De Vonk

Periodical of E.T.S.V. Scintilla

Main Article

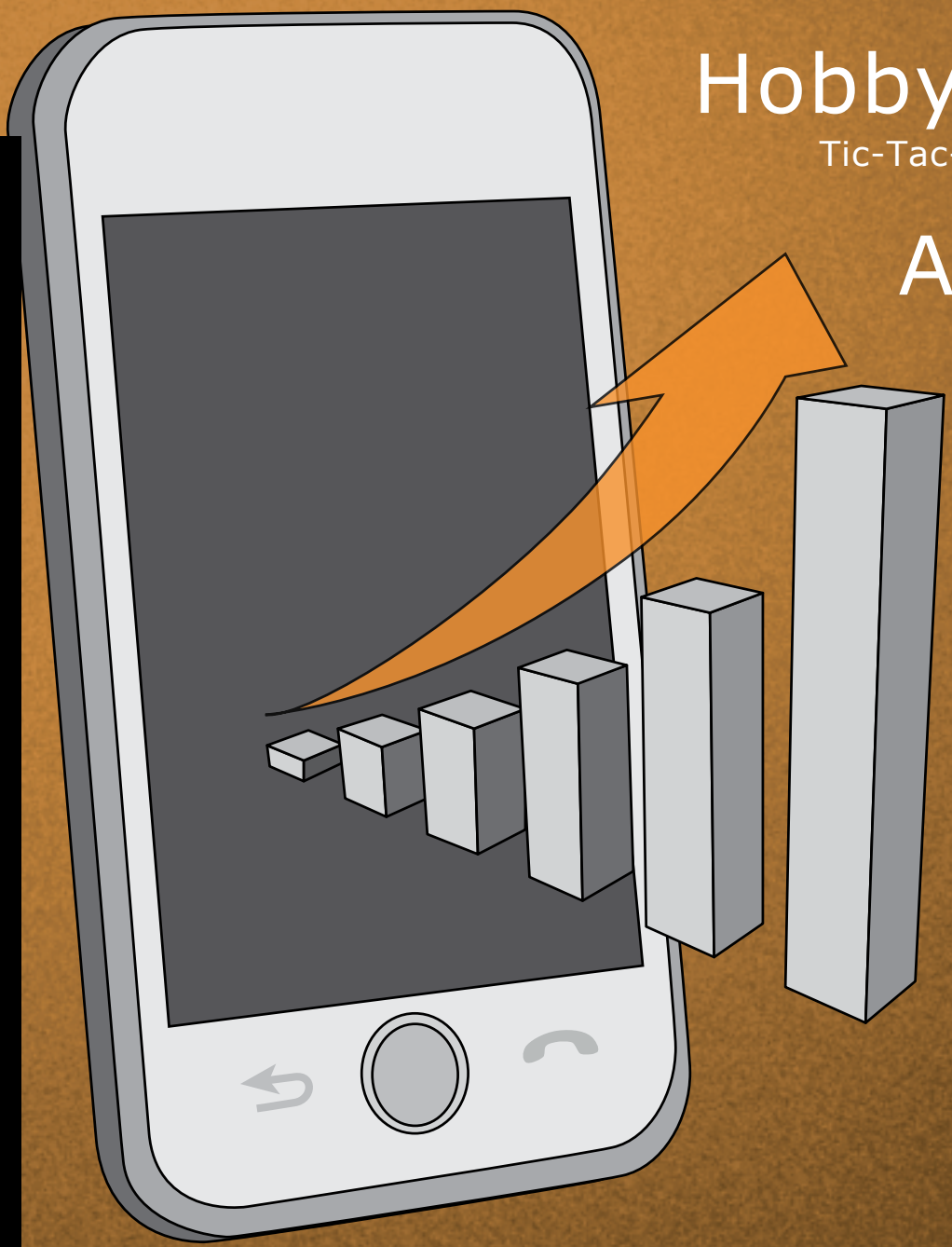
2G, 3G, 4G...5G?

Hobby

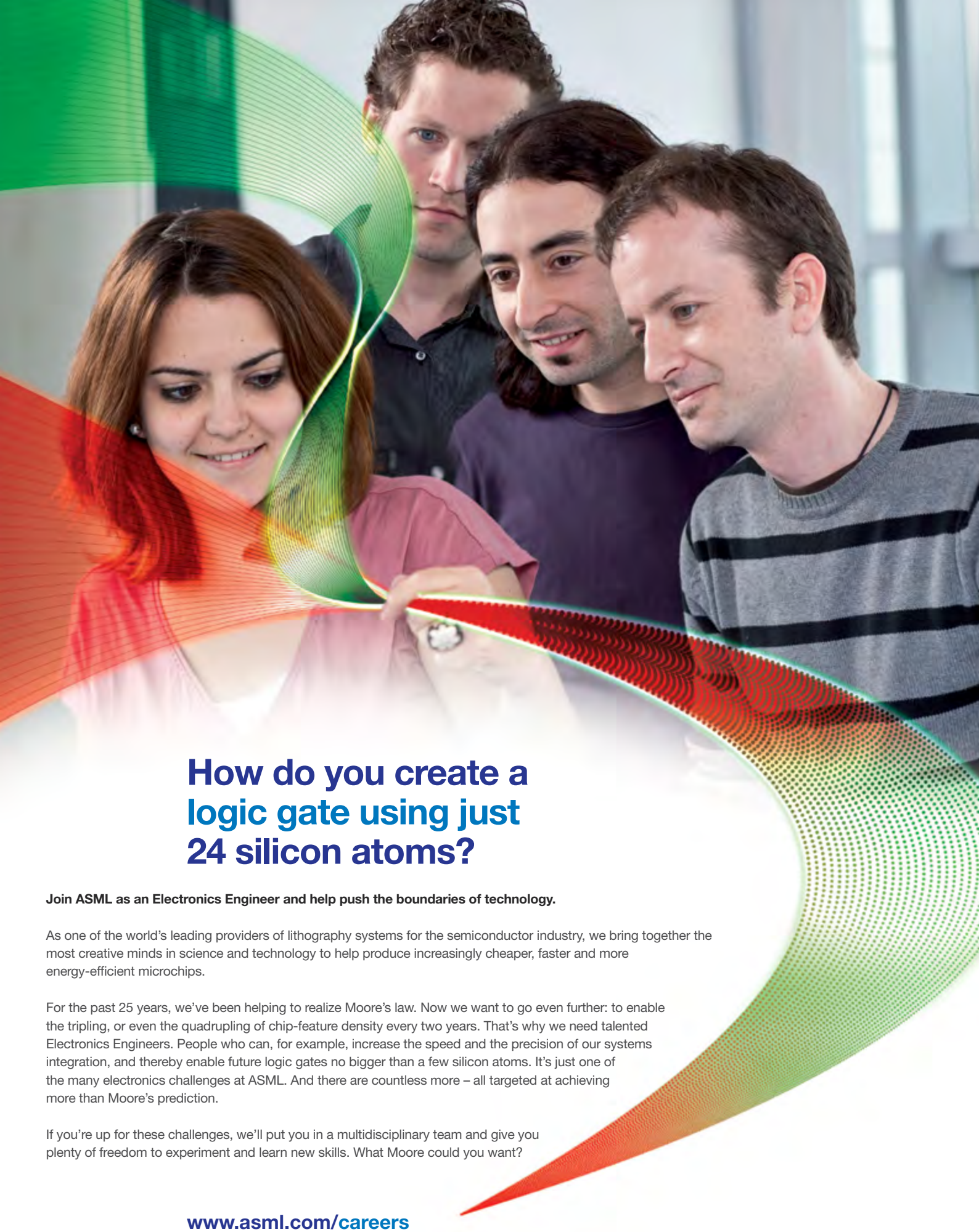
Tic-Tac-Toe

Afterlife

The path of a newborn civilian



Year 32 | Edition 2 | Februari 2014



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For students who think ahead

Fifty percent

Author: Robert Fennis

Dear people from the year 2014 and later years. After all, if all is right, we are now half way through the year. Other options are that this is ancient material or somebody brought back one copy from the future to a period in time before this one is supposed to be written. For the sake of this article, I regard the latter as the least likely possibility. However, I don't want to exclude anyone from feeling discriminated. After all, I'm against timeism. So hi to you too!

At the time of writing I can safely confirm that our board is still standing strong. Sometimes we have some space to breath but most of the time we are infinitely busy. For those mathematicians among us. I define busyness (B) as:

$$B(t_{free}) = \frac{T_{tot} - t_{free}}{t_{free}} \quad for \quad T_{tot} > 0$$

Lately we are approaching the limit of tfree goes to zero. Perhaps not all of you know the answer so I'll give you a hint: it's at least OVER 9000!

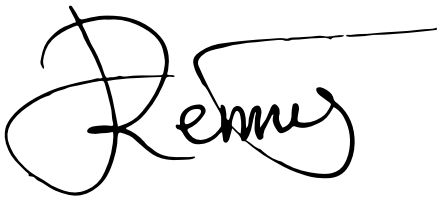
Our association is also halfway through the introduction of the new education. I am glad to see that it is all going well. I am noticing that lots of people are working hard to make it work and that is nice to see. As a result, we were able to fill all of the freshmen committees with plenty of members. Great! Two third year students stood up to help these guys facing the first confrontation of organizing big events. A big shout-out to you too!

In previous years, the income of Scintilla was taken care of by the Commissioner of External Affairs. He(or she) contacts companies to sign contracts. The company gives us money, and we do the best we can to help those companies to spread their names and promote their activities. This year, we don't have one of those commissioners so we have to distribute the workload. A talented group of traveling well tongued talkers are helping to build this new committee up from the ground. I am really curious how this chapter will end. I have a lot of faith in this committee!

Soon our study trip people will go off to Japan. There they will spend 3 weeks, some a lot longer, to learn about the country and their technology. The Scintilla room sure will be very quite.

All in all I feel that this will be a great year. I'm really looking forward to the next half of it!

Op de koningin, op Scintilla!



Robert Fennis,
President of E.T.S.V. Scintilla

Lasergaming, pooling
Thursday 13 Februari
19:15h, LaserGame Hengelo

11 beer trip
Tuesday 19 Februari
15:30h, Several locations

Scrapheap Challenge EE
Friday 7 March
20:00h, Westzaal

Excursion ASML
Friday 14 March
08:00h, ASML

Theme drink
Thursday 24 April
20:00h, Abscint

42nd Batavierenrace
Friday 9 May
20:00h, Nijmegen-Enschede

Masthead

De Vonk

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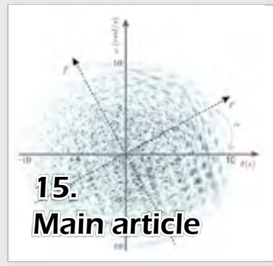
Last October, the biennial World Solar Challenge took place in Australia. For the fifth time Twente competed in this race and with The Red Engine, Twente tried to win this race. In this edition of De Vonk, electrical engineer Tom tells about the race and how it went for the team. If you want to know more about this experience, this article is a great start.



Wireless communication becomes more and more popular in our society. Being online everywhere is very important for a lot of people and the speed and capacity of wireless networks has to increase to fulfill this demand. What is next after 4G, and what has it for impact on the battery life of your portable device? Wim Korevaar of the CAES group elaborates on this in the main article of this Vonk.

For a lot of students, the future is blurry and some of them even fear the civil life. In our recurring section `Afterlife', Rick van Keken tells about his life after his graduation. In the present, Rick has a full time job at Shell. In this article, you can read what kind of work an electrical engineer can do, in a big multinational, focused on the oil business.

One of the many challenging things in IT is how multiple different servers can be administered in an efficient and uniform way. In this Vonk, Koen of the committee SOT has written an article about Puppet, a professional tool to manage multiple servers with a single configuration. This makes the systems easier to manage and as a consequence, the systems become more stable.

Editorial

Apples

This delicious fruit is awesome, its tree is one of the most widely cultivated tree fruits worldwide, and it has many health benefits. The phytonutrients in apples can help you regulate your blood sugar and apples are a good source of dietary fiber. The whole food form of apples is also important if you want full satisfaction from eating them. Researchers have recently compared intake of whole apples to intake of applesauce and apple juice, only to discover that people report less hunger (and better satiety) after eating whole apples than after eating applesauce or drinking apple juice. Apples also contain vitamin C which is good for all different kinds of biological processes in your body. Vitamin C functions as antioxidant and helps your immune system to fight off nasty attackers. So there is maybe some truth to the old saying: An apple a day keeps the doctor away!
Apples are also a touchy subject in the Scintilla Room. In this case we don't mean the fruit but the shiny but slightly overpriced products from the company in California. There is a never ending war between the Scintilla members which are users of Apple products and those who aren't. In the end we have to accept that this war cannot be won and we will have to find a way to live with it.
The last order of business is the apparent metamorphosis of "De Vonk" into an Apple. We had quite a scare with the arrival of "de Appel" instead of "De Vonk",this was not what we ordered... Luckily "De Vonk" arrived a few days later. Apparently it was a mix-up at the company that handles the postage of "De Vonk". I guess the guy in charge of dispatching our magazine was not in very good mental health, or possibly very sleepy. He should have eaten more apples!

Peter Oostewechel

News for the Electrical Engineer

Author: Maikel Huiskamp

Fully functional loudspeaker 3-d printed

Researchers from the university of Cornell have 3-d printed a working loudspeaker which integrates the plastic, conductive and magnetic parts all at once. The difference with a normal 3-d printer is that the 3-d printer from Cornell can print complete functioning products consisting of multiple materials.
The biggest challenge in printing this loudspeaker was how to print the different materials used, since the materials require different temperatures to be printed and curing times. To print the loudspeaker they used silver ink for the conductor and a special blend of strontium ferrite for the magnetic material of the core.

source: http://tinyurl.com/vonk3221

Electron spin manipulation makes OLED Displays cheaper.

A team of German and American scientist has developed a new type of OLED that can output as much light as conventional and commercially available OLED displays, but without the use of the rare metals that are normally used in OLED displays. In the traditional OLED displays the metals iridium or platinum are used. Without the need for these expensive materials the cost of OLEDs could be reduced.
OLEDS convert only a small part of their electrical current into light. This is caused by a quantum mechanical property of the electrons and holes, which is called spin. Each hole and electron has a spin state, so when they meet there are four possible states. Unfortunately only one of these states emits light while the others produce heat. The rare metals are then used to increase the number of light generating combinations. But it is also possible for a spin to switch to its more light friendly nature on its own. If an electron hole pair can be held long enough in its electrical excited state for one spin to flip it will send its extra energy as a photon rather than heat.
The trick used to increase the number of light emitting pairs lies in the shape of the organic molecules used in the OLED displays. Two different kind of polycyclic aromatic hydrocarbons (carbon-based molecules having multiple ring-shaped components) where used. The atomic structures of these molecules where such that they could trap the charge carriers long enough for the spontaneous spin flip to occur.

source: http://tinyurl.com/vonk3222

Google's Shaft robot wins Darpa rescue challenge

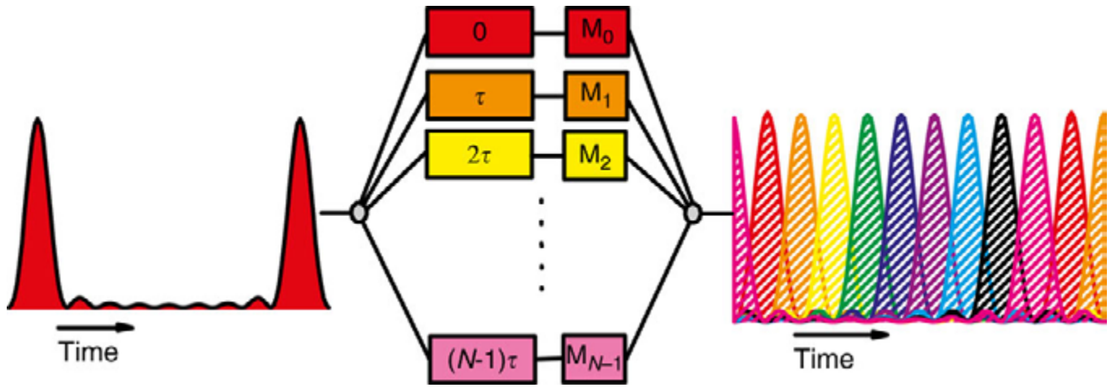
The robot that was recently acquired by Google won the Darpa challenge. It scored 27 points out of 32 points putting it seven points ahead of the competition. Three points could be awarded for completing a task, and one bonus point could be obtained for doing so without any human intervention.
The Darpa challenge was inspired by the nuclear reactor meltdown in Fukushima, Japan. The organization realized that robots were only capable of very limited things during such a breakdown. So to increase the development in this area a challenge with a price of $2M was held.
The challenge existed of several time-limited task of 30m each. Tasks included driving utility vehicle, climb a ladder, remove debris, close air valves and unreel a hose and then screw its nozzle into a wall connector.

source: http://tinyurl.com/vonk3223

Optic fibers throughput increase 10 times

EPFL scientists have shown that it is possible to increase the data throughput of optical fibers by a factor of 10. To achieve this result they reduced the amount of distance between two consecutive pulses that are send through the optical cable.
In optical fibers the data is send by a series of light pulses. These pulses have a certain distance between them so they do not interfere with each other. This space between the pulses leaves unused space that could be used for data transfers.
There are already several different approaches to increase the throughput of the optical fibers, but most of them require changes to the cables themselves. The EPFL scientists took another approach, the looked closely at the fundamental issue of the light itself.
The idea to improve the throughput was to fit all the pulses nicely together like a puzzle without distorting the data to much because of interference. To do this they used a technique called "Nyquist sinc pulses". These pulses are more pointed, and when shaped correctly do not interfere with the next symbol that is send. This way more symbols can be packed in a narrower space and thus increase the bandwidth as shown in the figure below.

source: http://tinyurl.com/vonk3224



Epilepsy prevented with brain implant

A company called NeuroPace created a Responsive neurostimulation (RNS) implant to control epilepsy. It has performed well in clinical trials and safely easing the symptoms of patients.
The system scans for abnormal electrical activity in the brain that could lead to a seizure. Once this pattern is detected the device delivers strong stimulations to the brain to disrupt the abnormal activity. Because the stimulation is so much more intense it masks the abnormal activity of the sensitive parts of the brain and thus preventing an epileptic attack.
The implant replaces a part of the skull of the patient. It has the same thickness and curve as the skull, and it is connected to the brain by two insulated wires. This implant is capable of treating two epileptic foci. The implant reduced the number of seizures by 38%.

source: http://tinyurl.com/vonk3225

A new curriculum for EE

Author: Miko Elwenspoek

Job van Amerongen said, repeatedly, that teaching becomes better after every fundamental change of the whole curriculum, and that the change itself is most effective, not so much what is changed. This sounds cynical but it is not: all professors think anew on their way and contents of teaching, throw out superfluous stuff, redesign the course and use all experience gathered during teaching on a whole course. This is different from continuously fine tuning. In fine tuning one changes many details which after time inevitably leads to imbalances, the amount of content increases and the course becomes overloaded in course of time. The fine tuning is going on in all courses, so the whole curriculum grows out of balance, so now and then a fundamental change is needed.

The need for a change of the curriculum of EE was evident: some courses that were intimately connected were scheduled with one year gaps, the volume of some courses (in terms of EC) did not match the students' experience, courses closely connected developed independently, resulting in unnecessary overlaps and gaps.

A more political issue was the extremely low efficiency and students took a very long time to finish their bachelors. A committee reviewing the curriculum complained that the field of electrical engineering was not made very clear to prospective students, and that the beauty and appeal of the field was not made clear in the teaching process. Politics demanded a faster and cheaper education system.[1]

More fundamentally, a rather philosophical set of arguments to review the curriculum and the way of teaching is related to changes in the society. The modern engineer has to work in a much more complex environment. The globalization demands engineers who are able to work in intercultural settings and in multidisciplinary teams. The engineering fields are changing so quickly that modern technologies become outdated within a decade, roughly the time a student needs for his study. The work conditions are changing: companies are divided, sold or merged. When I finished university it was expected that I entered a company, make my whole carrier in it and retire after having worked only in this company. Now you must expect to change company several times; in the US the situation is that a 35 years old engineer has had about 10 jobs. So we must conclude that we are preparing our students for jobs than do not exist now, to solve problems we do not know of their existence, using methods and technologies which do not exist now, in social contexts of which we have no idea of.

> "In the US the situation is that a 35 years old engineer has had about 10 jobs."

1. This needs a personal note: studying means to go for the details, to explore the whole range of the meaning of a subject. A subject is a multidimensional object (an example is a city, which you only learn to know if you come to several locations several times and from different directions) which is studied in time, meaning along a line: the study process is one-dimensional. This problem is solved by going through the material several times, on increasing levels of abstraction and from different perspective. It results in a kind of mind map in which all ingredients of the subject are connected. This process takes time and it is not always related to a conscious activity.

It is this latter complex of fundamental reason why the University of Twente is changing its way of teaching.

For Electrical Engineering the problems were most pressing because of the committee report mentioned earlier, and most professors agreed to a quick change, therefore EE started with a pilot for the new "Twents Onderwijs Model" (TOM). TOM has the ambition to cope with the challenges mentioned above. The following measures are taken:

1. Educate the new flexible engineer by introducing project or problem based learning (PBL)
2. Create units of 15 EC (=10 weeks full time) of coherent content, which are completed by a single grade
3. Divide the whole of the various curricula in four roughly equal parts: the subject (in this case electrical engineering), supporting sciences (here: mathematics and physics), a concentration on one of the fields of the subject (here for example a thesis in one of the chairs) and a free component (the minor at the UT)
4. For the sake of efficiency share as many modules with other curricula
5. Teach more cost effectively
6. Introduce a line for mathematics for all students of technical subjects and a line of scientific methods for the other sciences
7. A long term goal is to reduce the number of bachelors (now 22) to five to ten.

The idea to drastically reduce the number of bachelor programs was abandoned altogether, very unfortunately in my view, because this process had forced us to think anew on what engineering should be.

I think we have accomplished quite a bit with the renewing of the EE curriculum. Most modules are coherent units. We have formed well functioning teams of professors in the modules. Teaching and grading has been done in a way so that students invest the required effort to pass the modules. The pilot had three modules in the first three quarters of the year 2012/13. The basic ingredients were coherent contents, the foundation of well functioning teams of professors, a project integrated in the modules. In a second step we gave the project a bigger role by starting in the first week and we actively supported the formation of small groups of students to study together. All, students as well as professors seemed to be quite content with the results.
Still there are a few problems left for my successor.

Not all modules are coherent. In particular the module computer systems has the problem that there is a big chunk of mathematics which is totally unrelated to computer systems. A similar problem, albeit less severe, is in the module Electronics. The module on control has the danger to be overloaded, and a similar problem might arise in the module signal processing and communications. I am not happy that the modules device physics and computer networks are electives. I have no good idea what to do with the minor (we thought of a module with a multidisciplinary project). Finally we have no good idea how to cope with a final bachelor project of 30 EC.

The biggest challenge left is related to the first point in the above list. This requires a different type of teaching and learning in which the student is the active agent. To realize this we (the professors) need to learn a lot and this will take time.

From 2011 to 2013 Miko Elwenspoek was the educational director of Electrical Engineering. What I found most notable about this period of our history was the amount of (rapid) change. Everything was in flux, the first year students were to get a "jaarzaal" and due to the upcoming (mandatory) TOM model, EE introduced modular education for the first three study quarters as pilot. To get a feeling for what EE actually is and what all the chairs were up to, Miko Elwenspoek organised a very interesting symposium. All the research topics were presented and one of the, for me surprising, conclusions was that research is often, if not always, interdisciplinary. Miko Elwenspoek also experimented with different methods of getting students to work, which was not always to their liking as one can imagine. However, many lessons were learned and EE is definitely the better for it. We could always rely on him to react to the complaints of the students and he got to the bottom of the problem. On behave of Scintilla, I wish Miko Elwenspoek a great and restful retirement, though I expect we have not seen the last of him yet.

Rowan de Vries

SolarTom

A race under the sun

Author: Tom Kooijman
Photos: Joost van Baars

A race straight through the middle of the Australian desert, 3021 kilometers, in 37 hours and 38 minutes spread across 4 days, averaging at almost 80 km/h. Using only the sun's energy. This is what Solar Team Twente did past October, ending up in third place out of 23 contestants.
But a lot happened before that. It took us over a year of preparation, as you have probably read before in the Vonk. Last time we wrote something here The Red Engine was just unveiled, and we had started testing. This doesn't mean we were almost finished! As is common with testing, we found a lot of things that could be improved, and there were some things that weren't quite finished yet during the unveiling of the car.

Specifically for the electronics: The first tests with The Red Engine were also the first serious tests with the battery, and the brand new, self developed battery management system. This system monitors all battery voltages and currents, to prevent dangerous situations like a battery fire. It is also capable of automatically balancing out differences in charge between the battery cells. A complex system like that never works the first time, and especially problems with EMC can be very time-consuming to find and fix. Also, at the unveiling of The Red Engine, the car didn't have any solar cells yet. Before we went to Australia in August the entire solar panel had to be laid. We received the solar panel in small squares of plastic with a couple of solar cells in each of them. Every single one of them had to be cut to exactly the right size, had wires soldered on to them, and be carefully taped on the solar panel. In total we have over a 1000 single solar cells on the car!

"In total we have over a 1000 single solar cells on the car!"

Most of the panel wiring had to be done while we were already in Australia. The race started in Darwin, in the north of Australia. We were there about 6 weeks before the race started, and the box with The Red Engine came in a week later. Darwin is located roughly 12 degrees below the equator. This means the average temperature was around 32 degrees Celsius, and the humidity reached up to 70% at times. Doing physical work in that kind of weather is an... experience...

Darwin is very different from the Netherlands, not only in terms of weather. It is close to the sea, but the sea can't be used to cool down. There are jellyfish, sharks and salt-water crocodiles that make swimming very dangerous. At the few places where you can safely go for a swim, you notice the sea water is very warm as well.
There is no such thing as summer or winter in Darwin, all they know is the dry season and the wet season. We arrived during the dry season. In 6 weeks time we only saw rain once! Bushfires are very common occurrence, and often just left to be. One bushfire that was close to the city was actually lit by the firefighters, for training.

"It was an amazing experience I will never ever forget."

And all this together is probably the reason there are so few people living there. In Northern territory, a province spanning 1500 kilometers there are three times less people as in Twente!
This complete desolation in some places was very noticeable during the actual race. I won't tell too much about the race itself, the videos we made tell the story much better than I can do here. You can find our race videos at www.solarteam.nl/media/. But it was a strange experience, driving through hundreds of kilometers without seeing anybody else, farms that are probably larger than the Netherlands, a stunning amount of dead kangaroos and cows, and an awful lot of flies. I wouldn't recommend anyone going there, unless you have an adrenaline-fuelled race going on. It was an amazing experience I will never ever forget.

And after all of this, it was time for a well-earned holiday, cruising through Australia!
If you would like to go on a fantastic experience like this, send an email to info@solarteam.nl.

Unraveling the mysteries of the GaN model

Author: Maikel Huiskamp

At some point everyone has to make the important decision: "Where am I going to do my internship?" For some this can be a difficult decision. Do I want to go abroad? Does it have to be at a small or a big company? What do I want to do? Well, for me the decision was not that hard. During my study I got interested in the art of RF design, so my internship must have something to do with that. I also wanted to see and experience how it was to work in a big company, and one of the biggest RF companies in the Netherlands is NXP. And that is where I went, but not to Eindhoven as you would probably expect, but to Nijmegen, to the PL RF Power & Base Stations department.

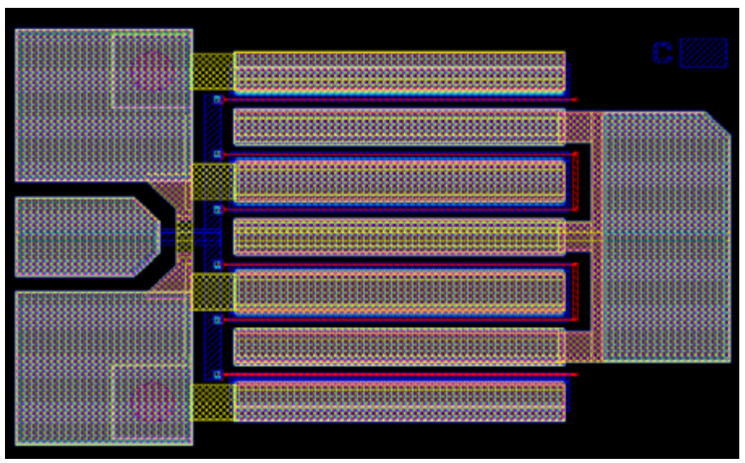


Figure 1: GaN interconnect.

My assignment at NPX is about improving the interconnect model of their gallium nitride transistors (GaN). In a chip the transistors are connected with each other via metal wires which have inductance, mutual inductance and capacitive coupling to other wires. But also a single transistor cell has metal wires in it which connect their in and outputs to the active areas of the transistor e.g. the gate, source and drain. These wires also have resistance, inductance and capacitive coupling between them which influences the performance and behavior of the transistor. Because of the capacitance and inductance of the wires the transistor has a resonance at a certain frequency. The current model of NXP describes the behavior of the GaN transistor up to 4 GHz correctly, but after that the performance of the model decreases because the higher frequency behavior of the interconnect is not modeled accurately. And that is what I should improve.

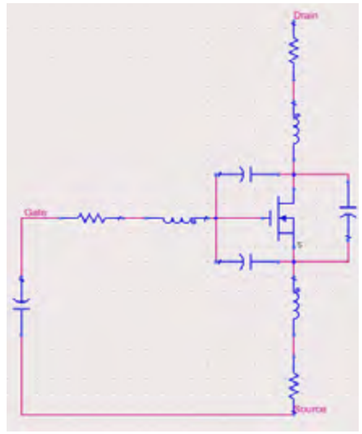


Figure 2: Improved interconnect model

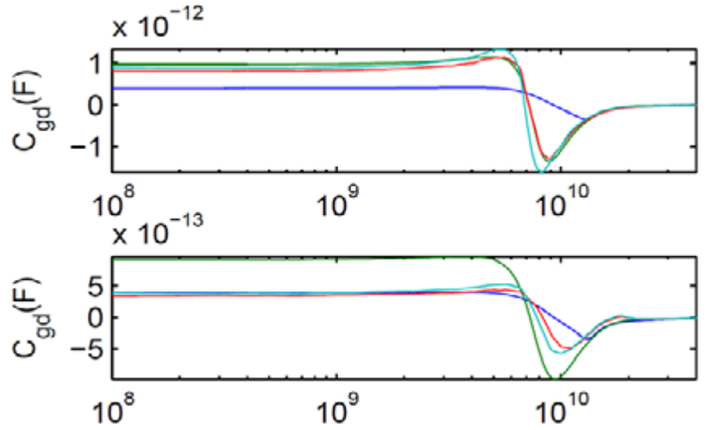


Figure 3: Results of the small signal simulation

But before you start improving something you should know what you are improving. GaN is an III/V direct band gap semiconductor which is mostly known for its use in LEDs. Since a couple of years GaN is also used in RF power transistors because of its high breakdown voltage, high electron mobility and saturation velocity. GaN also has a larger band gap compared with silicon which means that it can withstand higher temperatures while maintaining the same performance.

The GaN transistor I am working with is a High Electron Mobility Transistor (HEMT) which means that it is build off two materials with different band gaps, which in this case are GaN and AlGaN. When these two materials are joined in a hetero structure a two dimensional electron gas (2DEG) is created at the interface because of the difference in band gap voltage off both materials. At the interface of the two materials there is a deep spiked quantum well where there is also a large conduction band offset. This effect creates the 2DEG which is conductive. Because of this effect the GaN transistor is conductive with a gate bias of 0V and should be negatively biased to be turned off.

The first two weeks of my internship I spend mostly on acquiring information about GaN and figuring out what the current performance of the model was and how it worked. And during this time of acquiring the information I met lots of new people. Within the BL-RF power department everyone has its own specialty and task. You have the modeling group, developers, technology guys and principal scientists. Sometimes getting the information felt like a treasure hunt, and who does not like treasure hunts? The GaN model of NXP consists off a core model that describes the active materials of the GaN transistor and a model for the interconnect itself. When I started my assignment the interconnect model included the resistance of the fingers, their mutual inductance and their self-inductance. The only component missing in this schematic was the capacitor. Figure 1 shows the interconnect of the GaN transistor. The squares on the left are the contacts of the source, the one in the middle at the left side is the gate and the right square is the drain contact. In this structure there are metal bars in parallel with each other and there are also air bridges which both form capacitors. These capacitors cannot be described by the normal parallel plate formula since the width and separations of the plates are in the same order and thus the fringe capacitance (electric field on the outside of the plates) is not negligible anymore. When the fringe capacitors are included in the model the final interconnect is as shown in figure 2. The capacitors are placed after the resistance and inductance because they are closely "connected" to the effective areas of the transistor. There is one extra capacitor at the input which models the air bridge between gate and source.

> "Before you start improving something you should know what you are improving"

The first test to see if the model is improved is doing a small signal simulation. This test is done with different biases and operating frequencies to see if the model is valid over a larger operating range. Two results of this simulation are shown in figure 3. The upper graph shows the feedback capacitance at Vg = -1.5V and Vd = 10V while the lower one has the same gate bias but a Vd = 10V. The red and cyan lines are measurements, and the green and blue ones are two different core models. We see that in the first case the green line corresponds to the measurement, and in the other case the blue one does. Here we see that the behavior of the core model depends strongly on the bias since in one case the blue line fits the measurements better, and in the other case the green one does. From measurements and simulation it became clear that to improve the model the bias dependence of the core model should be improved. Unfortunately this is a problem that is deeply embedded in the core model.

The second test was a load pull simulation. Load pull is a large signal technique frequently used in RF and microwave transistor designs. In load pull the load impedances is varied, and the performance of the

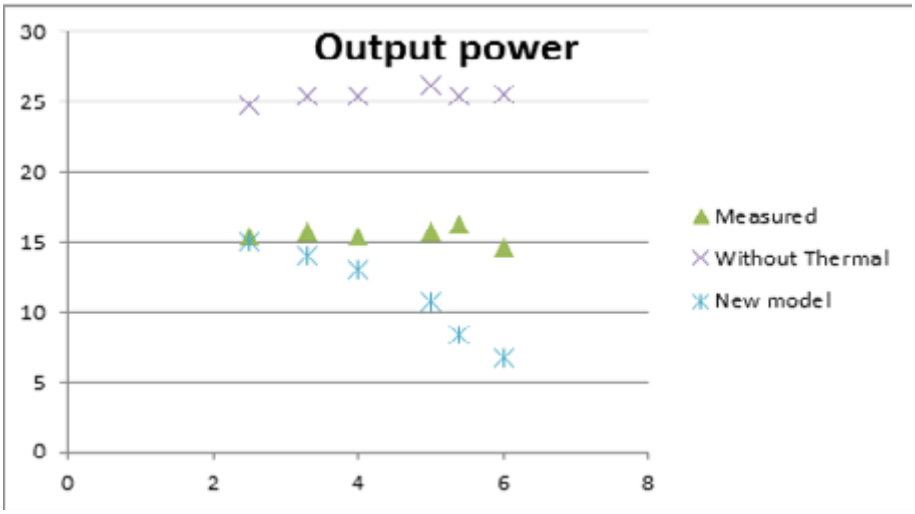


Figure 4: Results of the simulation for the output power

transistor is measured. This load pull results in contours on the smith chart which give you the load impedance for the maximum output power or efficiency. From the simulation you can also derive the input impedance, power added efficiency (PAE) and gain.

The results for the output power are shown in figure 4. The measurements show that the output power should remain flat over frequency, but the new model shows a decrease of power over frequency. After trying some things we found out that when we made the transistor isothermal the output power would also be flat over frequency. Then we set the most important thermal dependent components in the core model to isothermal one by one. This resulted in the conclusion that the velocity saturating resistor which models the velocity saturation of the electrons was the most important cause of the power drop. With the velocity saturating resistor in isothermal mode the output power is almost flat over frequency. The drop is probably caused by a drop of input power, but at the time of writing this still has to be investigated further.

In the end I am quite satisfied with the results of my internship, both in the results of my work and my experience in the company. Because my assignment included many aspects, from the core model to the layout of the real device, I met lots of new people. There are still a lot of things that can be improved in the model, but I think a big step was made. Finally I want to thank my colleagues for their help and support during my stay. Because of them I can look back at a great time at NXP.

2G, 3G, 4G ... 5G?

Prepare for the next generation...

Author: Wim Korevaar

Wireless technologies are rapidly evolving. Today we are happy with the third generation cellular technology (3G), but mobile operators already prepare us for the next goody on the market; Long Term Evolution (LTE). The major telecom operators in the Netherlands now offer LTE which tops at 300Mb/s and 75Mb/s for downloading and uploading respectively. But that's not all, 'LTE on steroids' (LTE Advanced) shall soon make its entrance on the market. LTE Advanced will allow for download rates up to 3Gb/s and upload rates up to 1.5Gb/s. That makes LTE Advanced the next treat to temporarily satisfy our everlasting hunger for more bandwidth.

CAES

Computer Architecture for Embedded Systems

You may wonder whether we need all this bandwidth. Good question! History and forecasts may shed some light on this. In recent years our mobile data usage already grew with approximately 70% per year and that will continue at least till 2017 which accounts for a 13-fold increase in mobile data usage during the years 2012 and 2017. In 2017, monthly Internet traffic in North America will generate 7 billion DVD's worth of traffic, equalling 26.3 exabytes per month [1]. Wired devices will then account for 45 percent of IP traffic, while Wi-Fi and mobile devices will account for 55 percent of IP traffic.

To address this huge demand for bandwidth, academics, companies and standardisation committees are currently investigating which technologies will enable our future fifth-generation (5G) cellular systems. What is certain is that 5G will be a mixture of wireless technologies allowing more devices to communicate, higher throughputs, lower energy consumption (dependent on the mode of operation), lower latency and a higher reliability. 5G will include technologies using multi-antenna transceivers, millimetre-wave communications and cognitive radio aspects. These technologies should optimize the usage of two of our scarce resources; spectrum and energy.

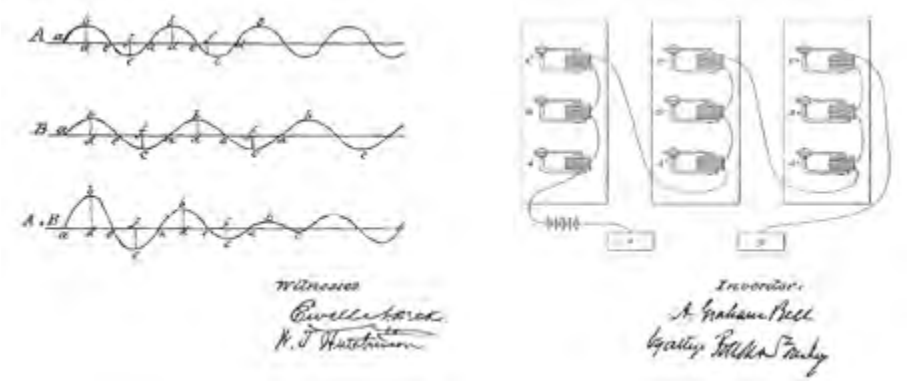


Figure 1: Figures from U.S. patent no. 174.465, filed by A.G. Bell (back in 1873!), explaining the idea of multi-carrier communications [2]. Waves A and B of different frequency are summed to A + B (left), sent over one single line, and excite a response in receiver A and receiver B tuned for waves of frequency A and B, respectively (right).

Saving an invisible resource

At the Computer Architectures for Embedded Systems group of professor Gerard Smit we are working on spectrum-efficient waveforms for wireless communications. In particular we are reinvestigating the signal basis for wireless transceivers. From the moment Abraham Graham Bell patented multi-carrier communications, communication systems have heavily relied upon the modulation of (co)sinusoidal waveforms. His patent from 1873 already explained the basic idea of multi-carrier communications based on summing modulated (co)sinusoidal waveforms [2]. Two pictures from the patent are shown in Figure 1. It has proven to work very well and nowadays many wireless standards and devices make use of (co)sinusoidal waveforms for the transmission of

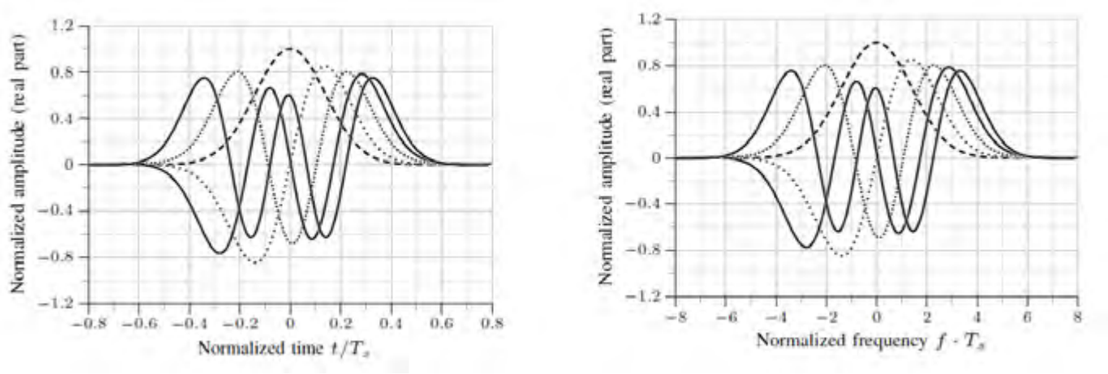


Figure 2 Illustration of the time and frequency presentations of Hermite functions.

information. However, you may know that time-limiting (co)sinusoidal signals – as we do in communication systems – leads to a frequency representation which is sinc-shaped. This is referred to as spectral leakage. Spectral leakage is causing interference to other spectrum-users and can be considered as wasting the spectrum. It is also a waste of money as mobile operators did pay billions of euros for spectrum licenses in spectrum auctions. E.g. Dutch mobile operators paid 3.8 billion euro in a recent spectrum-auction to obtain spectrum-licenses.

The main aim of spectrum-efficient communications is to squeeze as many signals (which can be carrying information) in a given amount of time and bandwidth. If we do the math and we constrain our signals to minimize the amount of interference to other spectrum users, then we arrive at a set of signals called Hermite functions [3]. The time- and frequency presentation of Hermite basis signals is shown in Figure 2. Hermite functions have an equal time and frequency representation (except for a phase change). The zero-order Hermite function is the Gaussian pulse (dashed line in Figure 2) and higher order Hermite functions oscillate more often. The order of the Hermite function is equal to the number of zero-crossings and higher order Hermite functions tend to behave more outside the active band in contrast to Fourier basis signals which have a frequency representation which decays by 1/f. This leads to the main advantage of Hermite functions compared to Fourier basis signals; they cause less spectral leakage to other spectrum-users and thereby allow for a more efficient usage of the radio spectrum.

Increasing battery lifetime

Another problem troubling academics and engineers in the wireless world is the problem of peak powers. Transmit signals generated in wireless transmitters – slightly dependent on the type of signals and modulation scheme chosen – can exhibit high peak powers. These peak powers lead to demanding requirements on the dynamic range of the wireless transceiver components, e.g. it leads to analog-to-digital and digital-to-analog converters which need a high resolution and the power amplifier needs to be able to generate the peak powers (which is consuming a lot of energy!). This leads to a high power consumption in wireless transceivers! Therefore a lot of research is dedicated to limiting the peak powers in communication systems.

Peak-power reduction by rotation of the time-frequency presentation

We have recently worked on a technique to reduce peak powers in wireless transceivers. The basic principle can be understood by looking at Figure 3. We have plotted two extremes from a peak-power perspective. The first signal is the delta pulse which has a time-presentation which has a sharp peak and a frequency presentation which is approximately flat. The second signal is a constant signal in time which has a frequency representation which is sharply peaked. The first signal is characterized by a high peak power whereas the second signal is perfect as it has a constant (low) power. Our basic strategy for reducing peak powers is to interchange the time and frequency presentations and use one bit of additional information to tell the receiver whether the time or the frequency presentation was actually sent.

Time and frequency presentations are just one-dimensional presentations of a signal. Mozart and other musicians are not using just the time or the frequency behaviour of a signal. They use two-dimensional time-frequency descriptions of signals, i.e. musical notes. In a similar fashion we can use time-frequency presentations to describe communication signals. In Figure 4 such a time-frequency presentation – by means of the so-called Wigner distribution function – is shown for a transmit signal.

Recall that our simple solution for lowering the peak powers is to interchange the time and frequency representations of a transmit signal. A more sophisticated approach is to allow rotations of the time-frequency presentation by corner α as shown in Figure

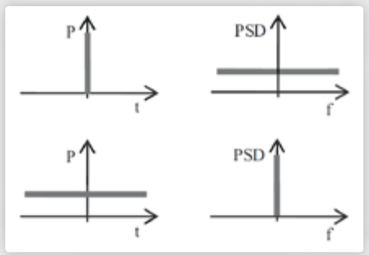


Figure 3: The highest peak power (in time) is associated with the lowest peak spectral power (in frequency), and vice versa. For the delta pulse, swapping the time and frequency information (a rotation of the time-frequency presentation by 90 degrees), lowers the PAPR dramatically.

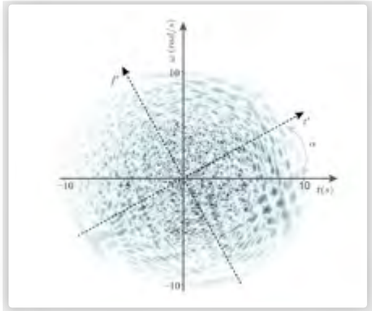


Figure 4: Intensity plot of the time-frequency representation (based on the Wigner distribution function) for a set of 64 Hermite functions, 64-QAM modulated. The angle α with the time-axis indicates a certain rotation of the time-frequency representation to potentially lower the peak powers. The peak-power are analysed for varying α in the range [0, π). The rotated time-frequency presentation giving the lowest peak powers is used for transmission.

4. By rotating the time-frequency plane we do not change the information, but intuitively move the peak powers (which manifest themselves over the t-axis) to the frequency domain.

In general, the more angles α we try, the more drastically the peak powers are reduced. The price for the peak-power reduction is some overhead (for transmitting the angle α) and increased complexity. An iterative method (only rotate when necessary) is future work and could strongly reduce the overhead and computational complexity.

The results are good and very promising and have been published last month in Atlanta on the Global Communications Conference [4].

A rough overview of the transmitter and receiver applying the principle of time-frequency rotations is shown in Figure 5. The signals $s_0(t)$ ... $s_{K-1}(t)$ are modulated by A_0 ... A_k according to the modulation scheme chosen. Note that the information is encapsulated in these modulation factors. The modulated signals $s_0(t)$ ... $s_{K-1}(t)$ are summed to form a symbol and are converted to the analog domain by an ADC, mixed to the radiofrequency, amplified and transmitted. At the receiver-side, the signal is received, amplified, mixed to baseband, converted to the digital domain and finally compared with the basis $s_0(t)$ ... $s_{K-1}(t)$ to recover the information encapsulated in A_0 ... A_k.

Now, the crucial difference – to lower the peak powers in the signal – is the rotation of the baseband transmit signal. Each symbol is rotated in time-frequency for different angles and the variant exhibiting the lowest peak power is used for transmission. As a side-note, the corner α needs to be transmitted as well. When the receiver knows α it can invert the time-frequency rotation prior to the demodulation process in which the information is recovered.

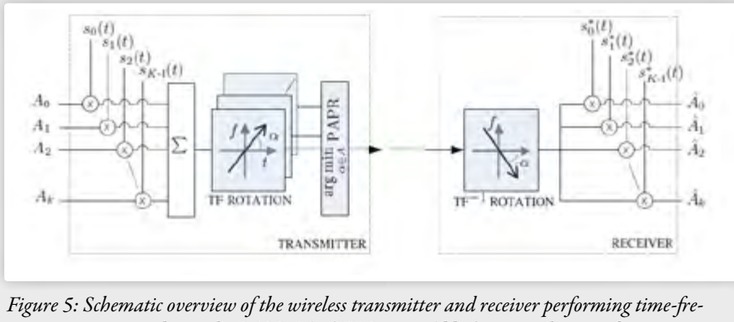


Figure 5: Schematic overview of the wireless transmitter and receiver performing time-frequency rotations to lower the PAPR. The 'TF Rotation' blocks rotate the time-frequency presentation by different angles. The time-frequency rotated representation exhibiting the lowest PAPR is selected for transmission. At the receiver the time-frequency rotation is compensated by a rotation with α.

Concluding words

More than 130 years of research on applying Fourier basis signals in communications has been very fruitful. It brought us four generations of mobile communications. However, we also discussed some of the associated problems – spectral leakage reducing the spectrum-efficiency and the peak powers (in multi-carrier communications) lowering the battery lifetime. We introduced Hermite functions as an alternative signal basis for communications, having a better performance in terms of spectral leakage. In addition, we discussed a new intuitive method using time-frequency rotations to reduce the energy consumption in wireless transceivers. We regard Hermite functions (and derived signal bases) promising for the communication systems of tomorrow. It might take another generation, but Hermite functions and the research we are doing may eventually allow us to communicate more efficiently in terms of spectrum and/or energy, in particular in multi-user scenarios. With more users, more connected devices and an explosive data growth, it is likely that 5G will only temporarily satisfy our hunger for more bandwidth. It will be matter of time before we are in need of something newer, better, faster! - It will take a young, bright mind like you to step up, revisit classical thoughts and enable the next generation!

[1] Cisco Visual Networking Index (2012) Global mobile data traffic forecast update 2012–2017. In: White Paper, Cisco, February 2013.
[2] A. G. Bell, "Improvements in telegraphy," U.S. Patent no. 174.465, 1876.
[3] C. W. Korevaar, A. B. J. Kokkeler, P. T. de Boer, and G. J. M. Smit, "Fourier-Hermite communications; where Fourier meets Hermite", International Conference on Acoustics, Speech and Signal Processing (ICASSP 2013), pp. 4723-4727, Vancouver, Canada, 2013.
[4] C. W. Korevaar, P. T. de Boer, A. B. J. Kokkeler, and G. J. M. Smit, "Peak-to-Average Power Reduction by Rotation of the Time-Frequency Representation", Global Communications Conference (GLOBECOM 2013), pp. 1–6, Atlanta, USA, 2013.

Afterlife

The path of a newborn civilian

Author: Rick van Keken

Suddenly it had happened, on a faithful day in July I became a Master of Science and I had to say goodbye to my life as a student. I celebrated this event with a big graduation drink with some very memorable presentations. To be honest I really enjoyed my student time and I would have enjoyed it for some more time if I hadn't graduated, but after almost exactly seven years it was also time for something new!

Luckily I did not need to think about the normal first big question that you would ask yourself: What now? I had already found a job at Shell as a Process Control Technologist thus I could immediately make plans for my new stage as a working and taxpaying civilian. When I was looking for an internship I wanted to go to a foreign country, in the end I succeeded in finding a spot at a university in Australia. You can find a description of my time there in some other past Vonk. But since Shell is a big international company I also sent my resume to Shell. I had to go through some solicitation rounds but as soon as it became clear that they only gave internships in the Netherlands I didn't pay it much attention anymore. Shell stayed in contact and after coming back from my trip to Australia I was invited for a Shell Recruitment Day and got a job offered. After going down to the site and visiting my future colleagues I accepted and was in the luxurious position to have a job at the same time I started my master thesis.

The next step after graduation was of course to go on holiday! I had still one and a half months of time left before I needed to start at Shell. So I got in the car with Laurie with our camping equipment and we drove south to France where we found a nice camping next to a lake where we stayed for two weeks and where we could recover from the past year of studies.

In the meantime I couldn't completely do nothing since I had to move for my new job. My contract was to start working in Moerdijk, the chemical plant of Shell, which lies between Rotterdam and Breda. Before I graduated we already explored the Moerdijk area and came to the conclusion that the only viable options were Rotterdam, Dordrecht or Breda. Klundert was also an option if I wanted to be able to cycle to my work but then my only neighbours would probably be two farmers and a horse... In the end Breda looked as the cosiest city to me so I decided to settle over there.

After I got back from my holiday the search for an apartment really started. This resulted in one day in Breda where we visited 14 different apartments on the same day. Luckily there was a nice one between all those and I was the first to have had a look at it. After some debating about the contract I was ready to move in a week before work started. This gave me some time to move my stuff buy some necessary furniture and just settle in.

Then the long awaited moment came around and I became a true civilian on the second of September. My job is to maintain and improve the baselayer control (the "simple" control loops with for example PID controllers), the development and maintenance of advanced process control (making models of parts of the plant and designing an optimizing controller) and day-to-day support to operations (the guys actually pushing all the buttons in the plant). I am responsible for the furnaces and quench section of the ethylene cracker, thus where the naphta comes in and the mixture of hydrocarbons comes out.

The first day and actually the first month were mostly just getting to know a whole lot of people, shaking hands and so on. One of the coolest things was that I was allowed to walk in total ten days with all five shifts of operations. I got the chance to actually see what everything looks like, where the measurement instruments are and just to look in a furnace for example. As an operator you are happy when it doesn't rain, the plant is so huge that almost everything is outside.

But after the initial couple of days work started to become more serious and more and more responsibilities keep piling up. People understand you are new and need to learn stuff but a project is still your responsibility and you have to make sure to learn really fast or ask other people for help. It doesn't matter how hard I studied, just walking around for the first couple of months at my new job made me feel very inexperienced. A feeling, that I am sure, many students that just graduated share.

I am happy that my job is not just sitting in some cubicle all day. I actually have an office with a nice view which I share with one other experienced colleague. A lot of time is spend with meetings and making sure all stakeholders are up to date. I also spend quite some time on my bicycle going back and forth between the office and the control room. The control room is where the action really happens and it often helps being close instead of working remote desktop.

What the future will bring is still unknown but for the next four years I will probably just stay in Moerdijk and follow the graduate program, two years working on the furnaces of the cracker and after that working for two years on another factory on the site. After that, who knows? Shell is a big multinational, so maybe a job in another country? It is all in the possibilities.

So all in all I am very happy with my afterlife, it is very busy but it is also very interesting and I learn a lot while doing this job. But still I haven't managed saying goodbye to the student live completely yet. So there is a high chance you'll see me around at Scintilla a couple of times a year. For example when there is an event like a cantus or the Christmas dinner or just on a normal day when I have taken a day off.

Cantus

Soccer

Wine tasting

Scinterklaas

Christmas dinner

A simulator for microwave photonic filters

Author: Leon Schenk

TELECOMMUNICATION ENGINEERING

For my bachelor assignment I went to the research group of Telecommunication Engineering (TE) to get an assignment which I wanted to do. They had an assignment for me which was to make a simulator for Microwave Photonic Filters in Labview.

Microwave photonic filters are filters for Radio-Frequent signals which make use of photonics to get filter characteristics in the electric domain. Filtering characteristics in the optic domain are different then in RF domain and are dependent on the modulation and demodulation techniques used.
Microwave photonic filters can roughly be divided into three groups. The first of which is a type of filter that filters both sidebands in a similar fashion so that the result after recombination is straightforward; the RF-filter response is the same as the optical filter response of one sideband, both sidebands do not interfere with each other.
The second group consists of filters which have an optical response which is different in both sidebands. The RF response is not very straightforward because at recombination both sidebands interfere with each other.
The third group consists of optically assisted electronic filters, which use the optical domain to create filter characteristics which are hard to create with just electronics (such as delay characteristics) or require reconfigurability and tunability.

For filters from the first and third group there is no need for creating a simulator. In the first group the RF-transfer is the same as the optical transfer and the third group uses building blocks which do not include many optical filter elements. The second group has four variables which interfere with each other at recombination (the phase and amplitude transfer of the lower and upper sidebands), therefore the simulator is needed to directly see the RF-transfer.

Setup

A common setup in microwave photonic filters consists of a laser, a RF source, a modulator, an optical filter and a demodulator. The laser creates a carrier frequency which is to be modulated with the signal from the RF source.
The simplest modulator is a phase modulator (PM), but by using two phase modulators and a mach-zehnder interferometer (MZI) an intensity modulator (AM) can be build.
For the optical filter there are already models in Labview, these models simulate the response of optical filter elements such as an optical ring resonator (ORR) and a MZI.
The demodulator is an photodetector which has a linear relation between intensity and current. An AM signal can therefore be directly converted into current, while a PM signal cannot.

Phase modulator

As I said the phase modulator is the simplest, there are materials which change the internal speed electro magnetic waves depending on the external electric field, resulting in a little phase offset. This effect can be reduced to the parameter V_π which represents the voltage that results in a phase shift of π.

$$E_{in}(t) = A_c e^{i(\omega_0 t)}$$

$$E_{out}(t) = A_c e^{i\left(\omega_0 t - \frac{V(t)\pi}{V_\pi}\right)} = E_{in}(t) e^{-i\frac{V(t)\pi}{V_\pi}}$$

Equation 1 and Equation 2

It is important to note that V(t) is an arbitrary time dependent signal corresponding to the voltage created at the RF source.

In the simulator the inputs are in frequency domain while in the equation both inputs and the output are in time-domain. The problem is that the equation cannot be transferred into frequency domain very easily and that is where a Maclaurin series comes into sight.

$$E_{out}[n] = E_{in}[n] * \left(\Sigma_{o=0}^{\#O} \frac{\left(\frac{-iV[n]\pi}{V_\pi}\right)^o}{o!}\right)$$

Equation 3

The Maclaurin series converts the exponential into a polynomial which can be used in the frequency domain. Due to the finite number of orders (#O) there is some loss of information. The bigger the applied phase shift the higher number of orders needed for the simulator to give a good description of the system. In the case of small amplitude, orders higher than one can be neglected and we have modulated the signal to the carrier frequency with both a lower and an upper sideband (which can be filtered accordingly).

Direct detector

A direct detector is just a photodetector. The photodetector has a linear relation between the intensity and the output current. The intensity can be calculated with the square of the electric field, this results, of course, in a convolution of the input electric field.

$$I_{out}[n] = E_{in}[n] * E_{in}[n]$$

Equation 4

And we are back in the electric domain.

Optical filter

To demonstrate the simulator a filter consisting of two optical ring resonators is created. The setup now has a phase modulator with a flat electric input spectrum, the optical filter and a direct detector. When no filter is applied this setup should not generate any results since phase modulation does not induce differences in the intensity of the signal. In the simulator this also comes out of the calculations. In the lower and upper sidebands there are parts of the signal which have destructive interference at recombination because they are out of phase.

$$E_{out}(t) = A_c e^{i\omega_0 t}\left(1 + \frac{-iAcos(\omega t)\pi}{V_\pi}\right) = A_c e^{i\omega_0 t} - \frac{A_c A\pi e^{i((\omega_0-\omega)t+\frac{\pi}{2})}}{2V_\pi} - \frac{A_c A\pi e^{i((\omega_0+\omega)t+\frac{\pi}{2})}}{2V_\pi}$$

Equation 5

Now the task for the filter of two optical ring resonators is to shift the sidebands into phase, generating a bandpass response at a tunable frequency. A simplified phase modulated signal of a single frequency and ignoring orders higher than one is worked out in equation 5.
Equation 6 shows the result, due to the ignoring of higher orders there are some terms left, but trust me, in the fact that they will disappear with increasing orders. These terms can therefore be neglected and we have no interest in these.

$$I_{out}(t) = A_c^2\left(1 + \left(\frac{A\pi}{2V_\pi}\right)^2 (2 + 2cos(2\omega t))\right)$$

Equation 6

Now we use the optical filter to generate a phase shift of pi/2 with respect to the carrier frequency, see equation 7.
And we filter the DC and double frequency terms.
So when applying the filter we get the same signal as we had put into the system.

$$E_{out}(t) = A_c e^{i\omega_0 t} - \frac{A_c A\pi e^{i((\omega_0-\omega)t)}}{2V_\pi} - \frac{A_c A\pi e^{i((\omega_0+\omega)t)}}{2V_\pi}$$

Equation 7

$$I_{out}(t) = \frac{-A_c^2 2A\pi cos(\omega t)}{V_\pi}$$

Equation 8

Results

This result was only for a single frequency, to apply this filter to a modulated signal consisting of many frequencies the simulator is used. Also the out-of-the-blue phase shift is replaced with a filter of two optical ring resonators. Now the system is put to the test, the results can be seen in Figure 1.
The test was repeated in the laboratory and these results are also visible in Figure 1. Dotted lines are simulated and solid lines are results from the laboratory. The tunability is shown by shifting the centre frequency of the optical ring resonators.
The results show that the simulator creates an output that is approximately the same as the output we've got from the laboratory. I am happy with this result and if you want to get more information please contact me.

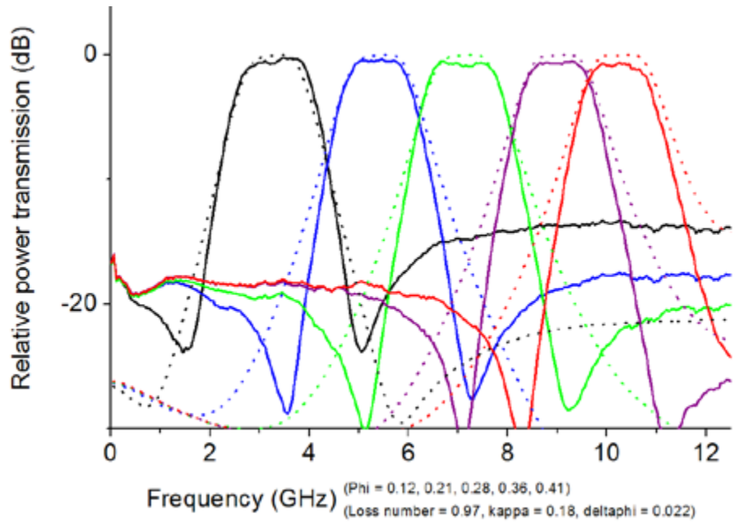
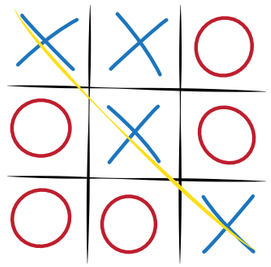


Figure 1

Tic-tac-toe

Author: Jens Oosterkamp

Do you consider the hobby projects featured in the Vonk a little bit too complicated sometimes? I do, so here is a beginner's project. I'm not a real electrical DIY genius, but a while ago I had a very nice idea for a project. Only, this idea is very elaborate.
The problem was, that in my opinion, projects which are too difficult for a given person's skill level are hard to finish. How many projects do we see which are unfinished? Mostly, the cause is frustration or boredom (because we don't get things done). So for this one, I set out to keep things as easy as possible. If I would still be enthusiastic after the simple project was finished, I could always expand it.



(For people who are interested in what my elaborate idea is. It is a Nintendo Game & Watch game, which is controlled with a microcontroller. The output would be LED's mounted in cardboard, instead of the LCD screen of a G&W system. This is also the way Nintendo R&D created these games back in the day.)
I decided to make an electronic game, with buttons as user input, and LED's as user output. Now, of course, hundreds of ideas were possible, but I chose tic-tac-toe (which in retrospect is not the simplest game one could think of, "a press the button when the light is the right color" game would be way easier!).

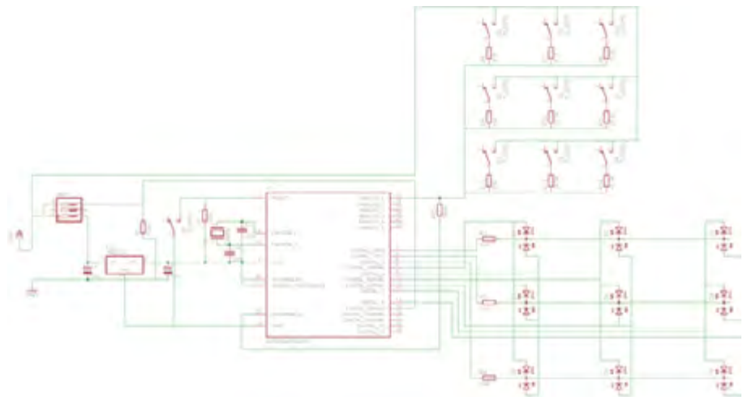
Code

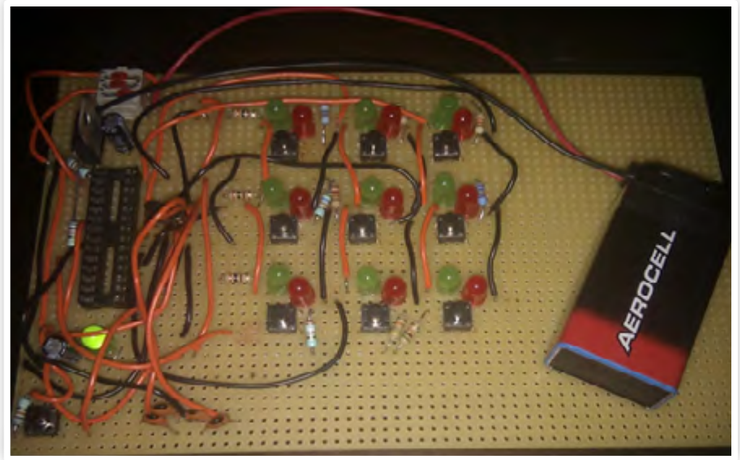
To begin with, I created some code in C. I did this using textual output on the screen of my pc. When the code was ready, one could play versus another human player, or versus the computer. To keep things simple, all the computer does is find an empty spot on the field and place its mark there. The code is very simple, and I think everyone who passed the first year's programming course should be able to work a code like this out for themselves.

Schematic

Reading buttons
I have made a schematic after I finished this project, because in the near future, I wish to improve the project. But if you take a look at the image of the board which I build, you can see, it's not a very difficult schematic. The buttons are all on one side connected to the +5V line. The other side is connected to an analog pin on the Arduino, through a resistor. Because the resistor values are different for each button, and because there is a resistor between the analog input pin and the ground, we have created a voltage divider. It is a very simple way to read out 9 buttons, since we know that with normal usage, only one button will be pressed at a time.

Controlling the LED's
Because there are two states for every position on the board, 18 LED's are needed to be able to show all possible states of the board. The Arduino (which I have used) does not have 18 output pins, so the easiest solution was not possible. Instead, multiplexing was used. This reduced the amount of needed inputs from 18 to 9, which the Arduino does have.





Arduino

Because a microcontroller and the PC, which connects to it, both have to be configured (which I don't consider a very intuitive or fun process), I decided to use an Arduino. Again, to keep things simple.
Since I already wrote my code in C, converting it to Arduino code was easy.
For easy prototyping, I used a breadboard to try out the configuration of the buttons and LED's, and in the Arduino, I used this same configuration. Fun question: Do you think I thought out how my LED's would be connected to the Arduino? No. In my Arduino code, I made a mapping of the buttons which I later changed to what it would be in reality. This saves a lot of time, because there are a lot of LED's.
Then, for the buttons, one could calculate every expected analog input, by using the resistances and the precision of the internal AD converter. Of course, I did not do this. Arduino allows you to serially return analog inputs. I pressed all buttons sequentially and wrote these down for all the buttons and put them into the code.

Power supply

A 9V battery was used as a power supply, along with a voltage regulator. The power supply is switched, so it can easily be turned off. A led on/off indicator was added for convenience. Also, a switch was used for switching if you want to play versus a computer or a fellow human.

Reuse that Arduino!

I think it would be a shame to 'waste' an expensive 15 euro (borrowed) Arduino board when I could use a cheap 2 euro Atmega microcontroller. Not everyone seems to be aware of this solution: easy programming and prototyping with Arduino, and using cheap Atmega chips at the same time.
If one programs the Atmega on the Arduino board, and then removes it from the Arduino, it can be placed into a new circuit (add a clock, a power supply, and you're there). You can reuse your Arduino for the next project.

> "I think it would be a shame to 'waste' an expensive 15 euro (borrowed) Arduino board when I could use a cheap 2 euro Atmega microcontroller."

Results

The game works! One can switch between playing versus the CPU or another human player. The game is powered by a battery, and does not waste an Arduino, yet it is still easily reprogrammed if necessary.
My goal of this project was to actually complete a small but fun project, and I think this goal has been achieved.

Improvements

I know a lot of things are not as fancy as they could be. On purpose, but still it is fun to think about what could be improved. Below a short list.

1. Use a (minimax) algorithm to make the computer more intelligent.
2. Charlieplex the LED's reducing the amount of needed pins back further from 9 pins to 5.
3. Use dual color LED's.
4. Use semitransparent button covers which slide over the LED's and take the LED's color.
5. Fit it in a box.
6. Print the circuit on a PCB.
7. Make the CPU/Human and On/Off switches easier to use.
8. Determine battery performance.
9. Power it with a 1.5V battery.
10. Add sound.
11. Add an online multiplayer mode.
12. Well, you got the idea... Go nuts!

I might expand this project, or make another project one step closer to the bigger project I had in mind. I haven't decided yet. But I had fun building this one!

C-, Arduino- and Eagle files

If you are interested, you can download the C code, the Arduino code and the Eagle board and schematic files from http://tinyurl.com/o5whnye. But be warned, the code's a mess!

IEEE Project

At the end of the fist quarter our first year students faced their first big project, the introduction to Electrical Engineering and Electronics Project. During this project the new first years have had a lot of interesting experiences, and we have asked a few of them to describe their experience.

"Tssssss"

Author: Alex van der Meer

The project of the first module was a very stressful time, especially for me a time filled with screens full of red letters. Victor and I were the first to try and establish a live connection with Matlab. After a lot of struggle and help from TimB, everything was understood and working as wanted, so we could explain things quick and easy to the other EE boys.
After a while every sensor worked on its breadboard. There was so little time left that I had to do a lot of soldering at home. But the soldering iron had no station, so the hot thing was lying on my desk, burning a notebook here and there. I came up with the clever solution of laying it on the ground where it coudn't touch anything.
I went to the bathroom and had some small talk with my neighbour, when I walked back to the desk I suddenly heard; "Tssssss" followed by my own loud scream. I ran to the bathroom which was locked so without much thought, I put my foot in the toilet and flushed. But there was a chill sink so I continued cooling in there. After this my drunk flatmate came by to laugh his face off. So now people know why I walked like a cripple the following week. My sacrifice was however for nothing since only have of the-final soldered stuff worked.

The moral of the story is, if you don't have a soldering station, buy one, at the STORES of course.

Which is exactly what I did the following day ;P

MatCom Crashes

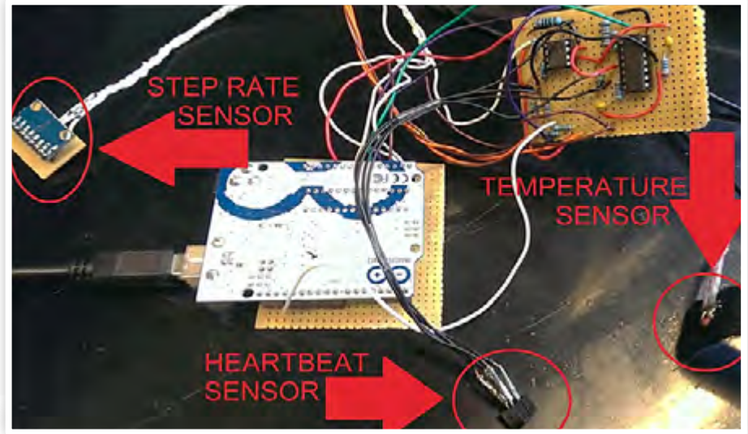
Author: Ewoud Vissers

At the end of the first quartile, the first year students had to do their first project. We had to design a sensor pack which would measure 4 parameters of the human body. My group had the sports package, so we had to measure heart-rate, temperature, sweat-rate and step-rate. After creating a project plan, the first day went as planned. I had to do most of the programming in Matlab, and after the first day I had figured out how I would have to use the provided MatCom protocol, and could start on the code for detecting the pulses from the heart rate sensor.

When doing this, it turned out the provided protocol wasn't really good. Matlab would crash at least 4 times an hour, which turned out to be because my laptop's power plan was set to balanced. My pc didn't have enough processing power in this mode, which MatCom didn't anticipate. After 20 crashes, I found out the problem. This made coding a lot nicer experience.

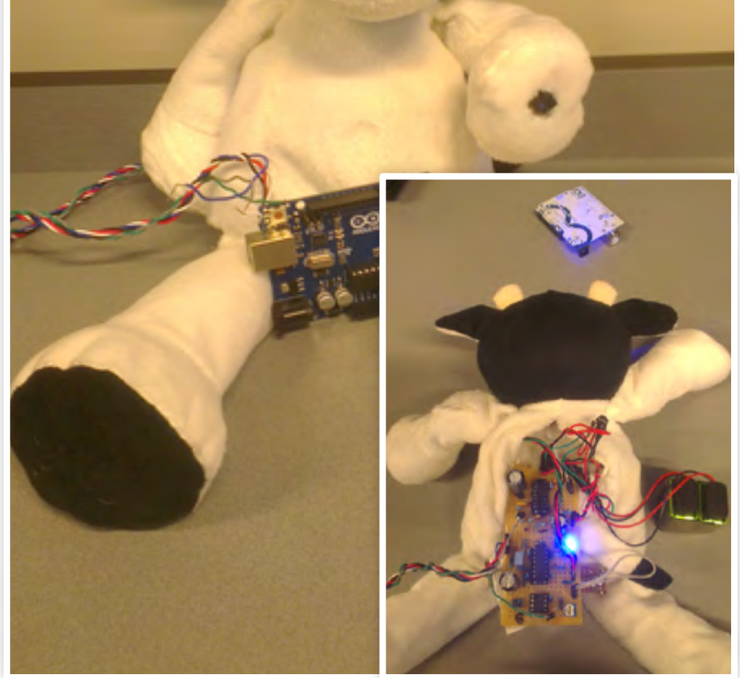
After a lot of coding, I had a program which should have detected the peaks, but I couldn't test this piece of software, since the heartbeat sensor itself wasn't done yet. Major flaw in our project plan! The next 2 days I helped Gert-Jan with creating the heartbeat sensor, and after these days we had it working on the breadboard. The other members of the team were done with the step and sweatrate sensors, and I took the task of soldering upon me. This took an entire day, but at 4 o'clock it was all working, without having to resolder anything!

During my soldering-time the rest of the team had done a lot on the report, so we wouldn't have to do much anymore on Thursday. On Thursday I put together all pieces of software, and polished it all up a bit. This meant it was time to go to the Vestingbar, and celebrate the fact that it all worked. After a nice evening, we had to be up early again, and finish up the presentation. It all went well, and everything worked as it did the day before, which couldn't be said by everyone. This was a nice start of the weekend.



Stitches

Author: Boi Okken, Petra Kuipers and Robert Visscher



We are Boi Okken, Petra Kuipers and Robert Visscher. Our final project consisted of designing a 'baby monitor' . Four sensors were used to measure the babies vital signs, these are: the heart rate, the body temperature, crying sensor and the wet diaper alert.

The heart rate was measured with the use of a IR reflection sensor(CNY70). This whole system was amplified and filtered with analog circuitry and the result was transmitted to the PC with AVR microcontroller. It was processed on the PC using Matlab.

The body temperature was measured with an NTC op-amp circuit and then amplified with a difference amplifier. If the baby pissed itself, this would be detected with an embedded copper strip in the diaper. When this strip is wetted, the output of an comparator outputs a logic high.

Last but not least a microphone was used to detect a baby crying. Because a babies cry is between 3 and 6 kHz, the signal from the microphone needs to be filtered. Instead of processing this filtered signal in matlab or the microprocessor like most groups, we decided to process it with analog circuits. This is done with an analog peak detector.

The whole sensor package needs to be integrated in a nice package which looks friendly to babies, so we created the 'terminator cow' a.k.a. 'Stitches'.

Green Team Twente

Find out how hydrogen drives your future!

Author: Sander Schotman

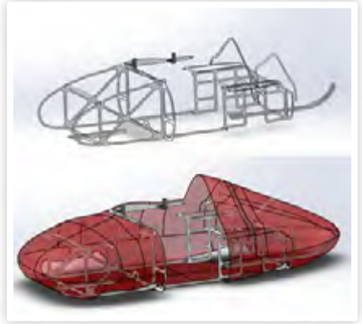
Green Team Twente believes in a sustainable future in mobility by using hydrogen as alternative fuel. But what is Green Team Twente and what do they do?
Green Team Twente is a team of students from the University of Twente that develop and build a hydrogen car for participation in the Shell Eco-marathon. This way, the teams demonstrate what is already possible when driving efficiently on hydrogen. This year's team consists of 2 mechanical engineers, 7 electrical engineers, 1 chemical engineer and 1 health sciences student. With this multidisciplinary team they hope to end in the top three again, but also they hope to promote this project amongst students.

The Shell Eco-marathon

The Shell Eco-marathon (SEM) is a race in which the goal is not driving as fast as possible but driving the most efficient. Around 3000 students, divided over 200 teams from all over Europe take part in the competition which takes place in Ahoy, Rotterdam, 15-18 May 2014. This event is open to everybody and also includes the Shell Energy lab, an interactive exposition on the future of energy.
The Green Team Twente participates in the Urban Concept class. This means that the car has to look like a real car. In practice this means having 4 wheels, mirrors, windscreen wipers and space for luggage.
The team participates since 2012 and already received the gold and bronze medal in the Urban Concept class. To compare the results of different fuel categories, the amount of used hydrogen is converted into liters of euro 95 gasoline based on energy content. Last year this resulted in an efficiency of 1 liter gasoline on 755 kilometers.

The UTmotive

The car has already taken a large step forward. Last year's team made a new body with an internal rib structure which made the car not only stronger but also reduced the weight.
Also on the electronics, developments are made. The motor is no longer controlled by a block signal but by a 'sensor less' motor controller which uses a sinus wave. This motor is specially designed for in-wheel use at the conditions of the eco-marathon.
Also a CAN-network of micro controllers is put up. This network makes sure that the signals are available all over the car without the use of a lot of wires. This also opens up the possibility of analyzing the data produced by the network, which is very useful for the driving strategy.



The Race

The Shell Eco-marathon of 2013 wasn't one without difficulties. Already at a test ride, a part of the front wheel suspension broke apart and the electronics had delay because the 8-bit microcontroller couldn't process the large amount of data. After these problems where fixed, the car was 2 minutes late at the finish resulting in a non-valid result. In the eco-marathon the minimum average speed is set at 25 km/h, otherwise everyone would drive even slower in order to reach a higher fuel efficiency. This problem was due the Hall sensors in the motor, which weren't placed at the right spot. Because of that, the motor controller was not efficiently controlling the motor. The created loss of time had to be compensated by driving faster, which has a negative effect on the fuel efficiency. The solution for this problem couldn't be found in a short period of time. Therefore, the team decided to use the motor controller of 2012. After all, a race had to be driven!

At the second attempt, the day after, luck wasn't on their side. After a ride of 8 rounds the fuel cell, which turns the hydrogen into electricity, stopped. This meant the end of the attempt. After analyzing, it was seen that by accelerating and braking, pressure fluctuations in the fuel system occurred. Because of these fluctuations the safety system of the fuel cell turned the fuel cell off. The team by-passed this problem by placing a switch on the dashboard so the driver could turn the fuel cell back on when necessary. A new attempt was made, resulting in an efficiency of 1 liter on 561 kilometers.
Further analysis made clear that the combination of the new controller and the old motor would deliver the best result. This was the last possibility to set a result and the team was determined to do so. The whole night the team worked to get the system in place. The driver was the only one who slept that night. Eventually the car was ready and tested on time. After 10 nerve-racking rounds the results were positive given the situation. The team reached the 3rd place with an equivalent efficiency of 1 liter at 755 kilometers! Not the result that was hoped for, but better than in 2012.

Green Team Twente 2014

As experience has taught, a large step can be made when the car is controlled in the right way. This year's team will focus on testing the different parts of the car in order to have a better understanding of the things that have gone wrong. With this information a model of the system will be developed. This is very useful to determine the ideal speed in order to reach the highest possible efficiency. The automatic pilot shall be implemented further to make sure the ideal speed is driven. This has to bring us again in the top three teams! Besides this, the car will be made ready to drive on the public roads! In this way, the team hopes to make the statement that the cars of the future are already closer than you think. Also the team wants to give a greater publicity to this project. It turns out a lot of students aren't aware of this challenging and multidisciplinary project in which, besides the technical part, also the management side plays a large role.
Are you interested in working in a project like this, or are you just interested in the developments of the team? Like us on facebook (facebook.com/greenteamtwente) or look at our site (greenteamtwente.nl) for more information.

Important Data

16 January 2014:	SEM Kick-off
28 March 2014:	unveiling of the new UTmotive
14/18 May 2014:	SEM race in Ahoy, Rotterdam
27 May 2014:	Report of the race

Puppet

Automating your configuration

Author: Koen Zandberg

A lot of the work the SOT does is working on a terminal, configuring the servers remotely. Mostly this happens by editing configuration files on a server or virtual machine. Currently we have around 15 Linux installations to manage, so when something has to be changed on all of these installations, we have to do this manually. This costs us a lot of time connecting to each server; editing the configuration; restarting the service and checking if it worked. A solution to this problem is Puppet.

Puppet is a so called configuration management tool, a program able to manage configuration files, services and other resources on a Linux or windows installation. Puppet consists of two parts, a puppet agent, installed on every server that you want to manage and a puppet master, a central server to manage all these servers.

The Puppet agent is the main component on the individual clients. The task of the Puppet client is to interpret the manifest. It ensures that the server is in the state described in the manifest. The puppet client is able to request a manifest periodically from a central puppet master or you can feed it manifests directly. Of course it would not make much sense to manage ten or more servers by feeding each server the manifest manually each time it needs to be updated. This is where the Puppet master enters the stage.

The central Puppet server (or puppet master) contains a catalog of all the resources an agent needs. Depending on which server requests a manifest, the puppet server creates a ready to apply manifest from the whole catalog for the specific host. Thus in normal operation the puppet master contains all

> "The task of the Puppet client is to interpret the manifest"

the instructions for all servers.
All these instructions are described in puppets own language. Puppet uses a declarative language for this, this means that you don't have to tell puppet what or how it has to do things, only what the result should look like. Puppet will make sure that it happens. This ensures that a system administrator doesn't have to spend time telling puppet how to do things only how he wants it to be.

Figure 1: The Puppet logo

Most of the time, when a configuration file is changed, you also want it to be loaded in the service that uses that file. Puppet is also able to do this, it does not only manage configuration files, it is also able to restart the services depending on these configuration files. For example if it needs to change the apache configuration, it is able to restart the apache server after the required changes have been made.

So how does puppet do all this? It all starts with a puppet master. A central server which contains the manifests of the hosts it serves. We have only one place where we have to declare resources. Resources can be almost anything. Files, user accounts, software packages, services that should be running, or even a random script installed on that server. For example, if we want a <insert random file here> to be on a server, we tell the puppet master that that specific file needs to be on that server. Let's say we want our very special test file to be on that server:

```
file {'testfile':
  path    => '/tmp/testfile',
  ensure  => present,
  mode    => 0640,
 content => "I'm a test file.",
}
```

This little piece of code is enough. It tells Puppet: where the file should be, that should be present on the machine, which permissions it should have and what content the file should have. This basic definition is enough to create a file. Either the puppet master contains this resource for a host in the catalog, or we can apply it once manually on a host by directly using the Puppet agent.

Of course different resources have different attributes. A file has a mode (permissions) and a content, a service has a setting whether it needs to be running or not. Another example, this time lets say we want to maintain the configuration file for our secure shell daemon.

```
file { '/etc/ssh/sshd_config':
  ensure => file,
  mode   => 600,
   source  =>  '/etc/puppet/files/
sshd_config',
}
service { 'sshd':
  ensure     => running,
  enable     => true,
   subscribe   =>  File['/etc/ssh/
sshd_config'],
}
```

The first bit is again a file resource. This time we specify a source for what the content should be. This way we don't have to write out our complex configuration file between bits of puppet code. Furthermore

> "The little bit of magic here is the subscribe attribute"

we created a service type resource. This way we tell puppet we want the secure shell daemon to be running. The little bit of magic here is the subscribe attribute. By subscribing to the configuration file we tell puppet that when that file changes, the ssh daemon should be restarted, effectively reloading the configuration file.
So now if we change the configuration of the ssh daemon, the next time puppet applies the manifest it will notice that the current configuration and what it should be don't match up. It will reapply the specified configuration file and restart the ssh daemon, rolling back all changes somebody made manually to the file. At last we might add another resource, one to specify that the ssh daemon should be installed on the server. Puppet will then automatically install that package on the server should it be missing.

These small bits of puppet language can be brought together to manage a complete server. We can of course define more resources, one for each service we need and one for each configuration file. With a few files and services this might still be manageable, but it would soon spiral out of control. To maintain an overview, puppet can group multiple resources into a class. The idea behind classes is to group resources with the same context into one resource definition. If we have a few resources to manage our ntp (network time protocol, synchronises the current time from a few servers on the internet with your computer) daemon, we could build a single ntp class for this. Instead of defining all resources manually, we just say:
include '::ntp'

Or if we want to tweak some settings we could do:

```
class { '::ntp':
  servers       => [ 'ntp1.utwente.
nl', 'ntp.snt.utwente.nl' ],
  restrict      => ['127.0.0.1'],
}
```

This way we retain our sanity and overview of the situation. It doesn't really matter how this ntp class manages our ntp daemon, we only know that it works and that we tweaked a few settings. If we really want to know how this class works we can always inspect the code from which the class is build.

With classes we have even better building blocks for our servers. Unfortunately, if we just apply resources and classes to our servers, some things might still go wrong. Maybe we have a few servers with Ubuntu, a few with Debian, and a strange Red Hat server some where left in a closet. These Linux distribution vary a little bit, but enough to sometimes break things if we want everything exactly the same between them. A obvious example is the Apache web server. On Ubuntu and Debian, this service is called Apache2, on Red Hat it is called httpd. To prevent our servers from installing nothing or the wrong packages, puppet has two tricks up its sleeve.
The puppet language as most programming languages supports variables. We could define our apache package as:

```
package {'apache':
  name    => $apache,
  ensure => latest,
}
```

Using the variable named $apache as the name for our web server. Somewhere else we then state:

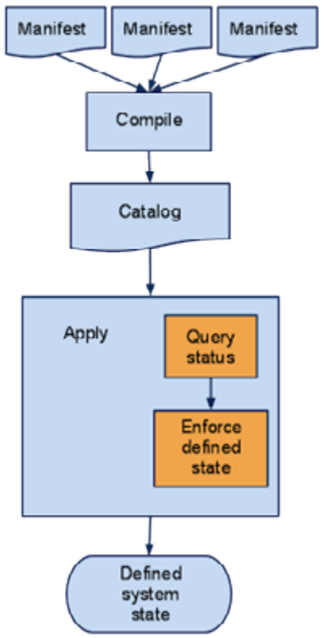


Figure 2: The process of applying a manifest to an agent

```
case $operatingsystem {
   # Note that these matches are
case-insensitive.
  redhat: { $apache = "httpd" }
  debian: { $apache = "apache2" }
  ubuntu: { $apache = "apache2" }
   default: { fail("Unrecognized
operating system for webserver") }
}
```

This defines the variable $apache for each operating system we have with a case (or switch) statement. But this only delays the problem. We still need the variable $operatingsystem to be defined somewhere. Puppet solves this with a tool called Facter. Facter is a support tool for the Puppet agents. On each Puppet run it collects variables from the agents and uses those to solve these problems. One of those variables is the $operatingsystem, which defines the operating system running on the client. Other variables are for example the number of processors or the host name of the system. Facter gives each agent the unique fingerprint to identify itself to the puppet master. We can make certain definition specific for an operating system, or even classes defined per host.

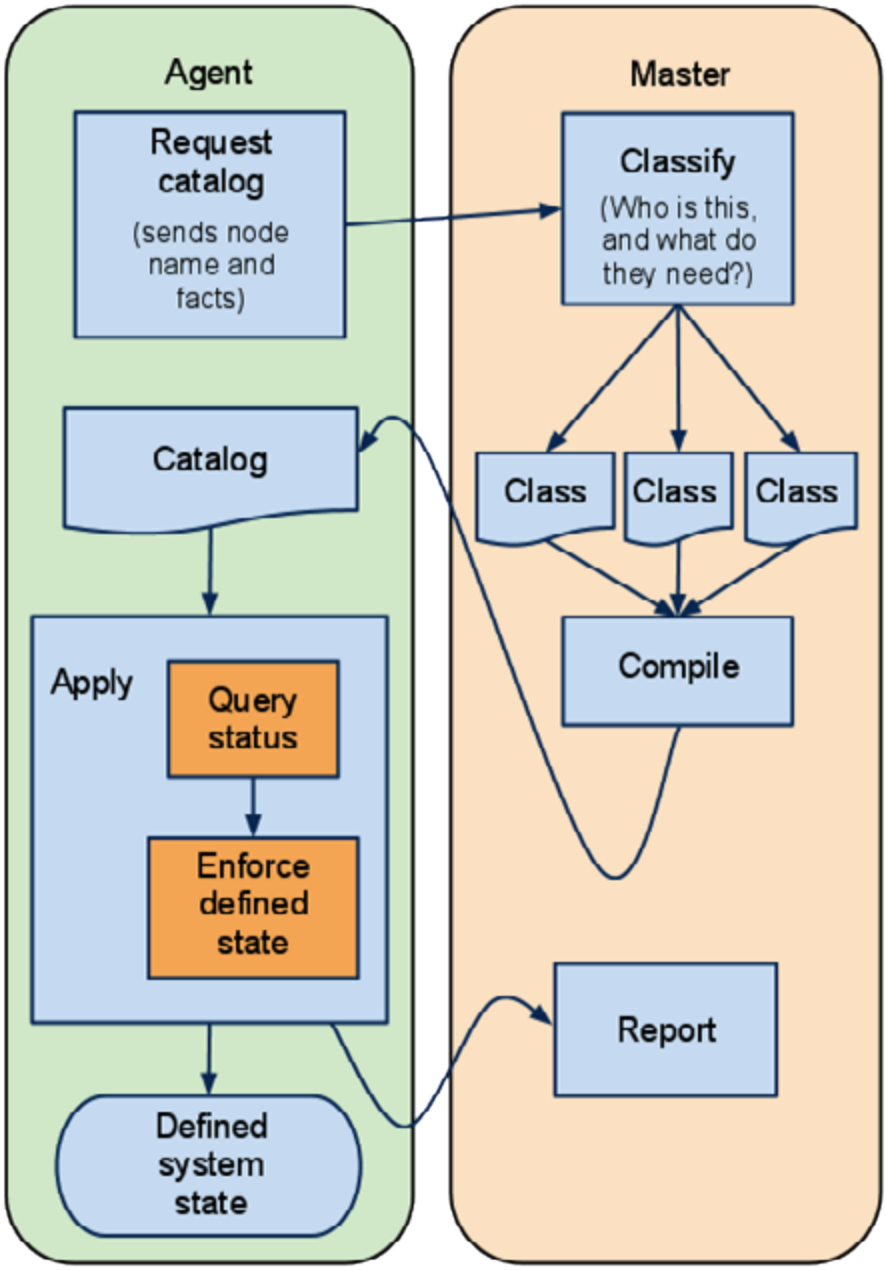


Figure 3: Agent sending a request to the Puppet master

As most system administrators are lazy (or want to do their job as efficient as possible), they don't want to be busy all day writing classes. Most of the time classes are contained in so called modules. A module can consist of multiple classes, but it always has a single context or functionality. Modules can be uploaded to the Puppet Forge, a website dedicated to making Puppet modules available to the world. With this system administrators don't have to write each Puppet module over again but save time by using the work of somebody else.

So what actually happens when a Puppet agent contacts the master. The process of applying a manifest to an agent works as shown in figure 2. The manifest is combined with any other included manifests and compiled into a catalog. The main difference between a manifest and a catalog is that a catalog is specific for one host. Any logic and/or variables are resolved. This ensures that an agent only sees the catalog for his host, thus improving separation and security. When an agent sends a request to the Puppet master, the process changes to figure 3. The agent sends his name and facts to the master. The master uses this to classify the host and combined the necessary classes and compiles these to a single catalog. This catalog is returned to the agent, which then can apply this catalog to enforce the system state. Finally the agent reports back whether the taken actions were successful. To secure all communications between agent and master, each agent identifies himself with an unique SSL-certificate. This certificate must be accepted by the master before any communication can take place.

With this combination of Puppet agent and Puppet master we can effectively manage multiple servers. This way we don't have to edit the same file multiple times, saving us a lot of time and errors. But it doesn't stop here, puppet has a few more tricks up it's sleeve to make things easier. Additional systems like Hiera and Augeas can be used to structure your puppet code even better and use it more efficiently.

Minor

Author: Petra Kuipers

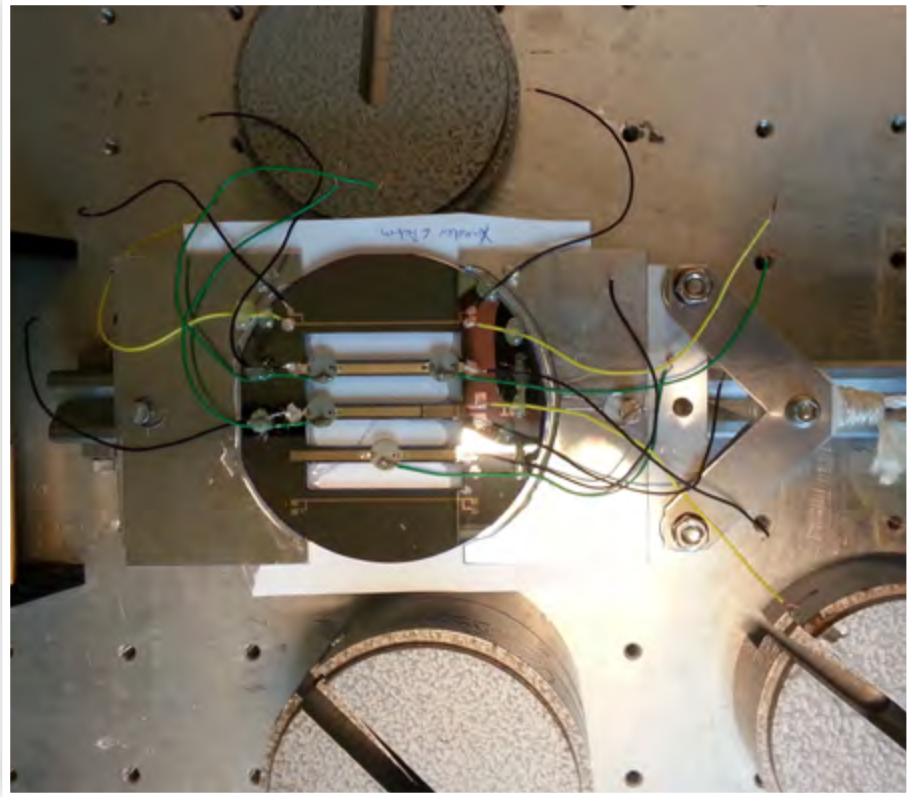
Petra Kuipers is a Mechanical Engineering student. She is now doing her minor in the field of Electrical Engineering. We asked her a few questions about why she chose this, and how she experiences it.

Why did you choose an EE minor?

Near the end of the subject System Analysis, where the analysis of electrical systems and some important stuff regarding electrical motors was introduced. The lecturer made a remark that the most important thing a mechanical engineer lacks is knowledge of electrical engineering. This seemed interesting and since none of the theme-minors seemed interesting enough, the decision was easy really.

Which subjects did you take?

I took the first year subject IEEE with lab work, the third year practical Realization In Materials (of a micromechanical force sensor). Currently I'm following ElBasFun (2nd year Advanced Technology) and in January I'll start on an assignment on Advanced Semiconductor Devices.



How is it going so far?

Well, so far so good. I passed IEEE and lab work, next week (at time of writing) we will get the result for RIM and a midterm test for ElBasFun, so then I know if those subjects are roughly going as well as I think they're going.

Are there similarities/ differences compared to Mechanical engineering?

What is similar is the physics and mathematics behind the subjects, even if they are applied to different area of theoretical problems. However, once the theoretical solution is tested and does not work as expected, the reason why is, for me at least, much more difficult to identify.

The biggest difference in the contents of the study is probably the amount of lab work and preparation needed for that.

From an organizational point of view, the biggest difference is probably caused by the TOM-model. For some subjects in my study, midterm tests are used as a bonus construction or as a replacement of an exam, even though there is still an opportunity to do the entire exam. However, those tests are planned after a specific part of the subject has been covered, not blindly every Monday. This way, it is more a reason to refresh what you learned and a test of acquired knowledge and insight, rather than performing the same trick to give the same answers as last Thursday.

minor

Minor

Author: Berjan Westerdijk

I am Berjan Westerdijk third year EE student, i.e. "Farmer of Sparks". Before I started my studies concerning the proper flow of electrons, I was not very sure what to do, whether to study EE, or Mechanical Engineering. In the end I chose more or less randomly, under the condition that during my minor I would do Mechanical Engineering courses. Over time I have grown more interested into perhaps doing (a part of) my master abroad. And last year when it became time to more or less decide what to do with the minor, I got the idea to the these Mechanical Engineering courses abroad (though not far), to get an idea if I would like to do a bigger part of my studies abroad. I liked the idea of studying in Germany especially since this would be a good opportunity to learn some German. It is quite a big decision to make going halfway across the globe to study for a year or two, you can't say "mwah it's not for me", and then return. It would be a pretty final decision. So it would be a good idea to more or less try it out first.

How I arranged all this

In December of last year, after I talked with Maarten Korsten about a course I was doing at the time, I decided to ask him about the possibilities of doing my minor abroad. Maarten Korsten is the Departmental Coordinator for the EWI bureau of International Relations. After talking to him he suggested a set of things which I should do. After the second quarter test had finished, I returned to Maarten Korsten with the things I had found out, and what I wanted to do more or less. I had decided to do this exchange program at the Technische Universität Hambug Harburg (TUHH) in Hamburg, since this university had an official contract with the UT (hoping this would decrease the expected burocracy a bit). After a bit of e-mail communication with the people at the TUHH, I found out that I needed to talk to the person in charge of International Relations of the Mechanical Engineering department, Dorien van de Belt. Because they are the only part of UT which actually has a contract with the TUHH. After discussing my plans with her, she said she would reserve the exchange position with the TUHH for me this year. After I then had to find a "sponsor" for my individual minor program, this is officially standard procedure if you want to do a minor outside of the few standard minors the university still offers. Maarten Korsten suggested me to talk with the people of Mechanical Automation, the ME counterpart of our Robotics and Mechatronics research group. This turned out to be quite a big hassle; everyone over there said to be overloaded already and couldn't sign the document for me. After being sent back and forth for a while I found one person who was willing to advise me on, and sign my plan for the individual minor. This was then sent to the exam board who accepted it. After this I had to get a learning agreement signed by both the UT and the TUHH about the courses in my individual minor. This part was relatively easy at least at the UT, and it meant just collecting a few signatures. However when I sent it over to the TUHH, which up to that point had reacted with the widely known `deutsche punktlichkeit`, didn´t react for over a few months. Ms. Jaarsma-Knol, also of the "bureau internationalisering" / bureau of international relations, helped me set up this learning agreement, and also told me that I was eligible for some extra financial support (an Erasmus grant). And after filling in quite a few forms sorting that out as well, I finally left at September the 30th.

Hamburg

Since my learning agreement was returned only at the end of July, I was too late to get a spot in the actual international student housing of the university itself. I feared this would be quite an issue, because it is notoriously difficult as an international student to find housing quickly in the normal circuit. A week before the lectures started in the Netherlands, I decided to drive to Hamburg to perhaps visit a few rooms, and at least talk to the Accommodation Office if they could help me further along. When I arrived there, and talked to this person of the Accommodation Office they luckily still had a place where I could stay for half a year. I rent a room in a "rijtjeshuis" from a lady which has rented rooms to international students for years now. I gladly took this opportunity.

During the first two weeks, there was an introductory program, (which is quite unimpressive compared to the kick-in) in which I did an intensive language course. Here I met a lot of other international students. The TUHH though small (only 6000 students) has a remarkably big amount of exchange students, the people I met were mostly from mostly from western –Europe, and Colombia. At the final day of the introduction weeks, there was a big assembly where all the "ersties" (German for sjaars) convened and there were speeches by the Rector Magnificus and other people from the University with some tips and facts about studying at the TUHH. This was all in German of course (in Germany they won't start talking English if there are a few people who aren't from Germany). After these first speeches, the regular "ersties" were sent to their respective FSR's (Fachschafts Räte), i.e. more or less the German equivalent of a study association), and we got a few specific speeches this time in English. There was also a speaker from Iran (an international student who is doing his 5th year at the TUHH now) which had also spoken during the general part, and here I realized that International students here speak better German than they do English (which would generally be the other way round in the Netherlands). My courses here are all in German which was quite challenging at the beginning but I am getting quite used to it now. Although it might be quite hard to actually do the tests and reports in German but I am not going to worry about that yet. A funny thing to note is that in Germany at the end of a lecture it is common practice to applaud the Professor/ teacher.

The University here and the UT are actually pretty similar, founded about 10 years from one another, size wise they are about equal (the technical part of the UT and the TUHH are about equally big). And they both try to stimulate extracurricular activities.

General life in Hamburg doesn't differ all that much from life in the Netherlands. Though there are a few differences, the lack of proper bike(lane)s and the environmentally responsible attitude of the German society. For instance, the university will never hand you a piece of new paper, all their documents are printed on recycled paper. I must say though that most of the Dutch preconceptions about Germans I have found to be true. They are quite strict, if one wants to talk to a Professor or other employees there is only a very narrow set of office hours and you are somewhat sneered upon if you ask people outside of these opening hours. And expectedly they eat a lot of meat, but apart from that there don't seem to be such huge differences. And though as a whole Hamburg is huge, 1,7 million inhabitants, this part of Hamburg where the University is (Harburg), which lies south of the Elbe, is more or less comparable to Enschede. I like it here quite a lot, though I miss Enschede and studying EE as well.

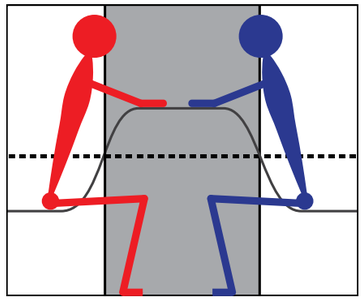
If you have any questions, I'll be back in the SK after January 31st

Junction

Karim Kok

Authors: Fieke Hillerström & Tim Broenink

Karim Kok is the administrator of the STORES and therefore part of the board. He started studying Electrical Engineering in 2009 and is a very active person, but still not very known at Scintilla. We invited him for this interview in the Junction, to get more insight in his daily life.



What is your favourite class during your Electrical Engineering studies?

That is a good question to start with, I will have to think about it. I think the more practical classes, such as ElBas (currently known as electronics) and computer systems, are the classes that I liked most.

That practical part is characteristic for Karim, as it turns out during this interview. He started his own company in electronic construction kits (digibytez) and works for 3T.

Why did you start your own company?

When I was eight I already started with engineering. I started with soldering construction kits and thereafter did more and more myself, for example the design and etching of PCB's. I posted my projects on my website. And I got requests from visitors if I could design and etch PCB's for people. That was when I decided to start my own company in order to facilitate this. But it was still like a hobby for me.

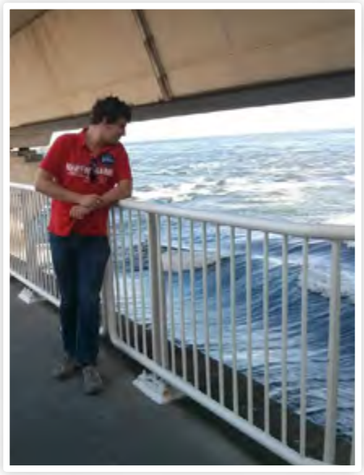
> "When I was eight I already started with engineering."

And when you decided to turn you hobby into a more serious business, how did you do that?

I started by selling individual components on the internet and designing small construction kit. For example I sold a set to make a LED cube. These construction kits consisted of a circuit board and the component needed for it. I sold these construction kits to schools and other associations. As the market for these types of construction kits grew, I stopped with the sale of the individual components and started to focus solely on the electronic construction kits.

You also have a job separated from your own company, what do you do there?

I work at 3T, an engineering company. At 3T I work with embedded systems and help designing electronics for companies. These are larger projects and require more knowledge and skills in order to complete the design. These projects include things like a control system for engines or large machines. This is an area of work where I would like to work in later.



Karim Kok

Age	Twenty-two
Study year	Fifth
Birth place	Smallingerland, Drachten
Country of origin	Fryslân

What do you want to do after your study?

After my study I want to start working at an engineering company to help with designing electronics etc. I also want to continue my own company part-time. I am more practical than theoretical. I have even thought about going to the HBO, but I like some challenge and theoretical background to go with my practical knowledge. So I choose the more practical classes and still hobby at home.

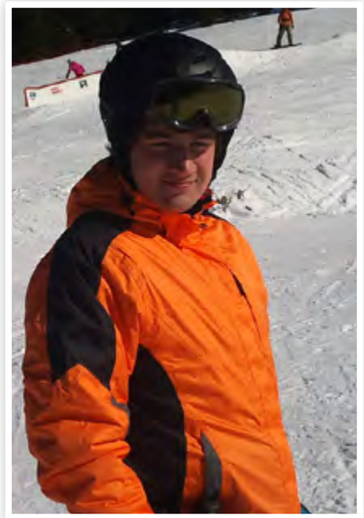
So where did you get this practical aptitude?

I grew up at the farm of my parents and helped a lot in the work. My father constructed a lot of things, and he learned me to be practical. This has influenced me a lot, for example the background of my computer is a tractor. I think they are incredible machines and learned to drive them when helping my father at the farm.

Besides his work, Karim is also active at Scintilla. He is the administrator of the STORES and participant of the upcoming study tour to Japan, where he is also involved with the administration.

How do you experience this third "job"?

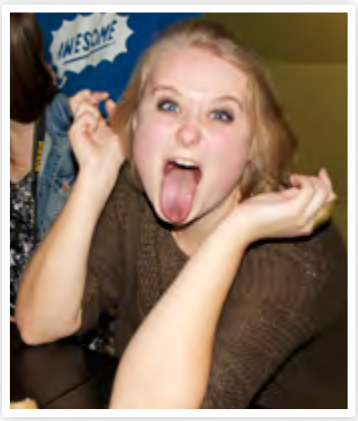
Doing the administration of the study tour is not that different from the administration of the STORES or my own company. It is easier, because the taxes are not involved. The administration of the STORES is checked by an accountant. For my own company and the study tour, that is not needed. I applied for the study tour, to see more of the world, to see more than only Europe. I am looking forward to visit the companies and to get to know the Japanese culture. It is another culture, but it is a well developed country. It will be interesting to experience this other culture. After the study tour itself I go on vacation for three weeks, to see other parts of Japan, together with Tim, Frank and Erik.



Communication dillemas

Author: Dieuwertje ten Berg

A while ago I attended a demonstration of a new communication tool. It was meant to make communication easier. The idea was that there are many ways to communicate these days, so many that a message could easily get lost somewhere. For example, most people have multiple e-mail addresses to which you can send stuff. And not only are there multiple ways to reach people, almost everybody has multiple ways of receiving the messages. Take for example my phone; it is, as so many people have these days, a smart phone. So it receives my e-mail, it has Whatsapp, Facebook, SMS, Googletalk, Instagram, Twitter and it's also able to make phone calls. Not bad for a phone, right? But that is only my phone, my laptop has probably even more ways for me to reach the outside world.



So there are not only different ways to communicate, but also different ways to receive these messages. So there are two ways were it can go wrong. But for some reason I don't think that adding another communication method is the way to solve the problem.
But the demonstration wasn't totally useless, because it did give me a few things to think about. How can I handle all the different communication canals in an efficient way? Is it necessary to be reachable at any moment? Is it a problem if people cannot reach me? What is an efficient way to deal with e-mail and a cell phone? Do I find it a problem if I cannot reach someone? Is it healthy to be reachable every single moment and can people expect you to always answer within an hour?
So communication causes quite a dilemma. At one side it is nice to know that people can reach you, and that you can reach someone when it is necessary and to get a quick response. But on the other side, it can be really nice to be unreachable at a certain time. The moment that my cell phone and laptop are turned off, I can truly relax. But nowadays it is more and more important to be reachable at all times. But how can you truly have free time when there is always the possibility that you get an important phone call or e-mail? I like to communicate, but sometimes nothing is more relaxing then knowing that nobody can reach you.

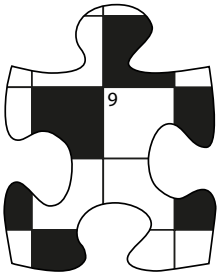
> "I like to communicate, but sometimes nothing is more relaxing then knowing that nobody can reach you. "

I know a few people who do not work in the weekends. When they have a project the first thing they say is that they do not work in the weekends. I used to find this weird, but I started working like that and it's really relaxing. I don't have to think or worry about anything in the weekend. It's also a stimulant to work on Friday. Because I can't say that I will do it tomorrow and some things can't wait until Monday. Conclusion: I'm actually free in my free time!
So no, I'm not always reachable. Taking time to relax is important. But this doesn't answer how to handle all kinds of communication. Well, I try to keep things were they belong. I send my student mail to my personal mail which I receive on my cellphone. But I don't receive my board mail on my phone; I like to keep that separated. This way I try to keep everything where it belongs and it should not get lost.
But if you ever have the idea I didn't read something or I don't react, you can always come and ask. Because nothing is as personal as face to face communication. But when it's in my free time, I might force you to drink a cup of tea with me first ;p

Puuzle

Author: Truusje

The year flies by, as already two quarters have passed. Besides all the studying, it is also very important to relax. And what better way to do this than with a nice puzzle?



The puzzle for this edition of the Vonk is a hexadoku. A hexadoku is a lot like a sudoku, but instead of nine possible entries, there are sixteen: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E and F.

If you want to have a chance to win a pie, please send your solution to me via e-mail (truusje@scintilla.utwente.nl) or deposit it with your name in the mailbox of the Vonk in the SK.

Also, there is still no winner for the puzzle from the previous edition of the Vonk. This means you can still solve this puzzle and send in your solution (even if you've only solved it partially). Good luck and have fun!

			9	1											
		3	B					A	5	1	F				
	C	1					B	6	D	9	E	2			
7	E					F	8	0	B	4	3	A	9		
8	0					D	A				6	E	5	9	
9	3				5	4						B	0	2	F
E	2				F	6		5	9				4	D	1
5	1				9	7	2	4	0					8	3
2	A					3	0	B	C	D				5	8
C	5	7				B	D		A	0				4	6
4	9	8	E						6	7				3	0
	B	0	D	7				2	1					F	A
		A	C	3	0	E	7	D	F					B	9
			5	A	B	1	F	C					8	7	
				2	4	8	6					5	1		
											1	0			



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