issue #5

UNIVERSITY OF TWENTE.

U-TODAY

Science & Technology Magazine

Saviors or *slaughterbots?*

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Poison-green

Just before this fifth edition of the Science & Technology Magazine went to print, the U-Today team had a special meeting. We asked professors from various departments of the UT and our rector Thom Palstra to jointly evaluate the first four magazines. All of this under the weighty name 'Scientific Advisory Board'.
In the end, it wasn't that weighty. Of course, there were renowned professors at the table, but they were all equally impressed by the recently pumped-up meeting room in the board wing, as was the rector and the author of this text herself. Every one of us stood still in front of the UT logo proudly displayed on the wall in bright white letters on a poison-green background. What particularly fascinated us was the green stuff adorning the letters. Was it moss? Grass? Or was it the plastic stuff used for toy railways?
The rector finally gave us an answer: real moss. How did it remain so green? Because of the humidity. Surprise all around. All around the huge conference table with luxurious leather armchairs on wheels. It probably cost quite a lot, sounded throughout the room.
Critical, that's what they were for sure. Especially about this magazine. We could spice it up a bit here and there. Keep on asking the researchers portrayed in the magazine more follow-up questions. They also expressed the desire for us to write more about the person behind the scientist. 'Because that's what is fascinating.'
Lastly, there were also questions about the distribution of this magazine. Why is it still limited to the campus? Well, a healthy eye for expansion is not strange to us. Behind the scenes we are working hard to make sure that copies of this magazine also find their way to doormats outside the UT. Just so you know.

Maaike Platvoet

Editor-in-chief at U-Today

u today

Colophon

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This magazine is climate neutral.

U-TODAY

Science & Technology Magazine

Content

Text: **Rense Kuipers**
Photos: **Shutterstock**

Drones: saviors or slaughterbots?

Will we be the last generation that can see a totally clear sky? A sky that isn't filled with flying, buzzing, blinking, surveilling and even rocket-launching drones? Let's explore the intricate spectrum of good and bad; of drones being the saviors we want them to be, or the slaughterbots we fear them to become.

Imagine yourself lying in your backyard, catching the last sunrays of this summer. Hearing a buzzing sound overhead. Probably those damn neighbor kids again, playing with their latest toy. Or is it the package you ordered just two hours ago? No, you know for a fact that a buzz of a delivery drone would sound way deeper than this one... Ah well, powering up the geofence with a push of a button kind of gives the same satisfaction as swatting a pesky mosquito. Let the kids have their fun somewhere else.

Playing God

Although this might just seem like some sort of futuristic scenario, Advanced Robotics Professor Stefano Stramigioli sees a huge potential in drone technology. 'Enormous developments in robotics, IT and electronics have already taken place. We now have long-lasting batteries, advanced GPS sensors, small and precise time of flight sensors, event cameras, inertial measurement units make sure the altitude, velocity and position of a drone are more precise than ever,' Stramigioli explains. 'A lot of the constraints that were there a few years ago are already gone. Which means we have even more space to be creative. As I like to say: the sky is not the limit, it's only the first layer.'
According to Stramigioli, drones are the integration of all disciplines – both technical and scientific. 'Science is the beauty of what humans are capable of. As a scientist, you can create things that weren't there before. First by abstracting, using the fundamentals from mathematics. After that, you start tinkering, being creative. Essentially, that's what engineering and robotics really do: bridging gaps. Robotics is the science of integration. And the complexity and scientific value of system analysis, design and integration, is far too often unjustifiably underestimated. You discover, you can be creative. In a sense, it's like playing God.'
That's what Stramigioli loves to do with drone

'I believe drones can find their place in our society'

technology and all other robots. 'Not necessarily on the visual inspection side of things, there are a lot of academics doing that already. My research group specifically focuses on physical interaction: having drones that can touch, measure, inspect and repair.' The professor names the inspection of windmills as an example. 'Nowadays, people have to climb a windmill to make sure it works properly. A drone can do the same task, safer and cheaper. The same principle applies to inspecting bridges and other infrastructure. So it's not hard to see that the technology potentially has a huge economic value.'

Principles and practice collide

Even though physical laws don't seem to apply to drones, there are laws that are withholding them from being part of our street view already. Michiel Heldeweg, professor of Law, Governance & Technology has an explanation for that. 'The first response from the government when drone technology emerged was very defensive,' he says. 'How dangerous are drones for air traffic, for instance? And soon after, more objections were raised: who is accountable when a drone runs out of battery and falls on someone's head? And then there's the privacy aspect: can we allow people to peek at their entire neighborhood from the air?'

And so, Heldeweg explains, a consensus started to grow. 'Yes, you are allowed to fly a drone, but only up to a certain height and far removed from civilization. But if you look at YouTube videos of people flying drones, you can say in almost every: this wasn't actually allowed by law,' says Heldeweg. 'Ironically, in reality principles and practice collide. You can buy advanced drones at electronics stores for a few hundred euros, but the only places where you are actually allowed to fly them are usually far away meadows.'

Geofences

But Heldeweg thinks legislation is at a tipping point. 'Everyone sees drones do have potential to be positively applied in all sorts of fields. From safety and surveillance to agriculture and healthcare. It can be possible for drones to get a defibrillator to a patient quickly. The same goes for emergency organ donation. But these possible applications can't be researched because of restrictive regulation.' Heldeweg says the European Aviation Safety Agency (EASA) also came to that conclusion and recommended EU politicians to literally offer space to experiment. 'It looks like specific zones will be designated as test zones. Parties that make use of an area like that, such as researchers and developing companies, will claim responsibility for that environment.'
Moreover, the Professor of the BMS faculty says there is an ongoing parallel process of designing responsibly. 'Meaning the design of both hardware and software of a drone can be techno regulated. Think of integrating geofencing into the drone software, so it automatically can't come near airports and hospitals for instance.'
Stramigioli adds to Heldewegs remarks that the technical possibilities like geofencing are indeed there. 'But legislation is more of hindrance than a set of useful guidelines,' he says. 'This technology can literally save lives. That's why I'm upset with politicians, who lack an engineer mindset and fail to see that there is an abundance of technological solutions, even for problems the technology itself didn't create.'

Constant loop

Aviation expert and chairman of the Platform Unmanned Cargo Aircraft, Hans Heerkens, knows like no other that 'drones' come in all sorts and sizes. 'Cargo drones can be as big as commercial airliners. They're from a whole different order and they serve a completely different function than your everyday toy store drones. So what if you make exceptions in legislation that make it possible to experiment with drones that have a specific goal or function?'
Heerkens believes that cargo drones can do for goods what the internet did to information. That everyone – even in remote areas – has easier access to the goods they need. But that would mean democratization of the airspace. 'Which has its own difficulties: unmanned vehicles getting in the same space as manned vehicles. And by law, a pilot is responsible for the so-called separation with other aircraft. So there have to be agreements made on the liability in the case of accidents with unmanned vehicles. There are going to be accidents, the same as with regular planes colliding. Even though I strongly believe unmanned aircraft can be safer than equal manned aircraft. The question is what kind of accidents will happen and how we act on it.'
It shouldn't be that difficult liability-wise, says the Assistant Professor. 'Looking at regular air traffic, a pilot is responsible for the safety of a plane. But you can't expect a pilot to inspect the entire plane from head to toe. In practice, he just signs a form saying the airplane is okay. But with unmanned aircraft, it's a constant loop

of constructors, flight companies and governments looking at each other to take action. Everyone is thinking defensively. Governments aren't looking at policy and why this technology is beneficial for us. Instead, they are looking at rules and singling out aspects like safety and privacy.'

High hopes and growing pains

Both Heerkens and Heldeweg think standardization of legislation can go a long way in helping drones develop. 'Now the technology is getting better and better, national drone laws are becoming obsolete. Europe can play a role in drawing a line everyone can agree on, while at the same time offering enough room for experimenting,' Heldeweg states. He has high hopes for the combination of pinpointing test locations and a form of experimental legislation. 'You can ease the step from high-risk experimental locations to low risk applications in society. In theory, you can get the best of both worlds: still being better safe than sorry, but also keep on developing the technology that is going to be there anyway.'

ITC researcher Norman Kerle agrees that both the development of the technology is not stopping and that legislation is lagging behind. 'That's inherent to a technology that has seemingly sprung up overnight. All of a sudden, it has become a reality and we can see the growing pains developing right before our eyes. Now, the technology itself enables both the good and the bad. For me, it's a completely positive game changer for the research field that I'm working in.'

For Kerle, drones mean that he can do remote sensing in a completely different way than was possible before. Which is especially helpful in the managing of major (natural) disasters, he explains. 'In the case of the Haiti earthquake, we made use of satellite images. But those don't completely cut it, since you can only view from above and from a huge distance. Drones, in terms of technology, fill in a huge gap for us. They allow us to zoom in on hotspots and provide much needed multi-directional information, for example allowing detailed 3D modelling of affected buildings, from which we extract damage indicators such as holes, cracks or structural deformation. And with a thermal camera attached to a drone, you can even see fires or other heat anomalies within damaged buildings that may pose a hazard to first responders. Outside closed buildings the thermal data can also help locate survivors scattered by events such as tsunamis.'

Endless war

As Kerle states, drones have an enormous potential to do good if it comes to saving lives. But a fellow UT researcher, technology philosopher Nolen Gertz, sees that the technology has potential to enable the bad. 'My main worries are that war has become much easier with the use of drone technology,' he says. 'It's lowering the threshold and thereby democratizing warfare. Which means we're starting to create an endless war. Boots on the ground are being replaced by eyes in the sky.'

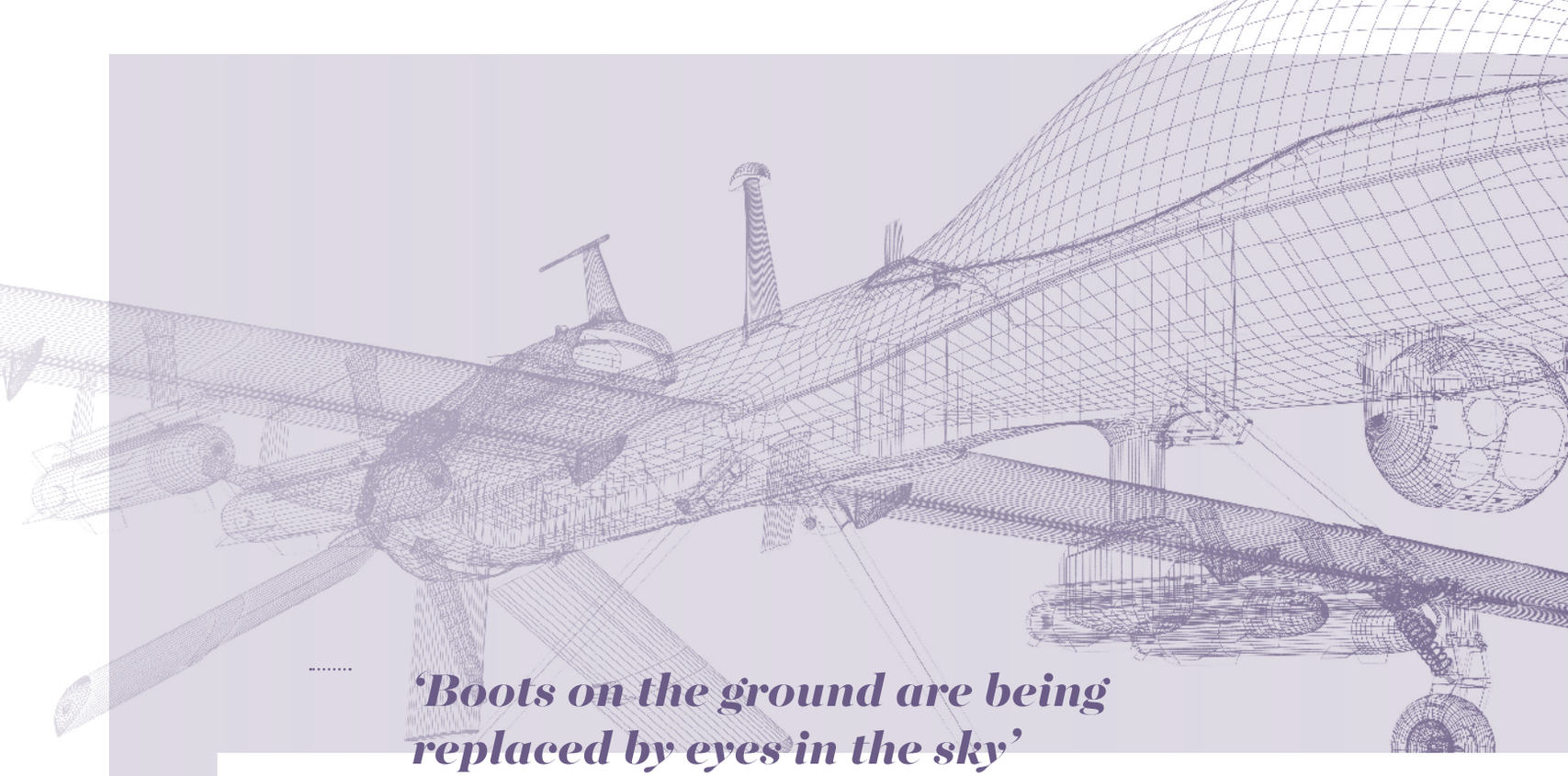
But having unmanned aerial vehicles in the air, doesn't mean there isn't a human side to armed conflicts anymore. Gertz paints a somber picture from the side of drone operators. 'Because you were good at playing video games, you were recruited by the army. At a mall possibly. And everyday life is nothing more than getting out of bed, doing your morning routine and getting behind a screen to operate the drone. Which essentially means getting up close to someone for a very long time, or racking up tens or even hundreds of kills.'

'The sky is not the limit, it's only the first layer'

Cubicle warriors

'What does this do to a human being?,' is the main question for Gertz, who states there is an important difference between the relationships surveillance technology and rocket technology create. 'With surveillance drones, it's possible to follow someone for more than a month. So you see someone's routine, every hour of every day. It's a kind of humanizing/dehumanizing paradox. You're getting up close and personal, while still sitting safely behind a screen at the other end of the world. It creates a form of intimacy that has never been there before on a battlefield. There are dehumanizing aspects like looking down on someone from above, seeing them as white dots. But once the kill order's been given, you don't leave the battlefield. You see the heat drain from someone's body after a rocket strike. And that person is someone you've been very close to for the last thirty days.'

Actually firing the rocket is also not free of contradictions, Gertz states. 'The military is doing everything to make drone operators feel like actual soldiers. So you wear a flight jacket, the clock displays the Bagdad time zone and there are cameras on the tips of rockets, so you see what you're hitting. Strengthening that is the human-technology relationship called embodiment. Which means drones essentially are an extension of the body. And embodiment makes you feel powerful, the same as firing a gun. It's a kind of power that is being revealed by the use of this technology, instead of being withheld.'



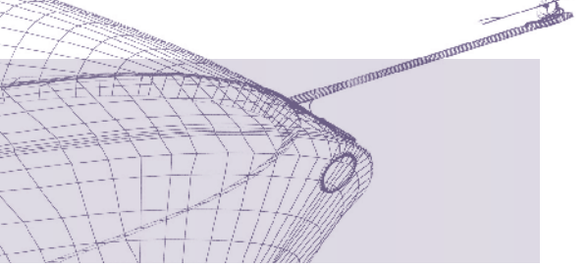
'Boots on the ground are being replaced by eyes in the sky'

Gertz states that drones shape the way we see the world and the way we act in the world. And that this shaping of experience is something that is ignored when we treat drones as tools that can be used for either good or for bad. 'Just like with guns, the issue can't properly be understood if we only think in terms of "good guy with a gun" versus "bad guy with a gun", as guns and drones, like any technology, mediate our relationship to the world in ways that promote certain aspects of experience while hiding other aspects,' he explains. 'Embodiment relations mean that we focus on what the technology lets us do, but we lose sight of the fact that we can only do what we're doing because of the technology.'

And there is a cruel sort of irony when it comes to drone operators and their embodiment relationship. While usually killing hundreds more people than soldiers on the ground, drone operators are seen as cubicle warriors by fellow military personnel. At the same time, Gertz worries that the rate of posttraumatic stress disorder amongst drone operators is relatively higher than with regular soldiers. That's one of the reasons why he thinks we should say a harsh no to drone technology. 'With any kind of technology, we just put it out there in the field. Humans are beta testers and the world is our lab to find out what the effects are. Never is there anyone who says: "we shouldn't do it, period." It's all about how we can fix it, after we've put it in the market. Move fast, break something. And profit, of course.'

Scary potential

Gertz knows he kind of stands alone in his views. Which is backed up by the other UT scientists. Like Hans Heerkens, saying that cars are in fact also potential everyday murder weapons, but they are seldom used that way in the real world. And Norman Kerle acknowledging that development is taking place anyway. 'Yes, we do need regulation. So why not have a parallel process of letting the technology develop in a safe way?' On the other hand, Kerle does see scary potential in the technology, to some extent. 'Since anyone can buy a drone in an electronics store, it does have a destructive potential for people that are keen on misusing the technology. So I do see abuse on an individual level happening in the future. Maybe even someone flying a drone strapped with explosives into a stadium, that's a somewhat realistic scenario. But naming drones slaughterbots is a step too far,' the ITC researcher states. 'If you look at the strides academics are making, you can always find a wrong. The same thing can be said about economics, turning people into greedy investors. And even medical technology can be misused.' Stramigioli agrees with Kerle. 'The technology offers so many possibilities, but it also creates potential doomsday scenarios. If we concentrate on the positive impact the technology can have and if we create policies to prevent said doomsday scenarios, I believe drones can find their place in our society. And as academics, we have an important role to play in making sure the technology will be used for the right causes.'



The last generation?

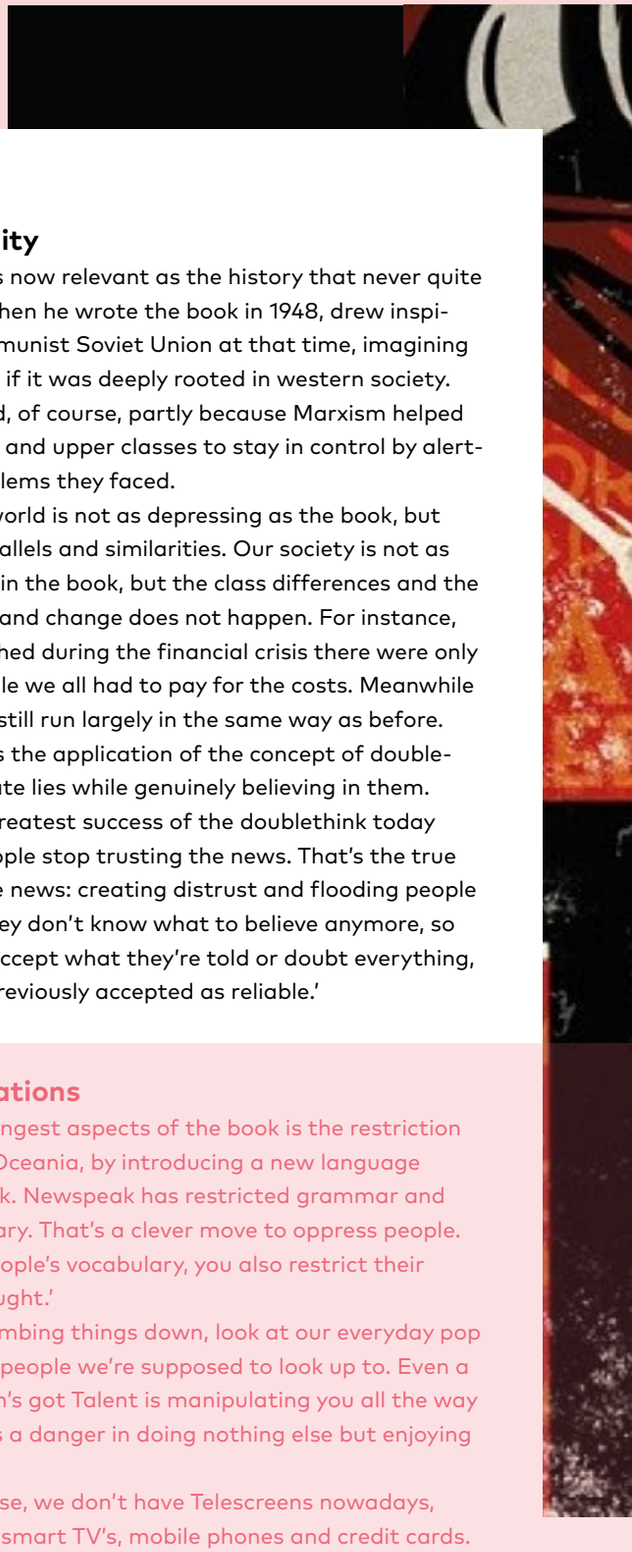
But if drones do find their place in society, will our fear of the technology gnawing away at our privacy also go away? Heerkens thinks that in a paradoxical kind of way, we as a society bring it on ourselves. 'We're in a cultural shift towards a 24/7 economy. Which means we want supermarkets and shops to be open later and we want the stuff we ordered online to be delivered the same day. It all has to do with the expectations we create ourselves, supply and demand. And drone technology fits right into the picture of "because we can, we apparently must do it".' Kerle adds that the privacy issues drones bring into our world are 'just another shade of gray'. 'Compare it to putting up curtains if you think people are looking through your window. Our society is accustomed to curtains and outlawing drones isn't a solution. Having the technology in the world can help to provide legislation.' Heerkens agrees: 'It'll mean the democratization of our airspace. It might well be that we're the last generation that ever sees a completely clear sky.' ●

Experts who contributed to the article:

STEFANO STRAMIGIOLI	Professor of Advanced Robotics, EEMCS Faculty
NOLEN GERTZ	Assistant Professor of Applied Philosophy, BMS Faculty
NORMAN KERLE	Adjunct Professor of Remote Sensing and Disaster Risk Management, ITC Faculty
MICHIEL HELDEWEG	Professor of Law, Governance & Technology, BMS Faculty
HANS HEERKENS	Assistant Professor and Chairman of the Platform Unmanned Cargo Aircraft, BMS Faculty

POP CULTURE

We binge-watch one Netflix series after another, we devour movies and games. Often it is no more than mindless entertainment, while at other times it even raises scientific questions. Pop culture, viewed through the eyes of a scientist.



This time, Kevin Macnish, Assistant Professor in Ethics and IT, shares his views on the book 1984 by George Orwell. Beware, if you haven't read the book: spoiler alert!

The plot

Big Brother is watching you. In a dystopian and totalitarian society, set in the year 1984, the so-called 'Party' controls everything in one of the three super-states the world has: Oceania. Under the ideology of 'IngSoc' (English Socialism) and the mysterious leader Big Brother, the Party makes sure anyone who even thinks of opposing its regime disappears. To monitor people, this ruling class has everyone under constant surveillance, through so-called Telescreens placed in people's homes, microphones, informers and the Thought Police.
The Party also controls the life of protagonist Winston Smith, who is a member of the middle class 'Outer Party' and a low-ranked employee at the Ministry of Truth. His job is to revise old newspaper editions to match the current 'truth' in the world. But Winston secretly opposes the Party's rule and dreams of rebelling. Those feelings get even stronger when he falls in love with Julia, who also loathes the regime. But they both know their affair won't have a happy ending...

First impression

Macnish: 'I first read the book when I was twelve years old. That was during the Cold War, when I was living in West Berlin. Ironically, that was in the year 1984, when the book also rose in popularity. I picked it up, read it and loved it. I still love it on the third reading. You have to put it down for about an hour when you are done reading and contemplate it: that's the power of this book. And it really shaped me as a person and how I view society. 1984 had a clear influence on me wanting to become a philosopher.'

Realism/feasibility

'In a way, this book is now relevant as the history that never quite happened. Orwell, when he wrote the book in 1948, drew inspiration from the communist Soviet Union at that time, imagining what it would be like if it was deeply rooted in western society. That never happened, of course, partly because Marxism helped empower the middle and upper classes to stay in control by alerting them to the problems they faced.
Thankfully, the real world is not as depressing as the book, but there are tons of parallels and similarities. Our society is not as stratified as the one in the book, but the class differences and the layers are still there, and change does not happen. For instance, when the banks crashed during the financial crisis there were only some minor riots while we all had to pay for the costs. Meanwhile the banks today are still run largely in the same way as before.
One similarity I see is the application of the concept of doublethink: telling deliberate lies while genuinely believing in them. My fear is that the greatest success of the doublethink today is yet to come as people stop trusting the news. That's the true masterstroke of fake news: creating distrust and flooding people with information. They don't know what to believe anymore, so they have to either accept what they're told or doubt everything, even news sources previously accepted as reliable.'

Stray observations

- 'One of the strongest aspects of the book is the restriction of language in Oceania, by introducing a new language called Newspeak. Newspeak has restricted grammar and limited vocabulary. That's a clever move to oppress people. If you reduce people's vocabulary, you also restrict their freedom of thought.'
- 'Speaking of dumbing things down, look at our everyday pop culture and the people we're supposed to look up to. Even a show like Britain's got Talent is manipulating you all the way through. There's a danger in doing nothing else but enjoying stuff like that.'
- 'Surveillance-wise, we don't have Telescreens nowadays, but we do have smart TV's, mobile phones and credit cards. So how are we not under constant wearable surveillance, mainly by big corporations? We have to deal with a kind of liquid surveillance that Orwell couldn't even imagine seventy years ago.'

Text: **Rense Kuipers**

Cover of the book '1984'.

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Everyday Science

How design affects your coffee

Do you ever take the time in your busy life to wonder about everyday phenomena? Things that are obvious to us, or perhaps just make for a handy trick? Nevertheless, there is always a scientific explanation for such phenomena. In Everyday Science a UT researcher sheds light on an everyday topic.

Text: **Michaela Nesvarova** Photo: **Shutterstock**

You might think that the taste of coffee depends entirely on the quality of the coffee beans. Think again. The beverage's taste seems to depend on a large number of things: the material, shape and texture of your cup, the looks of the package with the coffee beans... In fact, design appears to have an effect on the taste of whatever you drink or eat.

Let's start with the package that the coffee (or any other edible product) comes in.

'We've recently conducted a study in a café on the campus to show the impact of graphic design,' says Thomas van Rompay from the UT's Department of Communication Science. 'We tested two very similar designs: one with vertical stripes and one with horizontal stripes.' While drinking exactly the same coffee, people had different experiences – caused by the design. Vertical stripes inspired stronger and more intense taste and higher quality perception. 'Vertical stripes are generally associated with luxury,' clarifies the researcher.

'It's not a coincidence that Nespresso, for example, has a vertical layout of their stores and coffee dispensers.'

'It's also no coincidence that McDonald's changed the colour of their logo from red to green,' Van Rompay explains the significance of colours and their effect on our taste buds. 'We connect low arousal colours, such as green or blue, with healthy variants, while high arousal colours – the attention grabbing colours - like red or yellow are associated with unhealthy variants.'

Those are examples of how what we see influences what we taste. We have other senses than our sight, though. What we 'feel' is important as well. UT study proved that the surface texture of your cup or other tableware affects the taste of your food or drinks. For instance, smooth texture enhances sweetness, while a sharp surface intensifies bitterness. 'Through experiments with coffee and hot chocolate, we found out that round textures make the drink taste sweeter and angular textures make it seem more bitter,' says Van Rompay. So if you are in a mood for some strong coffee, make sure to have a 'spikey' and angular cup filled with coffee that came from a pack with vertical stripes.

Foie gras

We had only just left when the driver asked me for the hotel's phone number. 'So they can tell me what route to take.' 'Here we go again,' I thought. Swerving and driving slowly, the man called the hotel while I urged him to mind the road. By the time he hung up, he still had no idea of where to go. 'Do you know how to get there?' 'Listen,' I told him, 'you are the driver. You are supposed to know the way.' After driving around aimlessly for a while longer, he pulled up next to a colleague. 'I have no idea. You'd better get in his cab.'

I was experiencing déja vu and after this latest in a long line of bad experiences with the American taxi industry, I had had enough and installed the app for the taxi service that has been banned in the Netherlands. It was a revelation: I was fascinated by the screen of my smartphone, where I watched the many taxis driving to and fro in the area and saw the car approach that the algorithm had selected for me. After just five minutes, it showed up. The car was clean, the driver observed the rules of the road and had a friendly attitude and I received a digital invoice instead of an empty piece of paper that you have to fill out yourself. I was impressed by this user-friendly technology that provided me with a means of transportation and the driver with an income.

As it turns out, I willingly participated in a form of slavery. That is the term used by Sangeet Paul Choudary, who is not an anticapitalistic activist but rather a consultant in the field of platform economics, in a recent interview. I was slightly shocked. When you search for the terms 'Uber' and 'slavery,' you will encounter one horrible story after another. They all boil down to the same: drivers are grossly underpaid and have no autonomy whatsoever, even though Uber views them as independent entrepreneurs. In reality, the drivers are merely links in an algorithmically controlled production process, of which only one step – the actual driving – cannot be automated yet. Until that becomes possible, the company has to make do with human drivers whose criticism occasionally forces it to update its algorithm. The drivers are a nuisance to the organisation, which is probably a major factor in the push for the development of autonomous vehicles.

Will I ever get in the car of another friendly driver who is oppressed by the algorithm, or will I choose the old-fashioned taxi and risk another unwanted adventure? I suspect that I will not be able to resist the temptation of the user-friendly high-tech service. It is the foie gras of the taxi industry: problematic but delicious.

Wiendelt Steenbergen
Professor of Biomedical Photonic Imaging

Text: **Michaela Nesvarova**
Photo: **Shutterstock**

Rubber in the spotlight

UT RESEARCHERS WORK ON RECYCLING OF TIRES

Even though you might not notice it, rubber is everywhere around us. As UT researcher Wilma Dierkes points out: 'No rubber, no transportation.' It's in car tires, it serves as a damping material for trains, it seals ships and airplanes. But it wears down. Every year, over one billion tires is discarded. What to do with all this material? Recycling sounds like a good answer.

Recycling of rubber comes with many challenges, though. Scientists from the Elastomer Technology & Engineering Group know that first hand, as it is one of the many rubber related issues they work on - together with partners in industry. 'Our research is based on real questions from industry. There isn't one of our projects that wouldn't involve a company,' stresses Dierkes, Associate Professor at the group, which falls under the department of Mechanics of Solids, Surfaces & Systems (ET Faculty). 'And many of them are tire companies, because it is tires where most of the world's rubber ends up. If you'd take all the globally disposed tires, you could make a chain around the world five to six times.'

'Tires is where most of the world's rubber ends up'

That wouldn't be possible, of course, and not only for logistical reasons. 'In Europe it's forbidden to just discard tires. They should be forwarded to the waste management, such as incineration, pyrolysis, rubber reclaiming, and reuse for civil engineering,' clarifies Dierkes. 'In the Netherlands, they are partly incinerated, and therefore used for energy. Some of the tires are ground and blended into asphalt for low-noise and durable roads or partly remixed into new rubber products to make, for example, protective fields and playgrounds for sports services.' Although the researcher admits that these ideas aren't 'too bad', they also aren't that efficient. 'We want to reuse the rubber for rubber products, ideally for tires again because that is the number one rubber product,' she says.

Devulcanization

This is where the problematic part begins. 'Passenger car tires are a post-consumer waste. They are aged, dirty,' begins Dierkes. 'Moreover, when tires are made the rubber is vulcanized – to get a fixed shape with desired elasticity and performance. The real challenge is to reverse this process, called 'devulcanization', and

to make a kind of chewing gum from it, therefore give a new life to the rubber raw material. And that is very difficult. To achieve it, you need to breakdown the network of polymer chains created during the vulcanization, but there are two types of links: carbon-carbon bonds of polymer molecules and sulfur-sulfur bonds which crosslink the polymer chains. We need to selectively break down the sulfur bonds, otherwise the polymer chains are cut into shorter molecules that ruin all of its properties. This requires a very delicate balance of the thermo-mechanical and chemical input. It's a lot of work.'

A lot of work it might be, but it has paid off. UT researchers have succeeded and made the most important step towards recycling of tires. 'Yes, we achieved devulcanization on a small scale,' confirms Dierkes. 'Now we need to scale it up. We are helping to set up a large plant for devulcanization. But we can't share any details just yet, it's a confidential project.'

Natural rubber

That would be one challenge overcome, but there are many more in the world of rubber. Figuring out the differences between natural rubber and synthetic rubber, for one. 'Natural rubber, which we get from trees, is still the best rubber we have. It has unique mechanical and elastic properties,' says Wisut Kaewsakul, researcher from the Elastomer Technology & Engineering Group. 'We can't reproduce natural rubber in a lab. If someone manages that, it will bring them a Nobel Prize.'

The latex harvested from the natural rubber tree consists of a small constitute of non-rubber, including protein, peptides, fatty acids, etc. This makes natural rubber unique and inimitable. Creating natural rubber would indeed be a big step, as it currently represents half of the rubber used worldwide. Heavy duty tires, for example for trucks and earthmovers, are mainly made of natural rubber. However, rubber products cannot be fabricated using only natural rubber. The first reason is that there is an over-demand of rubber products compared to the annual quantity of natural production. Secondly, some special requirements in terms of properties for certain applications cannot be fulfilled by natural rubber. Therefore, synthetic rubbers with their wide range of property specifications come into play. Nevertheless, as Wilma Dierkes adds: 'Nature is still better than us.' ●

Fighting against resilient bacteria

COMMUNICATION TECHNOLOGY TO PREVENT ANTIBIOTIC RESISTANCE

Pathogens that are resistant to antibiotics are a growing problem. Professor Lisette van Gemert is in charge of several research projects designed to help turn the tide. 'Poor communication leads to some unfortunate blunders.'

Text: **Enith Vlooswijk**
Photos: **Gijs van Ouwerkerk & Shutterstock**

Anyone reading these words might be unknowingly infected with Methicillin-Resistant Staphylococcus Aureus (MRSA), also known as the 'hospital bacteria'. This single-celled organism can cause skin infection, septicaemia and pneumonia, among other things. Anyone affected by these symptoms is in quite a bit of trouble as virtually all antibiotics are ineffective. The improper use of antibiotics – too many unnecessary treatments or the wrong kind of prescription – has made the bacteria resistant.

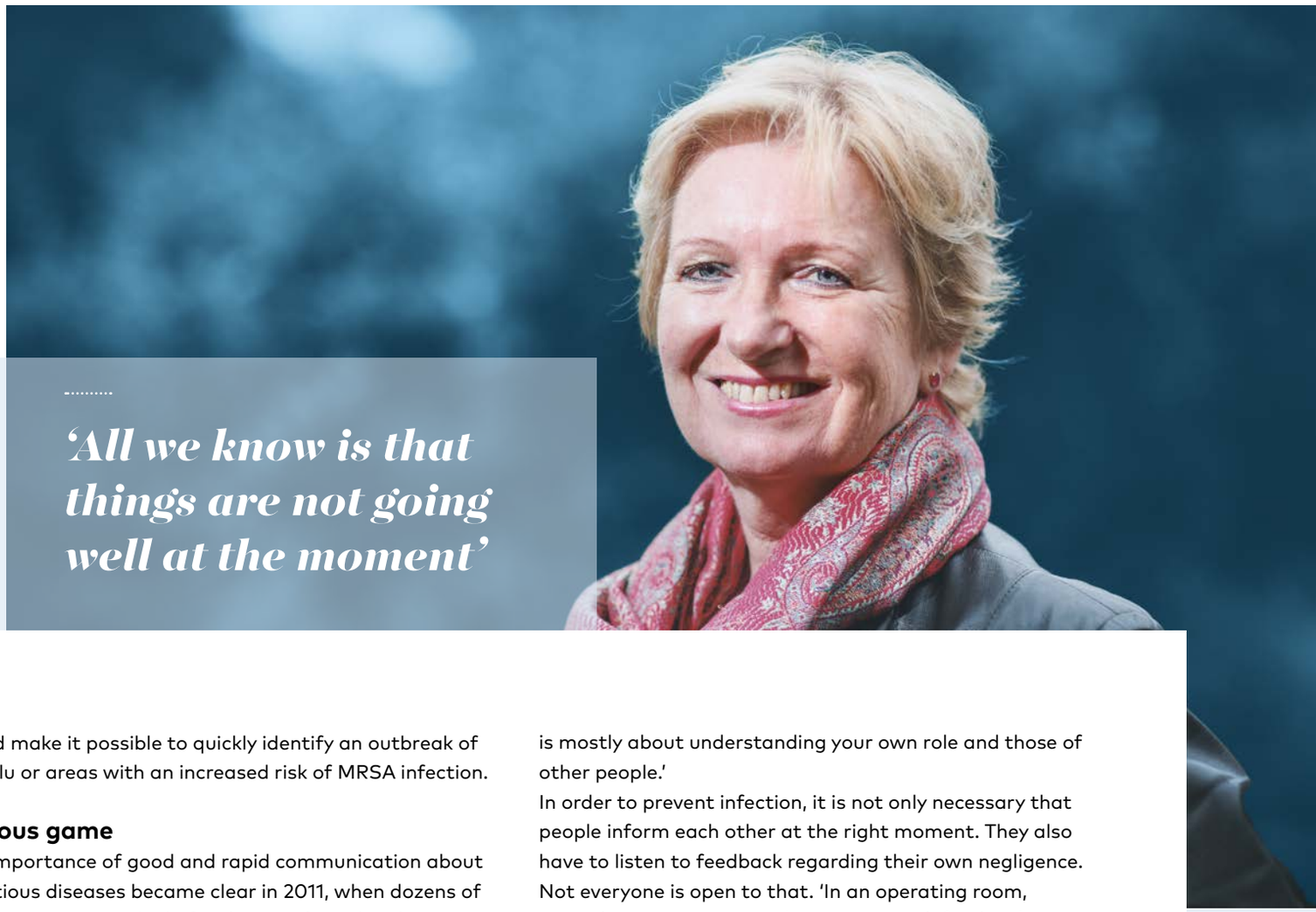
The European Commission is so concerned about the resistance of this and other pathogens that it has invested six million euros in a cluster of research projects known as EUR Health-1Health. The goal of these projects is to prevent infections with resistant bacteria. Lisette van Gemert, professor of Persuasive Health Technology at the UT, is involved in two of the projects with a combined research budget of €1.5 million. She collaborates with a number of Dutch and German healthcare and knowledge institutes, as well as dozens of businesses operating in the Dutch-German border region.

'In the border regions of the Netherlands, people move across the border: staff in Dutch hospitals often live in Germany and vice versa,' Van Gemert explains. 'This region is also home to many livestock farmers.' That leads to certain risks: because antibiotics have been preventively administered to animals for many years, the RIVM believes that 70-90% of all pig and veal calf farms are now infected with MRSA. Around a third of the people who come into close contact with these animals carry the bacteria themselves. 'On top of that, our population is aging and a relatively large number of people suffer from heart disease, diabetes or COPD,' Van Gemert adds. 'That makes the population more vulnerable to infection.' When you combine these three factors, it becomes clear why appropriate risk-reducing measures have to be taken here of all places.

Infection barometer

Healthy people often do not realise that they are carrying the hospital bacteria. For anyone vulnerable to infection, however, it is important to avoid any direct contact with infected individuals. That can be difficult, especially in hospitals. One of the researchers from Twente therefore focuses on the development of a model with which to visualise the risk of infection in hospitals. 'It is impossible to prevent all infections, but we can avoid a large-scale outbreak,' Van Gemert says. 'A doctoral candidate will therefore collect a wide range of data: what conditions do people suffer from, when were they hospitalised, where are they located? Hospital beds and staff can be equipped with sensors that let us track their movements throughout the hospital and between patients. All this combines into a large volume of data that we can use to develop a statistical model with which to predict the risk of infection.' The model should result in a real-time infection barometer for health care professionals. This lets them take risk-reducing measures, Van Gemert explains. 'If you know that the transport of certain beds may pose a risk, you might consider moving medical equipment to the patient, instead of the other way around.' Furthermore, researchers are developing a platform that allows knowledge institutes, health professionals and civilians to share information. 'It is like a crisis radar,' Van Gemert says. 'A network that parties can use to inform each other quickly, easily and reliably.' An app like that

'Healthy people often do not realise that they are carrying the hospital bacteria'



'All we know is that things are not going well at the moment'

would make it possible to quickly identify an outbreak of bird flu or areas with an increased risk of MRSA infection.

Serious game

The importance of good and rapid communication about infectious diseases became clear in 2011, when dozens of people in Germany died after being infected with a resistant foodborne EHEC bacteria. 'All of a sudden, people were calling for a ban on the export of cucumbers from the Netherlands to Germany, even though the cucumbers did not pose any risk at all. That was the result of poor communication.'

To avoid such situations in the future, healthcare professionals and other parties must communicate with each other properly and clearly. Because so many people are involved – surgeons, nurses, GPs, veterinarians, municipal health services – it is easy to overlook someone. The researchers are therefore developing a serious game for healthcare workers. Van Gemert: 'This is a game designed to support decision-making processes. We present various dilemmas to health professionals that motivate them to assume a certain role. Say, you are a GP, there has been an outbreak of bird flu in the area and a patient comes to you with strange respiratory complaints. What do you do and whom do you inform?' The game can be played by individuals on a computer screen, but it is also suitable for group training sessions. 'Evaluating the outbreaks that have occurred in recent years has taught us that poor communication leads to unfortunate blunders,' the professor says. 'Think of the unnecessary killing of livestock. We have to improve the communication between all parties and with the general public. That has little to do with knowledge; it is mostly about understanding your own role and those of other people.'

In order to prevent infection, it is not only necessary that people inform each other at the right moment. They also have to listen to feedback regarding their own negligence. Not everyone is open to that. 'In an operating room, extensive measures are taken to prevent infection: keep the patient's body temperature low, wear protective caps, masks and gloves, etcetera. However, people are sometimes hesitant to remind others of those measures. It is not easy for a nurse to tell a surgeon that their hair is not fully covered by their cap.'

The researchers want to change that with the help of virtual reality. They are developing a game scenario in which healthcare workers wear VR goggles that let them experience a situation from someone else's perspective. 'If an anaesthesiologist notices that a patient is losing too much blood and their heartrate is dropping, they have to give feedback to the surgeon during a tense situation,' Van Gemert explains. 'After experiencing such a role reversal, people might become more susceptible to feedback from others.'

It is not clear whether this approach is truly effective. 'All we know is that things are not going well at the moment,' Van Gemert says. 'People have to realise that they are responsible for preventing antibiotic resistance as a team. That is what the name 'One Health' stands for: we have to do this together. Hospital staff, veterinarians, GPs, municipal health services and the public have to work together to raise awareness of the proper use of antibiotics.' ●

David Fernández Rivas

Master of bubbles

Text: **Rense Kuipers**
Photo: **Gijs van Ouwerkerk**

Making something out of seemingly nothing definitely applies to our rising star, Assistant Professor David Fernández Rivas. From his Cuban roots to getting a PhD at the UT and starting up spin-offs in vastly different directions. For Fernández Rivas, it all began with the fundamental manipulation of bubbles, and he has never stopped to pursue a personal mission to immediately impact society with his research.

During his nuclear engineering studies at InSTEC (Havana), David Fernández Rivas got a glimpse of what academic and social life was like in Europe. In spite of the strict Cuban regime regulations, he managed to work part-time for the UT as a PhD candidate since 2007, and his thesis titled 'Taming Cavitation Bubbles' was published in 2012. Nowadays, as a tenure track Assistant Professor, it's still all about bubbles for Fernández Rivas.
Some colleagues call him a master of bubbles, since his research is based on the manipulation of bubbles in liquid, to the point that he has shown that it's possible to make them take on a square shape. He went even further and made them pop out from music instruments with ultrasound technology.
But that's just showing off the cool stuff. Fernández Rivas knows there are plenty of societally relevant applications in manipulating bubbles. In 2013 he co-founded the spin-off BuBclean. The company produces bags with a special pattern on the inside, that create more microbubbles when they're in an ultrasonic bath, thereby cleaning products like laboratory and medical equipment even better.
Since that venture has been going steady, the researcher looked into another way of using bubbles. So, he is creating another spin-off, InkBeams, in which Fernández Rivas and his team use the principle of thermocavitation to develop a needle-free injection method. 'By using a laser, we create a bubble within a fluid, and as the bubble grows, it pushes a small liquid drop that can be injected in the skin of people. This method has a lot of potential applications, like administering insulin or painkillers.'
The technology could also make Fernández Rivas a true Ink Master, since it could be used for tattooing. 'It has the potential to change a five thousand years old technology, by being less painful and more precise. We can use it to improve the lives of cancer patients, like tattooing nipples after a breast mastectomy.'
In the end, it's all about helping people and making an immediate impact for Fernández Rivas. 'I am not someone who wants to wait for twenty-five years before seeing my research being applied. My drive is to solve problems as soon as possible. There's nothing better than conducting exciting science that society truly benefits from.' ●

Our 'Rising Star' David Fernández Rivas:

2004 Suma cum laude diploma in nuclear engineering at InSTEC, Cuba

2012 PhD degree at MESA+ Institute, University of Twente.

2013 Founded the spin-off BuBclean

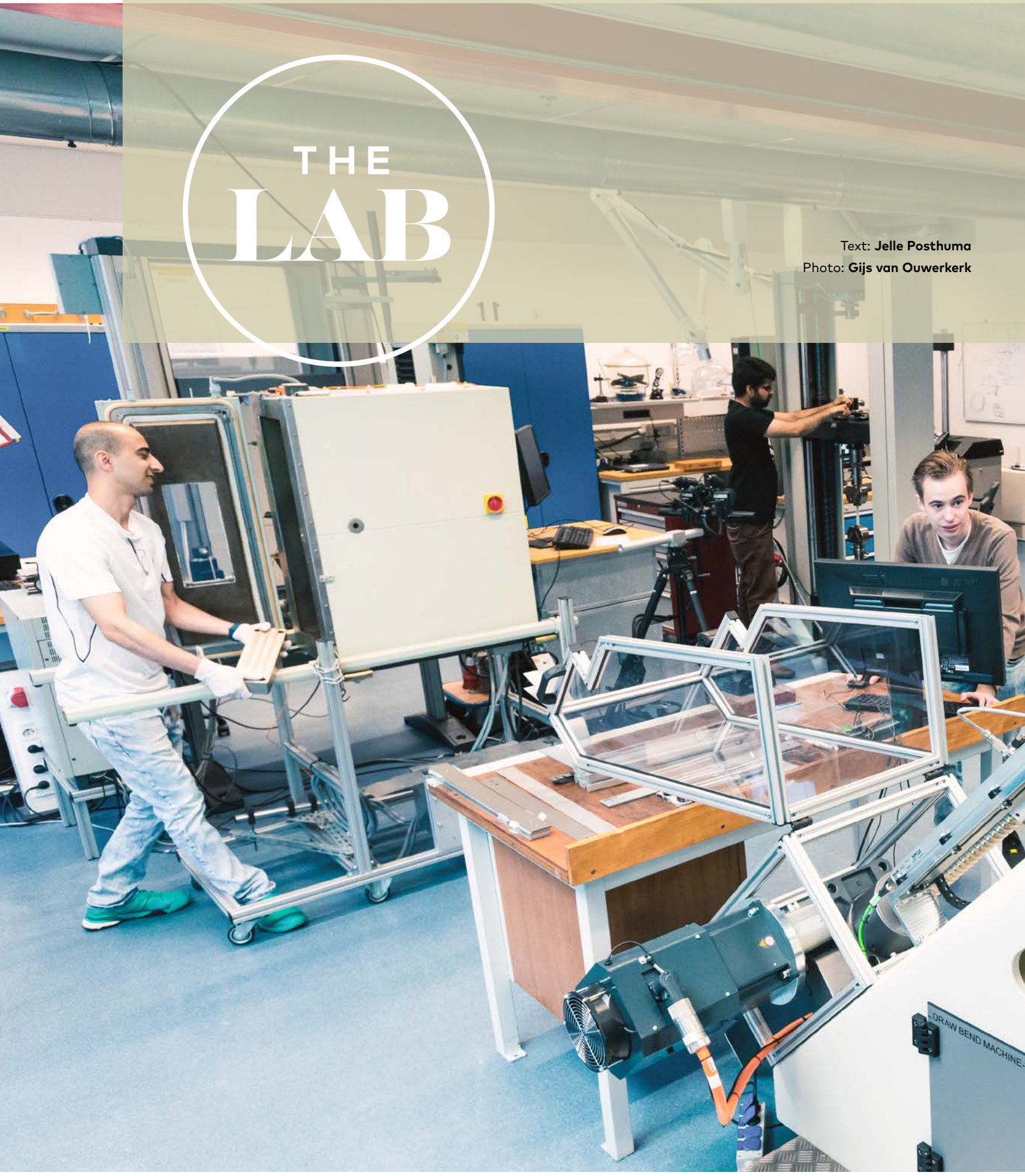
2014 Assistant Professor (Tenure Track) at the MESA+ Mesoscale Chemical Systems group

2016 Appointed Research Affiliate at MIT, Department of Mechanical Engineering

2017 Won the KIJK Magazine Best Tech Idea award for his other spin-off, InkBeams

THE LAB

Text: **Jelle Posthuma**
Photo: **Gijs van Ouwerkerk**



Mechanical Testing Laboratory

The Mechanical Testing Laboratory is not one lab with one owner, says its coordinator Ton van den Boogaard, professor of Mechanics. The lab consists of different spaces, used by seven different research groups. The participating groups work with different materials, such as rubber, plastics, metal, composite and biological materials. The people who work in the lab are mostly PhD students, often accompanied by the lab administrator. Occasionally, students come to do tests. They carry out tests to experience it first hand, to get the feeling. The lab on the photo is the largest room with the most important instruments, including universal testing machines (UTM's), which are used to test the tensile strength of materials.

These are tests for innovative production techniques, which are in line with the Advanced Manufacturing theme of the UT. Everything in the laboratory is industry-driven. The cars we use today consist of steel that did not exist ten years ago. This means that materials are in a process of constant development. In this lab researchers try to create Intelligent Systems, which predict problems and eliminate them during the process.

Text: **Michaela Nesvarova** Photo: **Rikkert Harink**

ALUMNA SONIA HEEMSTRA DE GROOT IS AN EXPERT ON 'ANYTHING WIRELESS'

From one challenge to another

Sonia Heemstra de Groot is always looking for a new challenge. 'The thought that tomorrow's work will be the same as today frightens me,' says this UT graduate who currently works as the Director of the Centre for Wireless Technology Eindhoven (CWTe).

Heemstra de Groot is in charge of a large number of (inter)national research projects. Still, she says: 'Sometimes I wish for something even more challenging.' Due to this desire, she has never got too comfortable in one position. She moved from academia to industry, later co-founded a company and then returned to science, becoming a full professor. Regardless the job title, however, Heemstra de Groot has never abandoned research, because: 'It gives you a lot of freedom to use your imagination. On the other hand,' she adds, 'industry gives you access to the latest knowledge and technology.' Which is also why, as the director of the CWTe, she is working hard to stimulate cooperation with industry.

From Argentina to Eindhoven

She's had quite an exciting career, but it is not necessarily how the professor envisioned her life going when she was younger. The daughter of a Dutch father and a Spanish mother grew up in Argentina. After she obtained her (first) master's degree in Electrical Engineering from Universidad Nacional de Mar del Plata, she swore she would never study for another master's or PhD. 'Back then I didn't really know what research was,' she says. 'It wasn't until working at the Philips International Institute that I realized research was very creative.'

You could say that her time at Philips in Eindhoven, where she came on a scholarship as one of a carefully selected group of students, was generally a big turning point. By pursuing the second MSc degree there, she got in touch with a lot of Dutch professors. One of them was professor Herrmann from the University of Twente, who eventually offered her a PhD position. 'I was in doubt, because the UT was very strongly Dutch back then,' says Heemstra de Groot. 'I didn't speak any Dutch and, as a foreigner, I was simply different from everybody else here, so it was a bit of a shock at first. But later I got integrated and started really enjoying the research. I stayed at the UT for quite a number of years and I consider Twente my home. I still live in Hengelo, after all.'

Chief Scientist

In 2003, Sonia Heemstra de Groot became the first UT researcher to receive the Marina van Damme Award, annually given to an alumna with the goal of furthering her career. This victory was thanks to the scientist's 'newest challenge' at the time. Together with two colleagues, she co-founded WMC (Twente Institute for Wireless and Mobile Communications), where she fulfilled the role of Chief Scientist. 'My job was basically to define ideas that are forward-thinking, but also sound enough to receive funding. And at the same time, I had to understand all the technical challenges that come with it.' She did that with some success. 'For example, we were part of a couple of projects worth 30 million euros in total. They were related to "personal networks", meaning a network that allows you to access all devices you own from wherever you are. Back then – ten years ago -, there was no cloud, so this idea was very innovative.'

Despite these and many other projects, the WMC closed

'I consider Twente my home'

SONIA HEEMSTRA DE GROOT

down a few years ago. Sonia Heemstra de Groot moved on to another challenge, and to another university, already before the Centre ceased to exist. In 2006, she quit the UT, where she still worked one day a week, to become a full professor at TU Delft and later on at TU/e Eindhoven. 'When Delft closed their Telecommunications department, Eindhoven offered me a position, because they thought it would be sad for the expertise to disappear from the Netherlands,' says the scientist, who specializes in wireless technology.

Ultrahigh data rate, ultralow power

On top of conducting her own research and 'regular professor's duties', she now runs the Centre for Wireless Technology (CWTe) at TU/e Eindhoven University of Technology. 'The Centre facilitates research on wireless technology. It involves most researchers from TU/e Eindhoven working in the field. We try to cover all aspects of wireless technology: from the physical layer to the network layer. We have about forty PhD candidates and annually receive roughly 3 million euros in funding on national and international projects,' specifies the CWTe Director. 'I create ways of cooperation with big and small companies and try to find funding. I also need to remain knowledgeable in all the research areas, otherwise I can't work on research proposals.'

The CWTe is active in several research areas. 'For example, we focus on ultrahigh data rate, such as 5G and what comes after. We aim to achieve data speeds of 1 terabit per second, which is roughly one thousand times faster than today's WiFi. We are also looking into ultralow power & Internet of Things (IoT). We are developing extremely small devices that take energy from the environment. Such tiny sensors are the building blocks of a truly implemented IoT, which would involve sensors practically everywhere – sensors that need to communicate with each other,' explains Heemstra de Groot. 'We also do research into Terahertz–based spectroscopy and radioastronomy – we are looking into a new generation of radio telescopes.'

The future is wireless

If it comes to the alumna's own research, she 'likes anything wireless' but is especially interested in radio access networks, indoor communication, a new version of WiFi or even car to car communication. 'Cars of the new generation are able to send out messages to their environment, communicate their position, for instance. But if many cars do that, the medium of communication becomes congested. We are therefore establishing a method that makes this communication reliable,' she explains. 'It could enable the cars to also communicate with traffic lights, decrease the number of accidents and increase the capacity of roads.'

The scientist believes that topics related to wireless technology will keep researchers busy for a very long time. 'There are many challenges, but we predict that ten years from now we will be able to support high data rates of several terabits per second. If you can communicate so fast, you could imagine applications such as extremely realistic images, perhaps holography or even projections that you can touch.'

'Just keep going'

With so many things to work on, what is it that keeps her motivated? 'I love the variety of my job. I like new challenges. Change gives me energy,' answers Sonia Heemstra de Groot. 'I come in contact with so many interesting ideas, companies, colleagues. Some of the young people I meet are incredibly creative. Every day I'm confronted with a sea of creativity.' Is there some advice the experienced researcher would give these youngsters? 'Just keep going. Be honest with yourself and go in the direction you want to go. Because if you have to work so hard, as we do in this field, you have to like what you do.' ●

'Every day I'm confronted with a sea of creativity'

Science is all about making choices. Some lines of research achieve great success, while others die unlamented deaths. Back to history delves deep into the archives looking for developments with historical relevance. This time we look into the creation of the deadliest weapon in mankind's history.

The destroyer of worlds

Text: **Rik Visschedijk**

16 July 1944. A line from the sacred Hindu text Bhagavad Gita flashes through the mind of physicist Robert Oppenheimer as he watches his creation, the very first atomic bomb, being detonated in the Jornada del Muerto desert. 'Now I am become death, the destroyer of worlds.' The intended goal of the atomic bomb is realised: Japan surrenders during the Second World War after the United States dropped two bombs, nicknamed 'Little Boy' and 'Fat Man,' on the cities of Hiroshima and Nagasaki.

The work Oppenheimer and his team were doing in Los Alamos, New Mexico, was a closely guarded secret.

They were engaged in a race against Hitler's Nazi Germany, where work on another atomic bomb had begun in 1939 as the Uranproject. After Albert Einstein warned of the nuclear threat that Germany posed, the United States rushed to establish its own nuclear programme: the Manhattan Project. It was believed that whoever was first to build an atomic bomb would win the war.

In that remote location near Santa Fe, the Los Alamos lab was erected in a rush. Oppenheimer brought the nation's most brilliant physicists together in the muddy barracks. Many of them would later receive the Nobel Prize, although Oppenheimer would not be one of them. In 1943, the facility was staffed by a few hundred employees; two years later, there were over six thousand.

After the war, Oppenheimer was celebrated as a hero and his picture appeared on the covers of Time and Life magazines. The scientist was undergoing a metamorphosis, however. He changed from the creator of the deadliest weapon in mankind's history to an outspoken pacifist. Just eleven days after the destruction of Hiroshima, he called on the American government to 'ban nuclear weapons.' As president of the General Advisory Committee of the Atomic Energy Commission, he advocated nuclear disarmament.

Oppenheimer never spoke much about his role as the 'father of the bomb.' He believed he had blood on his hands, but he did not feel guilty about what had happened in Nagasaki and Hiroshima; that was a 'necessity.' He mainly felt responsible for the arms race during the Cold War. He had hoped that nuclear technology would make life better for people everywhere in the form of atomic energy, instead of it becoming a constant threat to all life on Earth. ●

Growing miniature hearts in a petri dish

ROBERT PASSIER BOOSTS THE TREATMENT OF HEART DISEASES

Heart disease is still the number one cause of death in the western world. Robert Passier, Chair of the Department of Applied Stem Cell Technology, and his team study these diseases using heart cells growing in a petri dish. This year, he received a 675.000 euros ZonMW subsidy to further develop these in vitro systems. 'We aim to develop extremely realistic in vitro models by growing sophisticated miniature hearts that resemble mature heart cells.'

Text & photos: **Hans Wolkers**

'This is our newest batch of living heart muscle cells,' Robert Passier says, while holding a 15-centimeter wide plastic rectangular dish, containing six different wells. Each well holds a reddish fluid with dissolved nutrients, nourishing the heart cells. The heart tissue is visible as an opaque film on the bottom of the well. Under the microscope, the film reveals a spectacular picture: it consists of thousands of heart tissue cells, that are closely connected to each other. They even behave like a real heart and about every few seconds they contract harmoniously. Just a few weeks ago, these pulsating heart muscle cells were human stem cells.

'Since 2007 researchers are able to create so called pluripotent stem cells from human tissue, such as skin cells, blood cells or even cells from urine,' Passier says. 'These stem cells have the same properties as embryonic stem cells: in theory, they divide forever and can be grown into any tissue. In our case, we make them develop into heart muscle tissue.' Converting stem cells into heart muscle cells requires quite some knowledge about genes: the pattern of active and silent genes determines what tissue the cells will form. Passier and his team know which genes need to be switched on or off to transform stem cells into heart muscle cells. The scientists regulate this specific gene activity pattern using, for example, special proteins that modulate the activity of individual genes.

Enormous breakthrough

The novel stem cell technologies are an enormous breakthrough and continue to develop. However, one of the challenges the scientists face is the immaturity of the heart cells formed from stem cells: they resemble foetal rather than adult heart cells. Understanding how to promote the ripening of these foetal cells into mature heart tissue is important because the in vitro cultures used for research should be comparable to adult heart cells. Therefore, one of Passier's studies focuses on how different molecular markers, like DNA and RNA, change during the ripening from foetal to adult heart tissue cells. 'We expect to see patterns during the ripening process,' Passier says. 'For example in gene activity: which genes will be switched on or off during the conversion from foetal to adult heart cells?'

Fix the genetic defect

Besides heart cell ripening, Passier and his colleagues focus their stem cell research on learning as much as possible from heart diseases and their treatment. With developing technologies, they can now make stem cells from patient tissue, for example from patients suffering from cardiomyopathy. This is a life-threatening heart disease with a strong genetic component. Stem cells developed from tissues of these patients contain the same DNA defect causing the disease. They often reflect the disease characteristics in a reliable way. This allows scientists to study such hereditary heart diseases in vitro. Passier: 'But we can also imitate a disease in our cultured heart cells by mutating the stem cells, thereby mimicking the genetic defect, before we let them grow out into heart tissue.'

Testing heart medication also is an important research topic. For instance, checking the toxicity of newly developed drugs, or testing the effects of medication on heart cell functionality. 'It is possible to measure the electrical activity of

'We can imitate a disease in our cultured heart cells'

cultured heart tissue with heart rhythm disorders (comparable to an ECG in patients) and subsequently study the effectivity of new medication,' Passier explains. 'But we can also try to fix the genetic defect in cell cultures with a hereditary disease, using a state of the art technology like CRISPR-Cas. Afterwards, we can check the success of the procedure.' All these investigations can be performed using the patient's own tissue cells, that are converted into stem cells and subsequently transformed into heart tissue cells. Therefore, the experiments are highly reliable and mimic the real-life situation.

Perfect in vitro model

The efforts of Passier and his team to make in vitro cell cultures more and more realistic is gaining momentum due to the diverse expertise present in his team. Scientists from Twente, Nijmegen (Radboud University), Leiden (LUMC) and Amsterdam (AMC, VUMC) join forces to develop the close to perfect in vitro model by combining different disciplines in the fields of stem cell and molecular biology, heart development and disease, and tissue engineering. An important step towards almost life-like in vitro tissues is the development of so called organ on chip. Heart muscle cells can be grown in minute channels, milled out in a polymer material, for example. An artificial, miniature stream of medium supplies nutrients and oxygen to the cells. 'Using this technique we can study the cell processes live under a microscope,' Passier explains. 'We can see how the cell divides, if it survives or dies and how it functions.' To get a step closer to a real organ, different cell types can also be grown in the different channels, enabling scientists to study the interaction between different cell types, just like in an organ.

Real life situation

The development towards 3D tissue models is another important step towards real cultured organs. This is a huge and complex technological achievement, but it allows to study different cell types and their interaction, just as in a living human. 'Heart tissue has many different cell and tissue types, like atrium and ventricle muscle, pacemaker cells, blood vessel cells, and connective tissue,' Passier explains. 'We can make all these individual cells from stem cells and put them together. When conditions are right, they organize and interact with each other in a realistic life-like way.' An important advantage of this technology is that the use of experimental animals can be greatly reduced. However, scientists have to prove that the new in vitro models perform as well, or better, than in living animals. 'Using these 3D models, we hope to effectively and reliably study diseases, but also applications towards the regenerative medicine are possible,' Passier says. 'If we know how cells grow and interact with each other, we might be able to regenerate tissues and organs in the lab for transplantation in the patient in the future.' These scenarios are still far away, but the research is progressing fast. 'I'm really happy with this team. Due to our different expertise, we complement each other. The project is expanding like a snowball.' ●

'We hope to effectively and reliably study diseases'

Text: **Rense Kuipers** Photo: **Gijs van Ouwerkerk**

M

Master Research

Breathing life into the mining industry

'Bangka is my one, true motivation'

His Master's research started out with his love for the Indonesian island Bangka and its inhabitants. It led to ITC cum laude graduate Imam Purwadi (26) using remote sensing and bringing along forty kilos of samples. Thereby, finding possible ways to breathe life back into the mining industry and the local economy.

The Bangka economy relies heavily on the mining and production of tin, Purwadi knows. 'That has been the case for several hundreds of years. People make their living with it, but it looks like the tin deposits have almost completely run out. With tin mines shutting down over the years and no discovery of new deposits, things are looking bleak for the livelihood of the local community.'

Rare Earth Elements

But the Geological Remote Sensing graduate may have found a solution to breathe life back into the Bangka economy, in Rare Earth Elements (so-called REEs). 'Those elements were once considered unwanted and were discarded during mining, along with other tailings,' says Purwadi. 'Nowadays REEs have become precious resources for high tech industries and are used as critical ingredients for the making of mobile phones, hard drives and even windmills.'

With that knowledge in mind, Purwadi explored if it is possible to start re-mining the abandoned sites on the island. By using remote sensing he found a method to locate REE-bearing tailings in mine sites. As if that wasn't enough, Purwadi also went on site himself, to collect around forty kilos of samples. 'It's not your average luggage you take through customs, that's for sure. But after some explaining, they did let me pass,' Purwadi looks back, smiling. Spectroscopy and data analysis back at ITC led to the recent graduate discovering an unexpectedly high concentration of a REE called Erbium.

True motivation

According to Purwadi, it's way too soon to say that his research conclusions will immediately turn life around on Bangka. The results are promising, but he knows that more research is needed. He himself would love to continue being in academics, as a PhD student. 'Not necessarily for exploring REE locations, but for monitoring possible illegal mining activities,' Purwadi says. And there's one more demand, before he would even think of being a researcher. 'Bangka needs to be the centre of attention. The island is my one, true motivation. I want to preserve the beauty of it. To me, Bangka is a reminder that we did not inherit the earth from our ancestors. We borrow it from our children.'

Text: **Frederike Krommendijk**
Photos: **Rikkert Harink & Shutterstock**

22 MILLION FOR 4TU COLLABORATION

Research with a social impact

Conducting research together to resolve social issues. That is the challenge that the 4TU federation posed to the four participating technical universities, along with a research budget of €22 million. UT professors Tatiana Filatova, Herman van der Kooij and Michel Versluis are at the head of three of the five 4TU studies.

4TU

4TU is the federation of four leading Dutch technical universities: Delft University of Technology (TU Delft), Eindhoven University of Technology (TU/e), the University of Twente (UT), and the Wageningen University and Research Centre (WUR). It aims to maximize innovation by concentrating the strengths in research, education and knowledge transfer.

In total, seventeen research proposals were submitted to 4TU by scientists from the four technical universities. Five of these were selected as promising 'High Tech for a sustainable future.' Three of those five studies are run by UT professors: Tatiana Filatova, Herman van der Kooij and Michel Versluis. Although their research fields are nothing alike, they all have high expectations of the impact their research will have on the challenges our society faces. Current experts from all associated universities are not the only ones who will work on these issues; the programme also makes it possible to bring in young talent. It is expected that businesses and social organisations will be happy to collaborate with a 'thinktank' with so much brain power – more so than with an individual university.

The research programme will last five years and young talent is attracted to safeguard the continuation of the research and education in the future. The three UT professors are determined to make the collaboration a success. Time and money are not an issue and all three have felt a strong willingness to collaborate from the other technical universities. Less overlap, more access to each other's specific knowledge, greater efficiency: these are just a few examples of the benefits of this joint approach. The collaboration with people with practical experience guarantees that the research ties in well with today's major issues. Everyone involved in the project shares the same goal: to conduct research that will have a genuine impact on our daily lives. The three research leaders explain how they plan to realise that.

Tatiana Filatova

Resilience Engineering

'Our world is vulnerable'

It is perhaps the most comprehensive research field of all 4TU projects: designing for a resilient world. That is why research leader professor Tatiana Filatova sees so many opportunities in the collaboration with other knowledge institutes and businesses. 'The Netherlands has achieved worldwide renown with its wealth of knowledge of technology and design. However, the knowledge possessed by universities and businesses is often fragmented at the moment. By combining our strengths, this knowledge can have a far greater impact on our society.'

Our world is vulnerable: to natural disasters, terrorist attacks and cybercrime, but also to smaller disruptions such as power outages. In the past, an incident was often contained locally, but as systems become increasingly complex, a single incident can have a domino effect that leads to far greater consequences. Consider the collapse of the financial markets, the effects of this year's storm on the transport sector and the consequences of a major power outage for telecommunication and healthcare facilities. 'We can minimise the risk of a disaster, but it is impossible to avoid it entirely. There is always a slight chance that things will go wrong. We have to keep that in mind when we design our cities and regions. It is possible to design our society in such a way – on a technical and social level – that a system is fully operational again as soon as possible after an incident. Even better: it can emerge stronger and more resilient. We conduct research into that design method.'

'We are not out to make people afraid of what might happen; rather, we rely on the resilience of systems. How can we design them in such a way that they do not collapse entirely in the event of a hurricane or a heatwave? We do not deal solely with major disasters either. For example, one of our partners is the Vechtstromen Water Authority, which wants to know how to better prepare the region for periods of extreme drought.'

For five years, 'Resilience' will be one of the largest research themes of 4TU. In addition to forty-three professors, sixteen new talents will also participate in this study and collaborate closely with circa 100 Resilience Fellows from the world of business, students and postgraduates. The programme is supported by Henk Ovink, the special ambassador of International Water Affairs, major industrial partners and pioneers in the field of Resilience Engineering, such as ETH Zurich-Singapore.

Filatova will be satisfied when the research results have an actual impact on our society. 'We are not after individual successes. Our primary concern is finding a way to make the world more resilient in the face of all manner of hardship.'

Herman van der Kooij

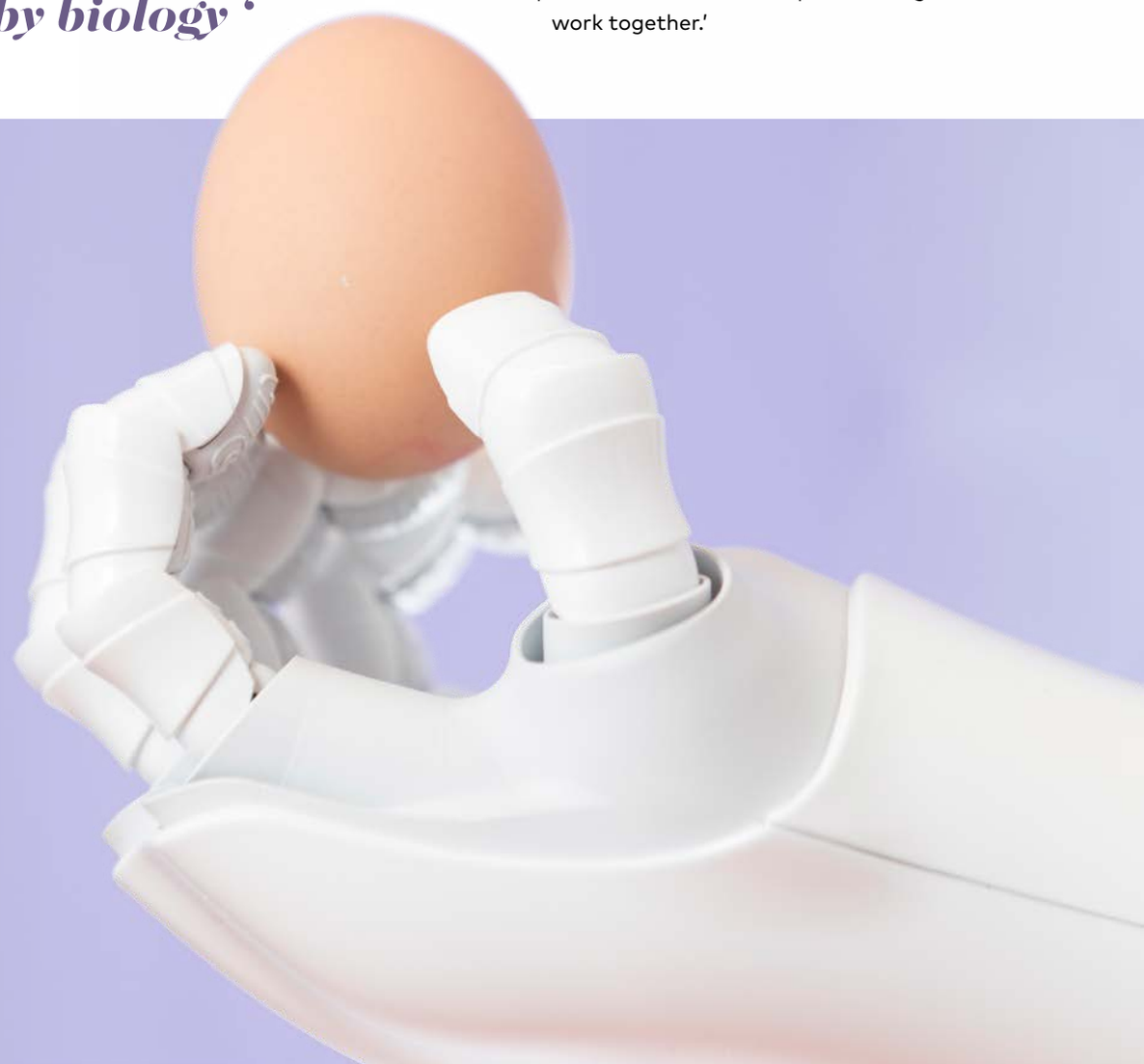
Robots with a soft touch

Robots can do a whole lot, but they are not known for their softness and suppleness. For some applications, those properties would come in quite handy. 'When a robot is used in the healthcare sector, for example to lift people, it would be great if it feels soft to the touch, like a real human body. A soft and supple robot is also less prone to damage. That is important when you use a robot for medical examinations such as an endoscopy, but also in the horticultural sector when handling delicate fruits,' says Herman van der Kooij. That is why finding the best talents in the new field of soft robotics is one of the 4TU projects.

At the moment, robots are constructed almost like Legos: using hard components that are controlled by sensors and motors. Soft robotics involves much more than putting a soft coating around all those technical bits. 'If you look at nature, you will see that many organisms do not have a skeleton. That makes species like the earthworm much more flexible. Combining that flexibility with strength is like trying to replicate the structure of muscular tissue. That requires research into materials that, like a muscle, can change their length or shape. Perhaps these materials can come from a 3D printer. These new robots are inspired as much by technology as by biology, where every part of an organism functions in an integrated manner,' Van der Kooij explains.

Because the four technical universities want to collaborate on this project, they can also invest in it together and prevent overlap in their research. Attracting new and promising talent to this innovative field offers the advantage of starting with only new people who, although they each belong to a different university, are primarily part of the bigger picture. 'It will be an entirely new talent pool. We are looking for ambitious, promising individuals with excellent cooperation skills. It is easier to approach businesses together as 4TU than on our own. We also expect it to be easier to acquire funding when we work together.'

'These new robots are inspired as much by technology as by biology '



'More precise diagnosis'

Michel Versluis
Precision Medicine

Although he does not want to get ahead of himself, professor Michel Versluis, leader of the Precision Medicine research programme, has high hopes for the improvements that the collaboration between the four technical universities will bring to the healthcare sector. 'With more precise diagnoses, it will be possible to achieve far better results.'

To make such a precision diagnosis, artificial intelligence (deep learning) is applied to the results of an MRI scan, a CT scan and a biopsy. 'Our challenge is to feed the right physical, biological and physiological data into the computer. That makes it possible to interpret the results of various studies in a way that even the best radiologist in the world cannot match.' In addition to improved precision and fewer faulty diagnoses, that will also save time during surgical procedures. 'A computer will soon be able to predict the optimal place to cut to remove a tumour in its entirety with clean cuts and without any functional side effects. Particularly with such conditions as tongue cancer or a brain tumour, accuracy is paramount. By having a computer process the data from millions of existing images, deep learning creates a far more accurate picture that can be presented to the surgeon in real time during a procedure. Furthermore, you can combine the results of different studies: during a procedure, it is not only important to know where the disease is located, but also where the blood vessels are, how elastic the surrounding tissue is, etc.'

The collaboration between eighteen researchers from the four universities results in a wealth of highly diverse knowledge and expertise. Additionally, seven talented young researchers and seven postgraduates are brought in. The five-year study includes a close collaboration with clinics and manufacturers of medical equipment, such as Philips. 'During such a large-scale joint research project, people must be willing to collaborate – with other faculties, other universities, businesses and clinics. Everyone definitely has that drive to achieve a breakthrough, because precision diagnostics ties into all of our lines of research. That focus keeps everyone sharp.' ●

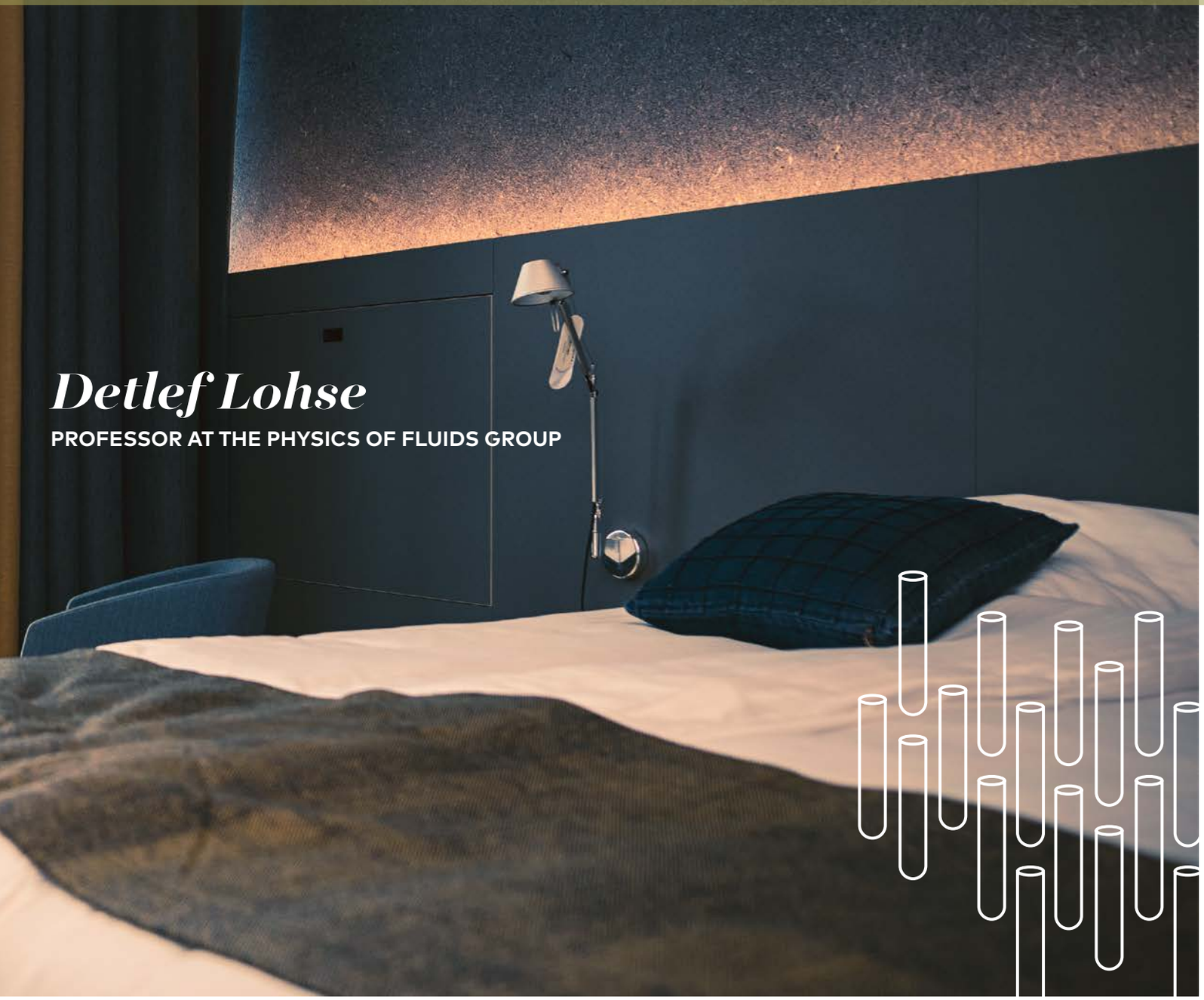
E! EUREKA

The eureka moment, the moment when you have a brilliant idea or a sudden discovery. We asked UT researchers about their eureka experience.

I have had several eureka moments over the course of my scientific career. One of the most recent ones happened in a hotel room in Taipei (Taiwan). I was there for a conference. After I had gone to bed, I could not stop thinking about the stability of nanobubbles. When do they dissolve and when are they stable? Normally, I tend to fall asleep within a minute, but not this time. I had the idea to apply the calculation of the famous coffee-stain effect to the nanobubble stability problem and was suddenly wide-awake again. I immediately sat down at the desk in my room and began the calculations. I was right. When the calculation was done, I looked at my watch and it was half past three in the morning. It all happened fast. I began to write the paper the next day during my flight back to the Netherlands. Within a few days the paper was finished.

I knew that I had found the answer. Now I had to convince the community of the veracity of the solution. Some colleagues did not believe me at first. I encountered quite

Text: **Jelle Posthuma**
Photo: **Rikkert Harink**



Detlef Lohse

PROFESSOR AT THE PHYSICS OF FLUIDS GROUP

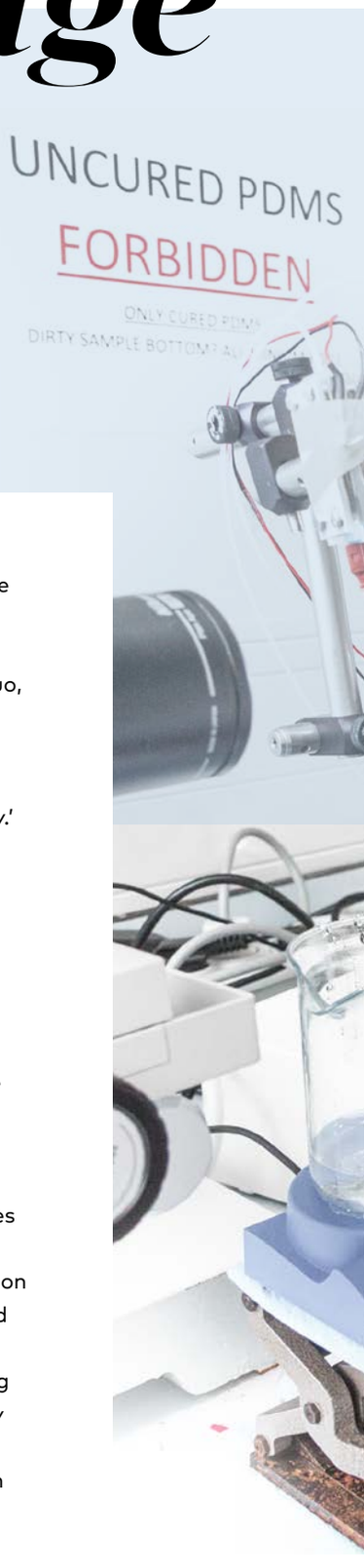
some resistance, as is usual with original ideas, but fortunately in science the facts are incontrovertible. Later I developed an ERC Advanced Grant application partially building on the idea I had that day and the application was granted. That allowed us to establish a new line of research at the UT for Diffusive Droplet Dynamics. We also developed practical applications, in diagnostics and the coating industry, for example.

As a scientist, you live for the eureka moment. I see it as a puzzle: it can only happen after you have collected every piece. That takes years of preparation: reading papers, talking to fellow scientists, experiments conducted by doctoral candidates, the requisite knowledge and the general scientific background. You then start to turn, throw away and move these individual pieces until everything suddenly fits together perfectly. That is the eureka moment.

Text: **Marc Laan**
Photo: **Eric Brinkhorst & Shutterstock**

Skin and *cartilage* from a 3D printer

These days, 3D printers are used to produce food, aircraft components and even living cells. UT researcher Claas Willem Visser is developing a printer that will allow to produce entirely new and futuristic materials.



Claas Willem Visser (36) from the Engineering Technology Faculty works with microdroplets: liquids at the micrometre scale. The technologies he co-develops sound almost unbelievable: some allow us to print gold, others make it possible to produce complex 3D (Bio)materials, one day maybe even living tissues.

Liquid gold

Using a 3D printer, the physicist prints droplets of liquid copper and gold to produce new micro equipment.
'Standard 3D printers have been able to print with plastics for years. The printer heats up the material and applies it layer by layer through a nozzle. The melting point of materials such as gold, silver or copper is much higher. A standard nozzle cannot cope with such heat. That is why a film with a thin layer of metal, such as copper or gold, is used. The heat of a focused laser pulse aimed at the material causes it to expand. The force of the expansion releases a small droplet of material on the underside of the film. This creates miniature building blocks. By stacking these into pillars made of different metals like platinum and gold, you can create a thermal sensor.'
Together with his colleagues Ralph Pohl and Jun Luo, Visser used this technique to develop an extremely small thermometer that can measure heat flow as close to a surface as possible. 'The demand from businesses for such microsensors is growing rapidly.'

In-Air Microfluidics

The researcher from Twente also developed a new technology to produce droplets and microparticles. Known as In-Air Microfluidics, this technology combines two liquid substances into a solidified new microparticle. Visser worked on this new invention for three years, together with his colleague Tom Kamperman, a researcher in Developmental BioEngineering group. Their technology is a hundred to a thousand times faster than the existing technique commonly used to produce microparticles under carefully controlled conditions, Visser says.
The initial idea was born during the 'Friday afternoon sessions', when Visser and his colleagues discovered more and more ways to fuse droplets of material into new substances. They started out by producing individual particles. Because liquid particles solidify when exposed to open air, these particles can also be stacked. 'That lets us build microstructures with a controlled internal structure. Each particle is a

'We realised that we can also fill the droplets with living cells'

functional module within the material.' These new materials can be used by the cosmetics industry to develop a new type of cream. A food manufacturer can use them to package dietary supplements in capsules.

Living cells

Visser: 'We realised that we can also fill the droplets with living cells. In a certain solution, they can grow inside the droplets. We can also have stem cells grow into other types of cells inside a microdroplet. The next step was to develop living fibres that can be used to print pieces of cartilage or skin for patients with tissue damage.'

'These days, it is not that hard to print living cells with standard equipment,' he continues. 'However, if you want to produce larger quantities, you need a system of veins to keep them alive with oxygen. combining our technology with the printing of blood vessels is a promising way to print living tissue larger than a few millimetres.'

The scientists have since founded their own company, IamFluidics, to commercialise their patented invention. Visser himself will continue his research at the UT, where he has been given the opportunity to establish a new research group named "Fluid Mechanics for Functional Materials" to study fluid dynamics and develop new, fluid-based materials.

'Create something that will *change the world*'

After obtaining his doctoral degree in Twente, Claas Willem Visser spent two years at Harvard University, where he experienced the American way of conducting research. 'My proposal was ripe for the trash.'

How did you end up at Harvard?
'After obtaining my doctoral degree in 2014, I wanted to build an academic future for myself. During a convention in the US, I visited Harvard and spoke to professor Jennifer Lewis of the Wyss Institute, one of Harvard University's research institutes. Together, we drew up a grant request. In 2016, I received a two-year Rubicon subsidy from the NWO. That was remarkable, because the selection process for these grants is quite strict. It allowed me to go to Harvard as a postgraduate fellow.'

Is the American academic climate different from ours?
'In some ways, yes. You are part of an extremely dynamic environment. Everything happens on a large scale and at a high pace. Research proposals have to have a major impact. I only learned that after I got there. My proposal had been well received and approved in the Netherlands. At Harvard, they immediately said it had to be bigger and the stakes had to be raised. I was told to create something that would change the world. It is considered better to shoot for the stars and fail than adopt a safe approach. My plan was guaranteed to have good results. To them, this was too easy and too small, so it was scrapped. Right after I got to Harvard, I had to start from scratch and develop an entirely new proposal. That took the better part of a year.'

Did that make you nervous?
'I was under a lot of pressure. Of course, I wanted to achieve results. I was quite stressed, because I had already used up nearly half of my two-year grant. Although good ideas cannot be forced, if you just get to work in your lab one will come along eventually. The academic climate at Harvard was a huge help. The Wyss Institute is home to researchers with a variety of technical and biological backgrounds. The people in my department had a range of specializations, which allowed me to develop new ideas quickly. The lab was also packed with equipment that I could use to test my ideas. Eventually, I succeeded in developing a 3D printer that can print porous materials, like a kind of foam. I cannot reveal too much about it, because it has not been patented yet.' ●

'Research proposals have to have a major impact'

Mosquitos

Don't blame me if this turns out to be a lousy column. The culprits are hiding somewhere in my bedroom, drunk on my blood. Behind a curtain, atop my wardrobe and on the ceiling, they quietly wait for nightfall before resuming their attacks on my body. I did not sleep a wink last night.

I have no problem with the mosquitos sucking me dry. They can have their way with my neck, my arm and my thigh, as long as they do so quietly. That is exactly what female mosquitos refuse to do. Their buzzing, which is caused by the flapping of their wings, is designed to attract males. I consider this an evolutionary blunder. Of course, sex is at the top of a mosquito's to-do list: they have to pass on their genes to the next generation. I just think it would make far more sense for them to suppress their sex drive during mealtime, because there is a considerable risk that their prey will jump out of bed to hunt them down with a rolled-up magazine.

Other animals are better adapted. Evolutionary biologist Menno Schilthuizen of Naturalis recently demonstrated this to me during an 'urban safari' in his hometown of Leiden. He pointed to the grey feral pigeon, whose ancestors once left the cliffs of southern Europe to move to the gutters and stone windowsills of man's cities. Since that time, the feral pigeon's colour has darkened. Schilthuizen explained that the melatonin that gives the pigeon's wings its dark-grey colour absorbs heavy metals. That makes the birds less susceptible to these toxic substances and allows them to thrive in our city centres. Their behaviour has also changed. In the wild, it is in any animal's best interest to be wary and to move away from danger as soon as possible. Our cities, however, reward the curious with surprising new food sources. City birds are more entrepreneurial and daring than their rural cousins. Even their wings have a slightly rounder shape, which allows them to fly out of the way of oncoming traffic at the last possible second.

We also spotted a bridge spider, which is related to the garden spider. While the latter prefers to build its web in dark places, the bridge spider constructs its home right in front of the city lights. Smart, because that is the best way to catch flies.

As I was scanning my room last night, dressed in nothing but my underwear and armed with a magazine, I presented this idea to the mosquitos: if they would stop their buzzing, they would have a greater chance to procreate! From their hiding spots on my bedroom walls, I could almost hear them thinking: 'You'll never catch us all!'

Enith Vlooswijk
Science journalist

Laser shoes bring Parkinson's patients one step further

MURIËLLE FERRAYE DEVELOPS TOOL TO PREVENT FREEZING OF GAIT

Not being able to take one more step and feeling like your feet are glued to the ground; many Parkinson's patients will be all too familiar with this phenomenon. Luckily, there is now a tool that can help prevent this freezing of gait: the laser shoe. It was developed by postdocroral researcher Muriëlle Ferraye.

Text: **Kitty van Gerven**
Photo: **Gijs van Ouwerkerk**

'The number of instances of freezing of gait was reduced by half'

Circa ten million people around the world suffer from Parkinson's disease. In the Netherlands alone, there are more than 55,000 patients. As our life expectancy grows, this number will only increase in the years to come. There is still no hope of a cure for this degenerative neurological condition, although the available medication for symptoms such as tremors and rigidity is becoming more effective. 'However, as long as there is no sufficient remedy for Parkinson's, we will have to improve our care for patients,' says Muriëlle Ferraye. She has made a substantial contribution to that goal herself by developing a laser shoe that helps Parkinson's patients walk.

This native French neuroscientist has been studying gait disorders for years, particularly the so-called 'freezing of gait,' a typical symptom of advanced-stage Parkinson's disease that causes a patient's gait to stop suddenly and prevents them from taking another step for sometimes minutes at a time. As part of her doctoral research, which she conducted at the University of Grenoble, Ferraye explored the possibilities of using deep brain stimulation to counter these blockades. This treatment was not effective enough, which inspired her to come to the Netherlands in 2010 to continue her research using MRI scans, together with professor Bas Bloem at the Radboudumc.

Prototype of the laser shoe

When she came to the Netherlands, Ferraye brought along a prototype of the laser shoe, which she had developed as an alternative to deep brain stimulation. Her idea was well received at the UT and she was soon able to start a postdoc study into the effects of this shoe at the former MIRA research institute. The study was conducted in collaboration with the Radboudumc's Donders Institute.

Ferraye says that it is still unclear what exactly causes the freezing of gait. 'What we do know is that it happens more frequently once a patient's medication starts to lose its effectiveness. It also tends to happen in spaces with many obstacles.' Curiously enough, those same obstacles help a Parkinson's patient take their next step. 'By focusing on such visual objects, so-called visual cues, walking becomes a deliberate action instead of an automated one. That triggers different circuits in the patient's brain and often helps them get over the blockade.'

Lines on the floor

Many patients may be able to cope with the problem at home by drawing lines on the floor, but such lines do not exist in the outside world. To improve the mobility and safety of Parkinson's patients, Ferraye developed shoes that project lines in front of the wearer's feet using a laser. 'The principle is simple: there is a switch in the heels of the shoe. When the patient's body weight is placed on the heel of the right shoe, a laser on the front of the shoe activates and projects a beam of light in front of the left foot. Once the patient steps over it, the laser in the left shoe activates and projects a similar beam in front of the right foot. The lasers create visual cues during every step.'

When a patient feels a blockade coming on, they can focus on the laser lines. 'It is not yet possible to prevent these blockades entirely,' Ferraye says, 'but this makes it a lot easier to get over them. That also reduces the risk of the patient falling down and suffering an injury.'

Reduced by half

The fact that the laser shoes actually achieve their intended effect was demonstrated during the tests that the neuroscientists conducted on twenty-one patients. 'The shoes were tested twice: once after the participants had been given medication and once without medication. They were asked to complete a course filled with corners and obstacles in a laboratory. During the test, the number of instances of freezing of gait was reduced by half, while the duration of the blockades that did occur was also reduced by fifty percent.'

In the end, the participants in the study were just as excited about the results as the researcher herself. Many patients said that they would like to have the shoes, which are currently being marketed by a British company.

Acceptance study

Her work is not done yet, says Muriëlle Ferraye. 'For the purposes of the shoes' commercial development, it is important to know whether Parkinson's patients actually wear them and if they feel any social discomfort while doing so.' Ferraye expects to start a follow-up study soon to determine the extent to which patients are able to accept the use of the laser shoes in their daily lives. 'Once we have arranged the funding, we can probably begin our research in November.'

With this new study, the neuroscientist expects to complete her search for a tool that, although it cannot prevent gait disorders entirely, will be able to – in her own words – 'improve the quality of life of millions of Parkinson's patients all over the world.' ●

‘Do what you like and go for it’

SONIA GARCÍA BLANCO AND HER LOVE STORY WITH TECHNOLOGY

How does a girl from a small town in Spain grow up to be an expert on Integrated Optics at the University of Twente? The answer involves NASA, Braveheart, prestigious grants and, most importantly, love for technology. ‘I’ve never considered doing anything else. Chips and small devices have always fascinated me,’ says Sonia García Blanco, Associate Professor at the Optical Sciences group.

Text:
Michaela Nesvarova
Photo:
Rikkert Harink

‘I’ve loved technology since I was little,’ says the scientist. ‘First I wanted to be an astronaut, but I would often get car sick, so I didn’t think going into space would be the best plan. I started researching other ways I could work for NASA. I noticed they worked a lot with small devices and decided I wanted to move in that direction. I looked up degrees that focused on miniaturization and chips and picked “Telecommunications Engineering” at Universidad Politécnica de Madrid. At least I wanted to make things that would be sent to space.’ That wish came true later on.

‘One female postdoc asked me if I was planning to have kids’

The eye-opener

First came IBM in California. ‘That’s where all my plans changed,’ says Sonia García Blanco, describing how conducting her Master’s research at this big American technology company inspired her to pursue an academic career. ‘It was like paradise. We were working on modifying materials for hard discs. All my colleagues were so smart and worked with so many cool devices. I wanted to get their job, so I asked them how I could achieve that. They told me I first needed a PhD and then become a postdoc. I got excited and began searching for PhD positions.’

Her time at IBM was an eye-opener in several ways. ‘It was the first time I noticed that being a woman in science is an issue,’ says the researcher. ‘I got invited to lunch for women and there were only ten of us there. Yes, all my direct colleagues were men, but I didn’t think about it. It wasn’t a challenge. Then one female postdoc asked me if I was planning to have kids. I answered that I was and she was quite shocked. For her, career in research and having children were completely incompatible.’


SONIA GARCÍA BLANCO

Braveheart

Sonia García Blanco didn't get discouraged. She took a map, choosing where to settle down for her PhD research. She had just watched Braveheart and thought Scotland looked nice, and so she applied for positions in Edinburgh and Glasgow. She got accepted to both and also elsewhere, but picked Glasgow 'even though the other offers were better'. Why?
'I have a theory,' she answers with a smile. 'I had to go to Glasgow to meet my husband. He was working at the university. It was destiny.' It was also an interesting research project, of course. On integrated optical biosensors. 'That was when I entered the field of optical sciences.'
The scientist has remained faithful to one field – but not to one location. After obtaining her doctoral degree in Glasgow, she moved to Toronto for her postdoc research. Not for long, though. Company INO in Quebec soon offered her a job as a scientific staff member. 'It was a very hands-on and varied job. I got to work on many projects for space applications for the Canadian Space Agency. One of my detectors for infrared satellites went to space.' Hence the childhood dream came true. And it was time to move on. 'I enjoyed my time in industry, but I was always given the project. I wanted to influence the direction I went in and I also wanted to teach. So I began looking for academic positions.'

'Our cleanroom is the best I have ever seen'

Doubts and successes

She soon found one at the University of Twente. 'I love it here. There is a big scientific community and the local facilities are great. Our clean room is the best I've ever seen,' says García Blanco, but adds: 'It was hard at the beginning. Moving from industry to academia, moving to another country. It took a while for me to "infiltrate" the system. I didn't know anyone in academic circles and after six years without any publications, it's hard to catch up. People didn't trust me because I used to work in industry.' She got 'saved' by the Marie-Curie Integration Grant. 'That was a great starting point. It shows that someone does have trust in you.'
That was the first, but not the last prestigious grant that García Blanco received. In 2015, she was awarded the ERC Consolidator Grant worth two million euros for her project

Sonia García Blanco in a nutshell:

2015	ERC Consolidator Grant
2015	Associate Professor of Integrated Optical Systems at the UT
2010	Assistant Professor in Optical Sciences at the UT
2005 – 2010	Microfabrication and microoptics researcher at company INO (Quebec)
2003 – 2005	Postdoctoral fellow at the University of Toronto
2002	PhD degree in Photonics at the University of Glasgow
1999	Master's degree in 'Telecommunications Engineering' at Universidad Politécnica de Madrid
1998 - 1999	Student researcher at IBM Almaden Research Center, Silicon Valley

RENOS (Rare-earth doped novel on-chip sources). The project aims to develop compact on-chip laser sources for uses in optical sensing, spectroscopy, metrology and telecommunications. 'Actually, many people told me I must have gotten the grant because I was a woman,' mentions the researcher. 'Of course these grants are based on the excellence of your work, but if you're a woman, people somehow question your success. I would say I was in disadvantage, if anything. I was very pregnant during the ERC grant interview, it was the day before I started my maternity leave, and so I was worried they would not even consider me.'

Making a difference

Now with two young children, Sonia García Blanco is on the tenure track and continues to be one of the leading experts in the field of Integrated Optics. Her research focuses on Active Nanophotonic Devices: development of novel on-chip active devices (lasers and amplifiers). In simpler words, she works on miniaturization of optical devices on chips. 'I believe our research can do something really relevant for the society. There are so many possible applications. Our chips could go virtually anywhere. For instance, I work on projects with medical applications that could be used for an early detection of diseases,' says the scientist.

As an example, the Associate Professor mentions project GLAM (Glass-Laser Multiplexed Biosensors), that could offer groundbreaking technology for detection of cancer. It aims to develop a new diagnostic tool to detect biomarkers from biofluids obtained in a non-invasive manner, focusing on genitourinary cancers. 'In essence, we are working on an optical laser on a chip that could be used in any doctor's office. The doctor could simply put a drop of urine in the device and it would show concentration of cancer biomarkers, possibly detecting cancer at a very early stage,' explains the researcher. 'If it works, it would be absolutely amazing. It would offer a much cheaper alternative to current technology. I would really love to see our chips enter the market. Bridge the gap between research and application and make it really useful. I want my technology to make a real difference in the world.'

A word of advice

The scientist's passion for her job is unmistakable and pure. Her face lights up when she talks of her research. 'I love developing technology. I wake up every day and I'm happy to go to work,' she confirms. Is Twente the place where she will finally settle down forever? 'Possibly. I enjoy my research now, but you never know what future holds.'

Regardless the future, the present is looking bright for this young academic. It's the past that led her here. Is there anything she would have done differently? 'When I was making big decisions, perhaps I should have considered academic requirements a bit more, not decide based on somewhat random parameters. Maybe choosing to go to Glasgow because I liked Braveheart wasn't the greatest reason. But on the other hand, then I wouldn't have had the experience. And an advice I would give to my younger self? That would be something that I actually did. I would say "Do what you like and go for it!"' ●

C

Captured on Camera

Text & photo:
Gijs van Ouwerkerk

Acoustic camera

The device captured on camera here is, in fact, a camera itself. It could be called an acoustic camera, because it measures the intensity and position of sound instead of light. Researchers of the Engineering Fluid Dynamics group, associated with the aeroacoustic wind tunnel in the Horst, use this instrument to analyze the noise coming from things like airplane wings, wind turbines and drone propellers. The array of cleverly placed microphones detects the position of a sound source by the phase differences recorded at each node. PhD researcher Julian Biesheuvel explains that the software used to analyze the data is more sophisticated than the hardware. Clever coding can, for example, allow the measurement of distributed sound sources and eliminate interference in the data caused by the camera itself.

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