on their crane. In fact, two different solutions for the weighting were proposed: one relatively straightforward, one more complex.

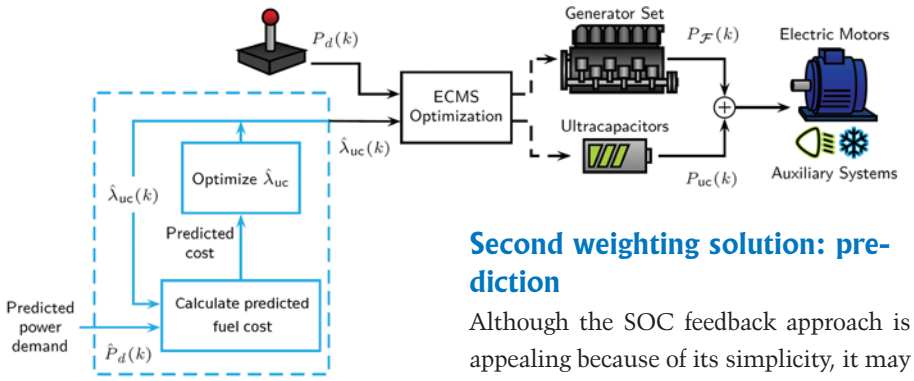


Figure 4: Block scheme of second weighting solution, using prediction

First weighting solution: state of charge feedback

The influence of λ_{uc} on the use of stored energy can be used to approximate whether λ_{uc} is optimal or not. As was just discussed, if the weight is too large or too small, the strategy will use too little or too much ultracapacitor energy, and the average energy level of the ultracapacitors will slowly drift away from its initial value.

By looking at slow variations in the energy level, the optimal value of λ_{uc} can be approximated. Figure 3 shows a schematic of this approach. The energy level of the ultracapacitors is compared to a reference level, for instance 65% charged. The approximation block consists of a PI-controller with a very small bandwidth, so only slow variations of the energy level are controlled.

Second weighting solution: prediction

Although the SOC feedback approach is appealing because of its simplicity, it may not always produce the best possible results. Essentially it is constantly reacting on things that have already happened, because it relies on feedback from the ultracapacitor energy level. Especially when the average power demand of the crane abruptly changes, for instance when a ship arrives at the terminal and suddenly a lot of containers need to be moved, the feedback approach might react too slow to optimally deal with this change.

A predictive system is an obvious solution for this problem. For an RTG crane, making predictions about upcoming tasks and the related power demand is feasible. In the near future, detailed information about the upcoming crane activity can be obtained by communicating with the logistic software system that controls the movement of all the cranes, containers and trucks on the container terminal. Based on this information, the software can make a reasonably accurate prediction of the power demand in the next few minutes. This information can then be used to optimize the current value for uc in real time, using basic line search methods.

This approach is computationally a lot more demanding than the simple feedback system, but given the fierce competition in the "green" RTG market, every possibility to improve the fuel efficiency is worth investigating.

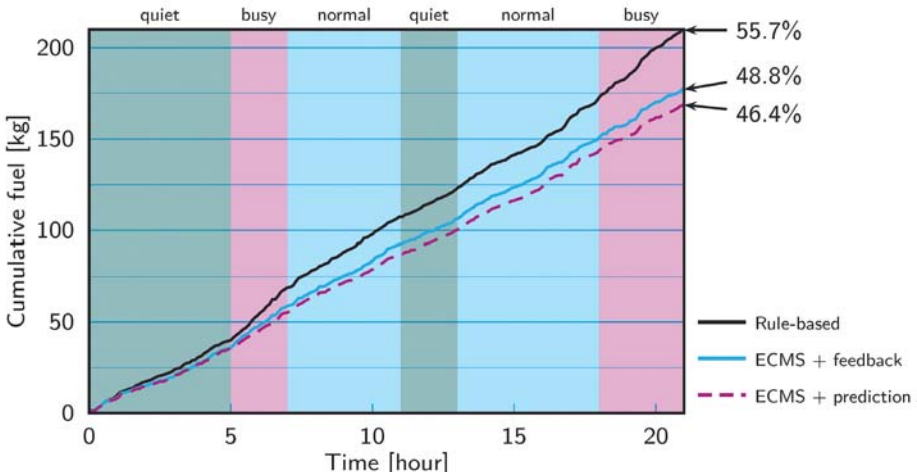


Figure 5: Cumulative fuel consumption over 21 hour day with varying activity

Simulation results

The two new strategies were compared to the strategy that Siemens currently uses for their Hybrid ECO-RTG. All three strategies were applied to a simulation of a full (21 hour) working day. Over the course of the day, the level of activity fluctuates just like the real workload of RTG cranes.

Figure 5 shows the day's schedule and the cumulative fuel consumption during the day. There is an interesting difference between the quiet, normal and busy periods: when it is quiet there is little difference between the strategies, but in more busy periods—when the fuel consumption is larger—the gap increases notably. This means that busier terminals will gain more from using the new strategies.

These raw fuel consumption figures can be translated into financial gains. After the hybrid cranes have paid off the initial investment in the ultracapacitors, they start making a monthly profit. Over ten years, the total cost of ownership of the Hybrid ECO-RTG cranes with the new feedback ECMS strategy is $ 230,000.- less than a regular ECO-RTG. Compared to the current hybrid system, the new strategy saves $ 55,000.- extra over ten years. A typical container terminal will have a whole fleet of these cranes, so switching to the new strategy will literally save hundreds of thousands of dollars for the terminal operator. Not bad for a few months worth of MATLAB work...

Electrip 2009: Wenen

De Electrip, een korte studiereis binnen Europa, georganiseerd door de drie Electro-verenigingen uit Nederland, is intussen vaste jaarlijkse prik. Helaas kon Thor uit Eindhoven dit jaar niet meedoen in verband met hun studiereis, maar de ETV en Scintilla uit Twente besloten de Electrip toch doorgang te laten vinden. Als bestemming werd cultureel capitool van Europa, Wenen, gekozen.

Auteur: Jeroen Ouweneel

Na enkele maanden van voorbereiding was het dan zover: in de nacht van 27 op 28 mei, om 12 uur 's nachts, verzamelde zich een groep van 9 ETV'ers voor het faculteitsgebouw. Na de bagage te hebben ingeladen werd koers gezet naar het oosten. Na wat korte pauzes tussendoor, een goed ontbijt bij een bakker in Fürstenzell en vooral vele kilometers asfalt kwam dan eindelijk, een goede 12 uur na vertrek, Wenen in zicht. Voor uitrusten was echter weinig tijd, want een stadsrondleiding stond gepland voor de eerste middag.

Een aantal leden van 'IAESTE', een Oostenrijkse vereniging voor uitwisseling van studenten, zou deze rondleiding verzorgen. Er was echter nog niet geluncht, maar een barbecue van een Weense studentenraad bood uitkomst. Een broodje grilworst en een biertje later kon met de rondleiding worden begonnen.

Eerst werd de binnenstad aangedaan. Hier zagen de deelnemers alvast de buitenkant van het imposante operagebouw, werd de Stephansdom uitgebreid toegelicht en zelfs een Joods gedenkteken bekeken. De diversiteit bleek enorm.

Hierna werd een uitgebreid bezoek gebracht aan Schloss Schönbrunn, beter bekend als het kasteel van prinses Sissi, en de enorme tuin die hierbij hoort. Het uitzicht vanaf het 'tuinhuisje', waar tegenwoordig een restaurant huist, bood eenieder een prachtig panorama over Wenen, met het Schloss op de voorgrond. Ook werd de groepsfoto hier gemaakt, met als achtergrond één van de fonteinen die de tuin van Scloss Schönbrunn rijk is. Het avondeten en -programma was vrij, dus de deelnemers kozen elk wat naar hun smaak en gingen ofwel naar bed, ofwel nog ergens een biertje drinken.

De dag erop was het weer vroeg dag. Voor de ochtend stond een bezoek aan het bedrijf TTTech, kort voor 'Time Triggered Technology', op het programma. Dit bedrijf, dat samenwerkt met grote namen als Nasa en vrijwel alle grote automerken, specialiseert zich in complexe computersystemen, opgebouwd uit losstaande componenten, die onderling kunnen communiceren en op basis hiervan zich anders kunnen gedragen.

Voor de lunch werd de kantine van de Technische Universiteit Wenen bezocht. Voor het middagprogramma hoefde niet verkast te worden; oud-medewerker van de TU Delft en intussen TU Wenen-professor Vellekoop had een aantal van zijn studenten bereid gevonden hun onderzoek te presenteren. Centraal onderwerp was het manipuleren van optische vloeistoffen op microschaal. Onder leiding van professor Vellekoop werd hierna een eetcafé bezocht, waar een goede avondmaaltijd en borrelen

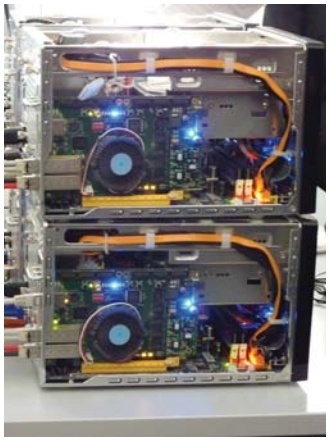
prima gecombineerd konden worden.

De laatste volledige dag was alweer aangebroken. ‘s Ochtends werd er een bezoek gebracht aan het enorm grote Technische Museum. Een geweldige collectie, variërend van complete stoomlocomotieven en vliegtuigen, tot een verzameling muziekinstrumenten en allerlei interactieve tentoonstellingen bood een interressante ochtend.

Om de tijd tot het begin van de opera-voorstelling op te vullen, werd het Prater-amusementspark bezocht. Een ritje in het enorme, ruim 100 jaar oude reuzenrad bood een schitterend uitzicht over de Oostenrijkse hoofdstad.

Die avond zagen we de operavoorstelling ‘Werther’, een variant op het bekende ‘Romeo en Julia’, vanaf de bovenste verdieping in het operagebouw. Hierna liet één van de eerder genoemde IAESTE-leden het uitgaansleven van Wenen uitgebreid zien.

Een goede nachtrust later was het helaas alweer tijd om op huis aan te gaan. Na nog een kleine omweg langs het bizarre gebouw van kunstenaar Hundertwasser, en een rit van zo’n 1300 kilometer waren we, een hoop ervaringen rijker, weer terug het vertrouwde Delft.



Joost may know it

Hoe gevaarlijk is het voor een vogel om op een hoogspanningslijn te zitten?

Authors: Ir. J.F. Baalbergen, Ir. G. Hoogendorp

Toen wij van de Maxwellredactie het verzoek kregen om een stukje te schrijven rond de vraag: "Hoe dood ik een vogel met een hoogspanningsmast?" moesten we ons even achter de oren krabben. Dergelijke problemen behoren niet tot de onderzoeksvragen waar promovendi elektrische energietechniek normaliter mee te maken hebben. Normaal gesproken houden wij (de auteurs) ons namelijk bezig met respectievelijk het zorgen dat er ook in de toekomst, als in het net een substantieel deel van de elektriciteit wordt opgewekt met decentrale opwekkers, nog stroom uit ons stopcontact komt en het verkabelen van een deel van het 380 kV-net.

Een vogel doden met een hoogspanningsmast. Dat zal in ieder geval niet lukken door de vogel tegen de spanningsvoerende draden te gooien. Elektriciteit is pas dodelijk op het moment dat er een stroom van een zekere grootte door vitale delen van het lichaam vloeit (50 mA wisselstroom door het menselijk hart is dodelijk).

De vogel komt door het aanraken van de draden wel op potentiaal te staan, echter zolang hij op hetzelfde moment geen andere onderdelen van de mast met een ander potentiaal raakt, gaat er geen stroom vloeien. De vogel zal hooguit gedood worden als deze met zo'n grote vaart tegen de mast/draad komt, dat hij deze klap niet zal kunnen "twitteren".

Een manier die meer effect zal hebben is door ervoor te zorgen dat de vogel bekneld raakt tussen de geleiders. Zoals bekend trekken geleiders, die een stroom voeren in dezelfde richting, elkaar aan. In een hoogspanningslijn wordt elke fase meestal gevormd door een aantal geleiders (twee, drie of vier.) Om ervoor te zorgen dat deze geleiders elkaar niet raken, worden deze van elkaar gescheiden door een afstandhouder. Mocht de stroom echter te groot worden (bijvoorbeeld door een kortsluiting), dan zullen deze afstandhouders breken en de geleiders met grote kracht naar elkaar toetrekken. Een vogel die hier tussen zit, overleeft dit niet.

Kanttekening bij deze methode is dat er een kortsluiting in het hoogspanningsnet gemaakt moet worden. Als het al lukt zo'n kortsluiting te realiseren, dan is een tweede punt dat de beveiliging van het hoogspanningsnet deze in korte tijd af zal schakelen… De vogel moet dus wel op het juiste moment op de verkeerde plek zijn!

Brengt ons tot de prangende vraag: waarom zou je eigenlijk überhaupt een vogel willen doden met een hoogspanningsmast? Het is niet de meest eenvoudige manier, en je maakt er zeker geen vrienden mee. Voor het vlees hoef je het ook al niet te doen aangezien je met de geschetste methodes niet veel vogel overhoudt.

Deze vogels merken niets van hun zitplaats op hoog potentiaal

Column

Khashayar Kotobi
Student Electrical Engineering

The first day of my new life here in the Netherlands is among the days that I cannot imagine forgetting. From the plane, the first view was a beautiful green country with lots of rivers that, like vessels of a human body feeding the organs, carry water to feed this green land. On that day, the sun was shining and the temperature was 29°C. But to my wonder, every single Dutch student was complaining about that beautiful weather. After taking a road to Delft without any traffic, which is completely rare in Iran, I saw a tall building and I told my friends I hope that building is my school and you can guess the rest!

In the days after, I have tried to understand how tolerable Dutch people are, so I tried to make fun of the most important Dutch person I knew, which is her majesty the queen. This action has a death penalty in Iran, but here nobody cares! I was shocked. You can say whatever you want and they just laugh at your jokes. There are so many foreigners here in the Netherlands and it seems that nobody cares. Most of the time when I speak in my mother tongue in streets there are some Iranians here that greet me in Persian! Actually in one shop, a cashier when she understood that I was Persian, started to speak Persian.

Last but not least, I want to take a look at the drinking habits here. I think for electrical students who decide to come here it is really surprising that there is a Pub downstairs in EWI. During nights when I am walking in the Delft streets I can only see drunken Dutch people. I think the only entertainment here in Delft is going out and getting drunk! Do you know anything else?

Hitting the right spot

Image-guided drug delivery. These four words could one day revolutionize the way diseases like cancer and cardiovascular disease are treated. For patients, it could change lives: more effective treatment, lower systemic toxicity and new drug possibilities.

Author: Brandy Vaughan

Cancer and cardiovascular disease affect millions of people around the world. They're also two of the most deadly and difficult-to-treat diseases. Currently, most treatments involve powerful drugs that are distributed passively throughout the body – all for a disease that may be limited to one spot.

Doctors are left without an efficient way to ensure the treatment gets to where it's needed most. This whole-body' dosing also limits a doctor's ability to ensure the treatment is as effective as possible. Due to the inherently toxic nature of treatments like chemotherapy, doctors have to work within a tight margin – called the therapeutic window – to make sure the amount of treatment given is enough to have a positive effect while keeping side effects and toxicity to a minimum. Usually, this means the doctor has to limit treatment doses and spread them over a period of time. It's definitely not the powerful punch doctors – and patients – are hoping for.

Right on target

One solution is to deliver the treatment right to the target spot. Right now, the best way to do this is through injectable drug-loaded carrier' particles, which already exist for the treatment of some diseases, such as breast cancer. But they aren't as effective as they could be. The current generation of carriers localizes treatment but only in a passive manner, with drugs released as a slow diffused leakage over time. Ideally, there would be a better way to control – or trigger – the release of drugs right at the disease site.

Triggered release

With the goal of giving patients more benefit from potentially life-saving treatment, Philips Research began to develop localized drug-delivery techniques that aim to release treatment locally using an external trigger, such as ultrasound pulses or heat. The concept involves tracking the path of the drug through the body and then triggering its release from the carrier particles at the target spot – potentially making

Novel techniques

The potential of image-guided drug delivery has not gone unnoticed. In fact, Philips is heading a 15.9 million project focused on furthering the novel techniques. The Sonodrugs' project, which is partially funded by the European Union, draws on the expertise of 15 partners, including medical centers and academic institutions from throughout the EU.

The project will run for four years and work will focus on a number of different areas, including the development of new particles with the right size, structure, physical behavior, half-life and bio-compatibility, as well as exploring the bio-distribution and effectiveness of the drug-delivery techniques in-vitro and in-vivo.

the uptake of treatment into disease cells more controlled and, therefore, more powerful.

"New options that involve externally triggered treatment at the specific site of disease could really change patient care for the better," notes Klaus Tiemann, Professor of Cardiology at the University of Münster, Germany. This is because triggered local delivery means a higher concentration of the drug reaches the disease site. This may result in fewer side effects for patients and give doctors the option of increasing dosage in an effort to hit the disease harder straight away, possibly improving treatment efficacy.

Visual delivery

Not wanting to limit the possibilities, Philips is working on two different image-guided delivery techniques that could one day change the way these diseases are treated. The first technique, developed for the treatment of cancer, involves drug-loaded particles mostly made of phospholipids – called liposomes. Typically just 100 to 200 nanometers in diameter, liposomes are tiny enough to travel through small capillaries in the vascular system and penetrate deep into diseased tissue. After injection, the particles are tracked using MRI and once they're at the target site, a small amount of heat is applied using ultrasound, causing the heat-sensitive particles to release the treatment drugs on the spot.

Since damage can occur when tissue is overheated, MRI is ideal because it can be used to monitor local temperature changes in the body. "The physiological range of heating body tissue is very small," explains Holger Gruell, project leader at Philips Research. "You shouldn't heat body tissue much above 42°C. Beyond 44°C, you can do permanent damage. So the heating effect that releases the drug must occur within a certain temperature range, which requires a precise finetuning of the particles. It's a balance that we're still working on. But this is where the combination of ultrasound and MRI has a big advantage because MRI can monitor the subtle ultrasound-induced temperature changes very precisely."

MRI is also capable of imaging soft tissues and organs, as well as detecting the arrival of the drug-loaded particles at the disease site using contrast agents.

A burst of bubbles

The other method for image-guided drug delivery involves larger particles, up to two micrometers, often called microbubbles', which can be adapted to rupture when exposed to ultrasound pressure waves – or pulses. Philips is exploring ways to fill these microbubbles, currently used as contrast agents for ultrasound imaging, with treatment drugs and use them to deliver precise doses exactly where needed in the body. Ultrasound imaging would track the microbubbles in the bloodstream

and when they reach the target site, a high-energy ultrasound pulse would shatter the microbubble shells – releasing the drugs right at the disease site.

"When microbubbles are exposed to ultrasound pulses, they rapidly expand and contract in size eventually causing them to explode," notes Marcel Bohmer, who's responsible for microbubble development at Philips Research. "But actually one of the most exciting aspects of microbubble drug delivery is the aftereffect of that bubble burst."

Researchers have found that when microbubbles burst, the explosion somehow pierces nearby cell membranes making them more porous and, therefore, more susceptible to drugs. This phenomenon is called sonoporation and could allow for new treatment possibilities. In fact, there's a whole range of new drug therapies based on genetics and DNA that may prove to be the most powerful and tolerable treatments yet for diseases such as cancer and cardiovascular disease. But there's one main obstacle: getting the treatments into the disease cells.

Sonoporation may just offer a solution. The controlled opening of the cell membrane caused by the microbubbles may not only increase the local drug concentration but also facilitate the uptake of drugs that would never otherwise be able to enter cells.

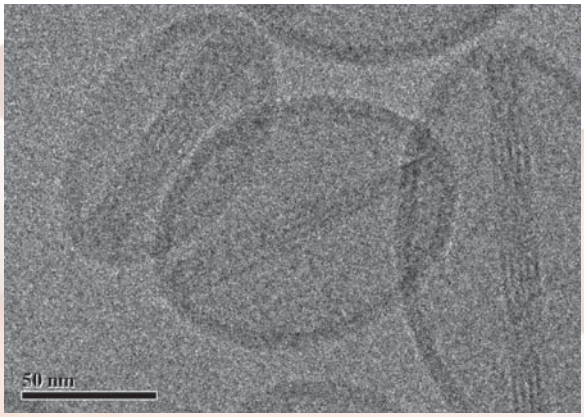
There are still many rounds of testing and many issues to be resolved before image-guided drug delivery hits the clinical setting – no sooner than five to ten years from now. But it may one day offer doctors more localized ammunition in the fight against two of the deadliest diseases known to man.

For more information, go to www.research.philips.com/password

Source: Password, Philips Research technology magazine, June 2009, www.research.philips.com/password/

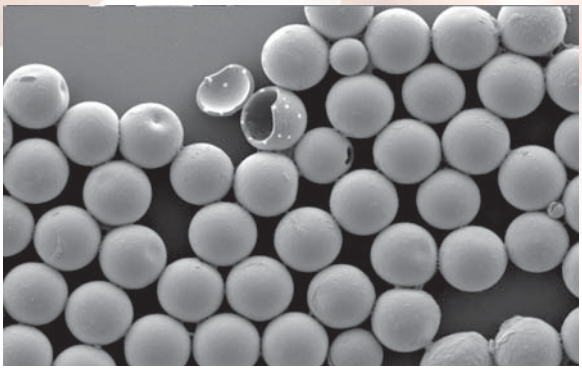
Particle particulars

Temperature-sensitive liposomes are formed by arranging different lipids into a bi-layer about five nanometers thick, which encircles a tiny reservoir that's filled with highly concentrated drug treatment. Liposomes have membranes that closely resemble that of natural cells but are 50-100 times smaller. When heated from 37°C to 42°C, the bi-layer develops pores that readily release the drug. The research process also involves fine-tuning the design and selection of lipid materials to ensure a precise drug-release temperature.



Temperature-sensitive liposomes

Microbubbles are currently used as contrast agents in ultrasound imaging. They have a gas core and a shell consisting of phospholipids, proteins or a biodegradable polymer. But for drug delivery purposes, the more robust polymer shell is preferred. These shells are formed around oil droplets containing the treatment drugs. The oil is then partially removed and a capsule with a polymer shell is the result. The oil acts as a liquid reservoir for the drug, whereas the gas helps trigger its release during the ultrasound application.



High-resolution electron microscope images of microbubbles before and after drug release.

Circuit Bodging

Atari Punk Console

Circuit bodging is back! Maxwell is proud to present small, simple, but ultimately lovable little circuits to build for your own, personal pleasure. In this edition we are featuring: The Atari Punk Console. The Atari Punk Console (or APC) is a 555 timer-IC based noise maker circuit. The original was designed by Forrest M. Mims III, and published in his book "Engineer's Mini-Notebook - 555 Circuits" (Siliconcepts, 1984). It uses two 555 timers to create a variable pulse width oscillator with a similar sound to the infamous Atari 2600.

Author: Ben Allen

If you take a look at the schematic you will see that there are two 555 timers involved. The first is an astable oscillator, which produces a rectangular waveform. The second 555 is a monostable oscillator and is triggered by the first 555. This means that R2 sets the first oscillator's frequency, and R3 sets the pulse length. The pulse length can be longer than the period of the first 555 which means that when this occurs the frequency will drop by half.

To calculate the IC1's frequency we use the following formula:

$$f = \frac{1}{ln(2) \cdot (R_2 + 2R_1) \cdot C_1}$$

This gives us a minimum frequency of 305 Hz (R2=470Ω) and a maximum frequency of 72,135 Hz (R2 = 0Ω). These values might seem high at first, but remember that IC2 acts as a frequency divider.

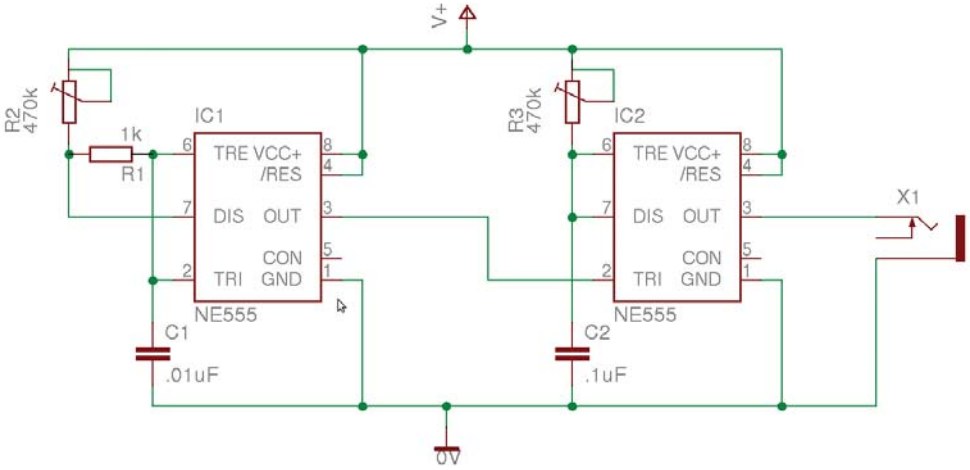
The waveform output of an astable 555 is not a perfect square wave, rather it has a variable duty cycle dependant on the ratio between R1 and R2. Because the second 555 is negative edge triggered, the duty cycle is irrelevant as we are only looking for when the output of IC1 goes from logical 1 to logical 0.

The length of the pulse delivered by the monostable 555 can be calculated as follows:

$$t = ln(3) \cdot R_3 \cdot C_2$$

Looking at this we can see that the pulse time can be set longer than the period of IC1's output. The 555 will not retrigger when it is delivering a pulse and the next pulse will only occur when the output has returned to 0 and the IC is triggered again. This means that when the pulse time is set to be longer than the astable oscillator's period, IC2 will have to 'wait' for another pulse thereby dropping the frequency by half, or one octave.

This circuit is very flexible, and the reader is encouraged to try applying various filters to the output. Another suggestion is to add a small amplifier to drive a speaker. As shown the circuit can be connected to either an instrument amplifier or HiFI system. The reader is once again encouraged to experiment and explore this circuit's capabilities and find out what has made this circuit so popular over the years.



Column

Samantha Liebregts
Medewerker Marketing & Communicatie EWI

Mijn visie op Elektrotechniek, althans de visie vanuit marketing op Elektrotechniek, dat was wat ik gevraagd werd te beschrijven in een kort stukje voor de Maxwell. Inmiddels hebben we het al niet meer over Elektrotechniek, maar Electrical Engineering, de nieuwe naam van de opleiding binnen de faculteit. Waarom die specifieke keuze voor Electrical Engineering? Iedereen kent waarschijnlijk wel de bekende elektrotechniekbusjes die we dagelijks tegenkomen op de snelweg, ook elektrotechniek maar net even anders. En dat verschil dat leggen we in de naam.

Electrical Engineering heeft een wervend karakter, body en klinkt vooruitstrevend, en dat willen we uitstralen als vertegenwoordigers van de opleiding. Een uitdagende, pittige studie met breed toekomstperspectief en dan ook nog ontzettend dynamisch. Zoals Nick van der Meijs altijd zegt: 'Electrical Engineering is nog niet af, het is altijd in beweging, het is veelzijdig en wordt continu doorontwikkeld'. En daar ben ik het mee eens, nu moet dit beeld alleen nog worden overgebracht bij scholieren. En dat is een van mijn taken het komende jaar, de beeldvorming corrigeren. Hoe laten we zien wat de studie nu écht inhoudt en hoe zorgen we ervoor dat de studie met de juiste ontwikkelingen en toepassingen geassocieerd wordt?

Allereerst was het natuurlijk van belang dat ik als marketing & communicatie medewerker overtuigd werd van de dynamiek en de aantrekkingskracht van de studie. Immers, je kunt een ander nergens van overtuigen als je er zelf niet in gelooft. Een stukje branding dus, Electrical Engineering in de markt zetten, en top-of-mind krijgen bij scholieren.

Klinkt simpel, maar absoluut een uitdaging kan ik je vertellen..

Het zit hem bijvoorbeeld in de 'momenten', de kracht van de momenten waarop je kan laten zien wat het nu echt is, tijdens een open dag, tijdens een meeloopdag, een proefstudeerdag, een workshop, een presentatie en zo zijn er nog veel meer vormen. Scholieren mobiliseren, informeren en binden op een relevante manier. Die momenten proberen we dan ook het hele jaar door te creëren, zo inspirerend en informerend mogelijk en met hulp van de experts binnen de faculteit.

Dan is er tot slot nog die onderscheidende factor 'Wat maakt Electrical Engineering in Delft nu zo aantrekkelijk?' Het feit dat we er bij EWI zelf in geloven en dit dan net even anders vertalen naar de buitenwereld toe. De gebaande paden zijn misschien wel de makkelijkste en de veiligste, maar de vraag is of die werkelijk gaan leiden naar wat we bij EWI willen.

Durf af te wijken van gebaande paden en durf vooral innovatief te zijn, dat is mijn credo.

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