



Portraits of science

 TU Delft



**20
18**

Foreword

It is not easy to sum up the year in one word, but 2018 was certainly a year full of surprises. It was a big surprise for Rhythima Shinde that out of eight strong candidates she was elected TU Delft Best Graduate 2018. Andy van den Dobbelaars was equally surprised when he received a royal honour. It was also surprising that four researchers led by Bruno Santos were awarded a large Horizon2020 grant for their research into condition-based aircraft maintenance. Remarkable, because for once these are not professors, but young tenure trackers. Apart from the element of surprise, these stories have something else in common: they score high when it comes to impact. Bruno Santos and his colleagues think millions can be saved by switching from regular to condition-based aircraft maintenance. In the long run, that could save Europe some 700 million euros a year. Andy van den Dobbelaars is very consciously working on his impact. He will only get on a plane if he is convinced that a business trip by air will actually lead to long-term CO2 savings. And it is Rhythima Shinde's mission to make her energy-sharing platform available to the more than 100 million households in India that currently have no electricity supply at all. Also impressive is the story of Jan Carel Diehl and Tope Agbana, who are working on affordable diagnostic devices for neglected tropical diseases. Teacher of the Year Calvin Rans believes his impact lies mainly in the students and PhD students he teaches. That may also be true for Conny

Bakker. After all, she teaches her students that when designing products, they should not only look at their first life span, but much further ahead in time until the final reuse of components and materials. Pier Siebesma, lastly, investigates the precise influence of clouds on weather and climate, because if we want to combat climate change, we first have to understand exactly what is happening. The twelve stories in this booklet are all portraits of people who consciously try to have a positive influence on society. It is not for nothing that impact for a better society is our mission as a university. The excerpts you read here are just a little taster; please visit www.tudelft.nl/pos2018 for the complete stories.

Professor Tim van der Hagen
Rector Magnificus / President
Delft University of Technology





Read the full interviews
in the online magazine:

**[www.tudelft.nl/
pos2018](http://www.tudelft.nl/pos2018)**

Andy van den Dobbelaar
Anouschka Versleijen
Calvin Rans
Conny Bakker
JC Diehl & Tope Agbana
Nicola Pezzotti
Pier Siebesma
Rhythima Shinde
Rolf van Wegberg
Stan Brouns
Team Bruno Santos
Jerry Westerweel

“Dutch people who think we shouldn’t be leading the pack annoy me. We are actually behind – it’s about time that we caught up with the rest.”

Andy van den Dobbelsteen





Andy van den Dobbелsteen

On the day before King's Day 2018, Professor Andy van den Dobbелsteen was surprised to be made a Knight in the Order of the Netherlands Lion. Although the professor of Climate Design sees this as a great honour, it is no reason for him to rest on his laurels.

For Andy van den Dobbелsteen, climate design is about much more than creating a pleasant indoor climate. "I teach my students how they can design sustainable buildings: energy neutral and using circular materials", he explains. In his research, he does exactly the same at the scale of neighbourhoods, cities and regions, because that is where the scientific issues lie. "Increasing the sustainability of cities is set to become a major challenge because of all the different streams – energy, water, food, transport – that are still so intricately entwined."

His chair plays an important role in the European City-zen research project that aims to create energy-neutral cities. "We have drawn up a roadmap for Amsterdam describing the interventions that will be necessary if the city is to be completely sustainable by 2040. It includes installing heating networks and achieving energy renovation in neighbourhoods."

Part of the project involves a roadshow visiting ten other European cities, organised by his colleague Craig Martin. "We aim to use Pressure Cooker workshops to help them to initiate their own energy transition", explains Van den Dobbелsteen. "Recently, we visited Preston in the UK,

where we spent a week working intensively on proposals to make an entire neighbourhood carbon neutral."

You could actually see Van den Dobbелsteen's life as one big roadshow as he travels at home and abroad as project manager, jury member, consultant or speaker, sharing his expertise on sustainable construction and design: "When travelling, I deliberately opt to use the train or bike where possible. In the Netherlands, I never travel to appointments by car", he says. This is not always the road of least resistance. "I recently attended the presentation of the Cobouw Sustainability Prize. It was held in Vinkeveen, right alongside the A2 motorway. But I ignored that fact and took the train to Breukelen", he explains. "The public transport bikes had run out and there were no taxis available. I eventually arrived just in time by bus. It's at times like that you realise how badly designed our country is when it comes to public transport."

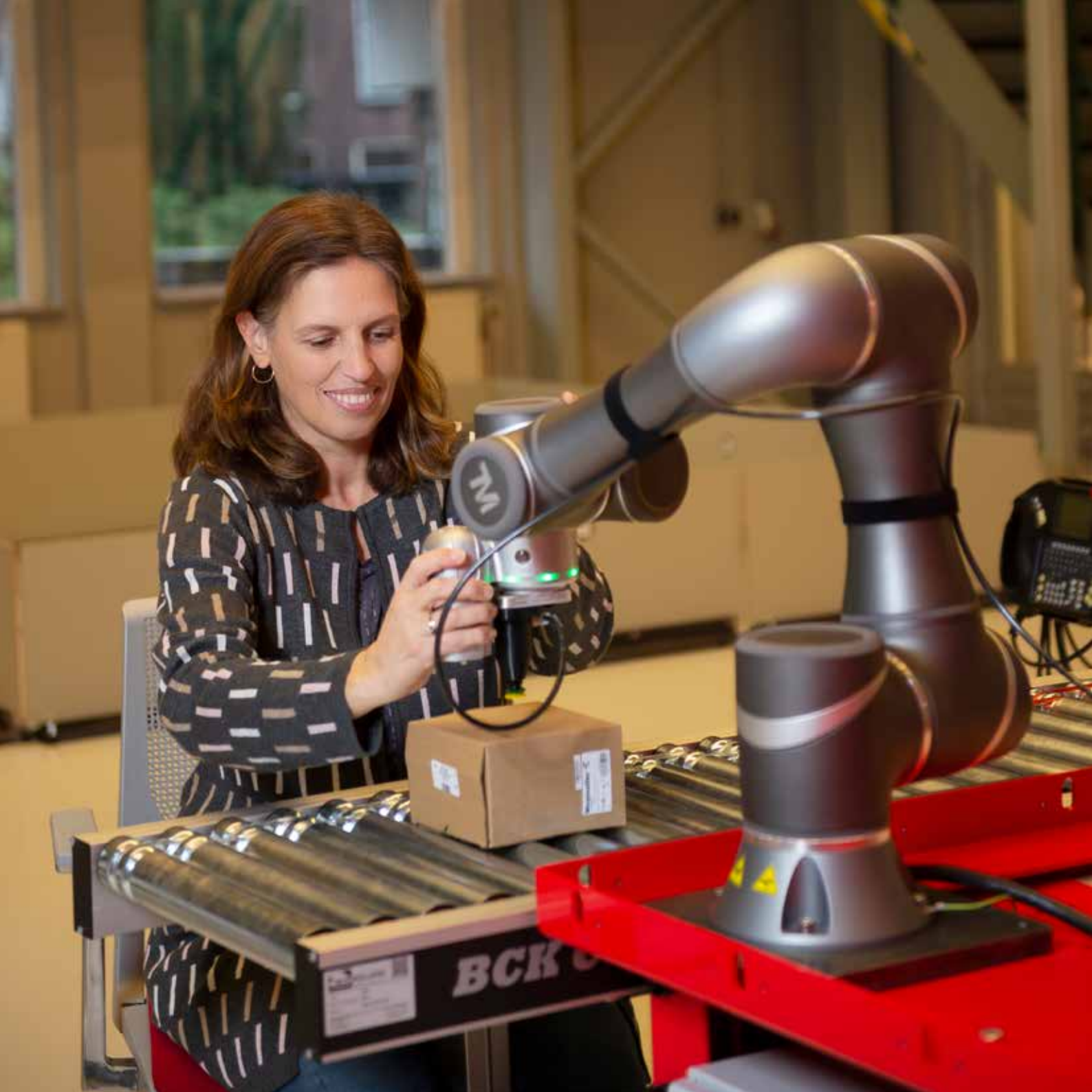
Van den Dobbелsteen travels by air only if there is absolutely no alternative. "I always offset the carbon emissions from my flights anyway, but, in the last couple of years, I've also started to question the real benefit of that air travel. If it actually results in a CO₂ saving, then I think it can be justified. In Preston, I really believe that we brought about significant change with the roadshow, so you could say that my flight to Manchester was justified. Occasionally, you look back and think was that really useful? That's something I now try to avoid."

Read the full interview at www.tudelft.nl/pos2018

*‘It is exciting to hear from scientists
what they see as the challenges in
their field and what next steps they
would like to take.’*

Anouschka Versleijen





Anouschka Versleijen

Anouschka Versleijen is the current director of the RoboValley innovation cluster. Working from TU Delft's Valorisation Centre, she is an expert in the interaction between research and business. For over ten years now, she has been committed to making research results available to society.

Robots and artificial intelligence play an increasingly important role in our daily lives. It is not for nothing that robotics is an important research theme at TU Delft. Scientists from six different faculties work together on this subject in the Robotics Institute, but what exactly is RoboValley? "RoboValley is actually everything surrounding the research: networking with stakeholders in the outside world, helping to set up start-ups or ensuring that existing businesses can make use of research outcomes," explains Anouschka Versleijen. "Some companies have their own research questions, others are interested in technologies that may have already been developed, but have not yet penetrated the market. RoboValley covers this entire playing field." The aim of all this is to make sure the results of TU Delft research benefit society. This is also known as valorisation, and is one of the core tasks of a university, alongside education and research.

"RoboValley is a good example of how to set up such an innovation ecosystem," says Versleijen. "We help researchers to expand their industrial network and to set up start-ups based on their research. And we offer companies

easy access to the university's knowledge and to joint innovation projects." Moreover, together with the Canadian capital investor Chrysalix, the Chrysalix RoboValley Investment Fund was established in 2018. "This was a particular success, because it not only enables us to establish the technological side of the ecosystem, but also the financing side."

RoboValley adheres to an open innovation model, in which everyone is welcome to learn more about robotics, for example during events ranging from monthly drinks to theme meetings for specific target groups such as the agri-food sector. "With other parties, such as Shell, Ahold Delhaize or ABB, we will sit down to see what their specific challenges are and how our expertise can contribute to them." This recently led to an agreement with Ahold Delhaize to explore new robotics applications in the retail sector together.

"In RoboValley, we offer everyone who wants to collaborate with us a physical meeting place," says Versleijen. For years, the address Julianalaan 67 was known as the Kluyverlab, home to the biotechnology department. RoboValley breathes new life into the building, with one wing containing housing for startups, and the other wing containing the brand new robotics field lab RoboHouse. "At RoboHouse, startups and companies from outside can do design sprints in the field of robotics and artificial intelligence."

Read the full interview at www.tudelft.nl/pos2018

“The biggest impact we have on society is through the people we mentor. Teaching is an impact multiplication process.”

Calvin Rans





Calvin Rans

Calvin Rans was voted Teacher of the Year 2018 at the Faculty of Aerospace Engineering; he subsequently scooped the overall TU Delft Best Lecturer title. Passionate about teaching, he tries to convince his students that it is not exams or grades that matter, but their increased understanding.

In my first year's bachelor courses I help students to discover their own intrinsic motivation. At secondary school, pupils are under huge pressure to get the grades they need to go to university. Now they are here, they have to flip a switch and say: this is where I want to be. I literally put a slide up that says 'no-one is forcing you to be here'. I try to teach them that it is not grades that are important, but what they actually learn. A lot of students come and tell me they enjoy the way I teach, because I do not simply transmit knowledge, but I try and show them its usefulness. I also show them even more complicated things they can do with that knowledge, even though it won't figure on an exam.

If I make the classroom a little bit more fun, students will be more receptive. So when I come in wearing a hockey jersey and carrying my hockey stick to teach them something about deflections of beams, I come across as more approachable. Something like that changes the whole dynamics in the room. I also like to show them videos of real-life situations that we can then discuss from an

engineering perspective. That is so much more interesting than letting them solve a contrived problem from a textbook. Think of it like a Discovery Channel documentary that is really entertaining but also has knowledge hidden inside it, versus a technical manual. They may have the same information, but that dry stuff is so hard to get through. Also, our current students grew up with the internet, and having so much choices online makes them picky in class. If something is not engaging enough, they disengage.

My first-year course Mechanics of Materials, I transformed into a blended course, where students watch the theory in short videos online, so in class we can focus on what they didn't understand. That particular course teaches basic skills that will come up again and again in later courses. I heard that students were forgetting a lot of it, and other professors had to spend time re-teaching it. So I decided to make videos on those topics that I can use in my course and that students can come back to in later years to refresh their knowledge. I also made sure I created interconnections between the different courses. That is helpful for students: otherwise they might focus on passing a course and then move on without realising these connections.

Read the full interview at www.tudelft.nl/pos2018

“Designers would not dream of making something that is not ergonomic, that does not work or is unsafe. It should be just as obvious when it comes to sustainability, but that is not yet the case.”

Conny Bakker





Conny Bakker

Conny Bakker is Professor of Design Methodology for Sustainability and Circular Economy at the Faculty of Industrial Design Engineering (IDE). When devising products for a circular economy, designers need to look much further ahead, beyond the product's first life to new forms of reuse and – ultimately – recycling.

Existing design methods are all practically the same: it begins with an idea and ends with a product. However, the core of sustainable design is that the design does not stop once the product leaves the factory. How do you create products that retain their worth for as long as possible in an economy in which they can continue to circulate? A product therefore should not have just one life, but like a cat, it should have at least nine. That's why I emphatically introduce the element of 'time' into the design process. Designers need to consider what happens after the initial lifespan of their product. Can we refurbish it and put it back on the market, or can we remove components and reuse them? If that is no longer possible, how do we ensure optimal recycling? As a designer, you need to think ahead when it comes to all of these considerations. That is at the core of the methods that we are now developing.

Access models are showing strong growth. Homie is a Delft start-up that allows users to pay per wash instead of buying their own washing machine. Washes at lower temperatures are cheaper, to encourage users to use

those programmes. Behavioural change plays a significant role in sustainability. Getting people to accept an access model such as this is the first step. You then give them a gentle push towards washing at lower temperatures. The savings are twofold: it costs less and you use less energy. Research has revealed that this price differentiation really works, so this is a justifiably sustainable concept. Add to this that washing machines that are returned after a few years are refurbished before being reintroduced to the cycle. This means that they are used for longer than is usually the case. Companies like this are the cornerstones of the circular economy, and should be cultivated.

I see enormous potential for designers: we need to stop using fossil fuels and switch to sustainable energy and a bio-based economy. That brings so many new opportunities with it. We are only now beginning to teach our students about biodegradable materials and their potential. And it is about time, too. There is now a lot of talk about climate adaptation. I think that is a worrying concept, as if we need to adjust to the inevitable. Yes, we are late, but perhaps it's not too late to hit the reset button if we are able to create an optimistic picture of the future. An inviting prospect of a new way of living, that does not necessarily have to be very different, but that uses different materials and energy sources. As industrial designers, we are ideally positioned to bring this about. That is what we are here for, not to help preserve dinosaur industries.

Read the full interview at www.tudelft.nl/pos2018

*“We have contacts across the board,
from the village chemist to the WHO
policymaker. With their input we
keep going back to the lab to improve
our system.”*

JC Diehl en Tope Agbana





JC Diehl en Tope Agbana

With over 200 million cases worldwide, the majority of them in Sub-Saharan countries, malaria is a disease in urgent need of affordable and accurate diagnostic equipment. So are many other, often more neglected, infectious diseases like schistosomiasis. Associate Professor Jan Carel Diehl and PhD student Tope Agbana have a common goal: to make sure that their affordable optical diagnostics tools reach health care workers and patients in low-income countries.

Unbeknownst to each other, Jan Carel Diehl (popularly known as JC) and Tope Agbana were working on the same subject: diagnostics for tropical diseases. As it turned out, their research is extremely complementary, but their paths had to cross first. “After participating in a medical hackaton in Uganda, my students came up with the idea of designing something to improve malaria diagnosis”, says Diehl, Associate Professor in Sustainable Development at the Faculty of Industrial Design Engineering (IDE). They designed a device based on a cheap smartphone, and started looking for the necessary diagnostic technology to integrate into it. “They first tried unsuccessfully to get in touch with researchers at Berkeley University. Then, more or less by accident, they found out that Tope was working on malaria diagnostics in the building right next door.”

Agbana picks up the story: “In 2016 we got funding from the Delft Global Initiative for our proposal to combine smart algorithms with technical optics into something that could automatically detect malaria.” He is currently pursuing a PhD at the Numerics for Control & Identification group at the Faculty of Mechanical, Maritime and Materials Engineering (3mE). “When JC’s students contacted me, it was great to hear that they were working on the same idea in the building right next to us. I immediately wanted to help them, so we decided to pursue their concept together.” It turned out to be a good match: “At 3mE we have a lot of knowledge about optical systems and the building of algorithms. That is so to speak the heart of the technology. We did not have the body. JC’s group is really into embodiment design and user interaction design. So this combination brought a complete product to life.”

That first product was the Excelscope, created by fitting a ball-lens to a smartphone camera, enabling it to operate as a microscope. Diehl’s students combined that with Agbana’s smart algorithm that can rapidly recognise blood cells infected by malaria parasites in blood samples. 2018 turned out to be a particularly good year for the Excelscope. In September, it won first prize at the Dutch National Finals of the James Dyson Award and the team were also runners-up in the international final.

Read the full interview at www.tudelft.nl/pos2018

“It would be nice if my work could also be used in such fields as space research and climate change, as they are two areas I am very interested in.”

Nicola Pezzotti





Nicola Pezzotti

How do you clearly display both large amounts of data and explore the way they are interlinked? That is the challenge researcher Nicola Pezzotti is tackling. His work has ready resulted in a technique for the detection of rare cell types amongst hundreds of others.

“I was interested in programming from an early age,” says Italian-born Pezzotti. “My father was a programmer, too. I still remember creating my first form of artificial intelligence (AI). Actually, it was a not particularly intelligent application which played noughts and crosses. That was in my first year of secondary school, and I’ve been working with AI ever since.” For the past four years, Pezzotti has been a PhD student with Dr Anna Vilanova in the Computer Graphics and Visualization Group at the Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS).

Pezzotti’s work centres on the visualisation of ‘high-dimensional data’, in which every data point has numerous characteristics. An example is found in a collaboration between TU Delft and Leiden University Medical Centre (LUMC), as a result of which scientists can now determine the extent to which dozens of different proteins occur on the surface of individual cells. In this situation, each cell is a data point with dozens of features, which are almost impossible for humans to identify and understand. “If you have a connection between two variables,” Pezzotti explains, “you can plot that neatly on a graph with an X and

a Y axis. You can even extend that to three dimensions; but any more is really not possible for a human being to visualise directly.”

His work, however, has now made it easier to clarify and interpret huge amounts of data and has resulted in concrete application. At LUMC, a device called a CyTOF mass cytometer determines the properties of millions of cells from, for example, intestinal mucosa or blood. This is done by measuring the levels of about forty surface proteins on each cell. The most interesting cell types in a tissue sample, those related to illness and health, are often rare and you can miss them if you study only a proportion of the cells in detail. The new analytical technique overcomes that problem. As a result of Pezzotti’s improvements, the algorithm used has become a hundred times faster.

A researcher can now follow the optimisation process in real time, in a web browser, rather than having to wait many minutes, or even days, for the final result. The user is first presented with a two-dimensional image on their screen, in which the cells from the tissue sample are grouped on the basis of their similarities. Pezzotti compares the process with Google Earth, where you start with a view of the whole world but can then zoom-in right down to the street where you live. In his version, as you zoom in you can discover rare cell types which are absent or present in a particular illness, such as the chronic bowel condition Crohn’s disease.

Read the full interview at www.tudelft.nl/pos2018

“In the Netherlands, people tend not to worry too much about the odd extra degree. But this extreme rainfall, which our system is not designed for, makes a real impression.”

Pier Siebesma





Pier Siebesma

In climate models, clouds are a factor of uncertainty, although our understanding of them is increasing all the time. This is partly thanks to Pier Siebesma, professor of Atmospheric Physics. Siebesma, who delivered the 2019 Foundation Day Speech, has been researching the link between clouds and climate change for decades.

One of the very first reports on climate change dates back to 1979: the Charney report, commissioned by the United States government. “It provides a crystal-clear description of the long-term consequences of CO₂ emissions, based on elementary physics”, explains Professor Pier Siebesma. Meteorologist Jule Charney calculated that a doubling of CO₂ emissions compared to the pre-industrial age would result in a global surface warming between two and three and a half degrees. “We only had relatively primitive climate models back then. Our observations and models have both improved significantly, but that projection is still broadly in line with the recent reports from the Intergovernmental Panel on Climate Change, the IPCC.”

“During the 1980s, warming accelerated and we were able to observe that the climate really was changing. Before then, the temperature effects were hardly perceptible above the ‘background noise’ of the weather”, says Siebesma. “All this has long been a subject of debate and is in some ways similar to the relationship between smoking and lung

cancer, which was also disputed for a long time.” Although the debate in society may still be continuing today, it was in the late 1980s that climate change became a subject for scientific research across the world. This included the Netherlands, where the Royal Netherlands Meteorological Institute (KNMI) set up its own climate department. Siebesma himself went to work there as a researcher, exploring the influence of clouds on the climate. “It was not something that came out of the blue; the link had already been established in the Charney report, but became much clearer in the course of the years.”

A climate model is similar to a weather model, a numeric computer model that calculates the state of the atmosphere. But instead of calculating for ten days ahead, you are looking a century or more into the future. “A model of this kind can include various scenarios. For example, you can explore how an increase in carbon dioxide influences the temperature.” If there is no change in policy, CO₂ levels are definitely expected to double in the course of this century, but different models show a range of temperatures for that situation, ranging from two to five degrees of warming. The difference seems to lie in the way in which the models deal with clouds. “The models that show two degrees of warming involve an increase in clouds”, explains Siebesma. “Clouds reflect sunlight and therefore have a cooling effect. Most climate models show fewer clouds and therefore a more significant increase in temperature. Clouds are a factor of uncertainty in climate projections.”

Read the full interview at www.tudelft.nl/pos2018

“We should not make the same mistakes as developed countries, and sacrifice nature and the environment for the sake of economic development. If we do it right, we can have both at the same time.”

Rhythima Shinde





Rhythima Shinde

Rhythima Shinde was voted best graduate of TU Delft 2018 for her thesis on electrifying rural India through institutional innovation. That was just part of her achievement: she also graduated in Computer Science, and set up the Energy Bazaar, a start-up aiming to bring decentralized energy exchanges to rural India.

Rhythima Shinde has always been a very active student. Having grown up in Indore in Central India, she moved to Mumbai to study mechanical engineering at the Indian Institute of Technology. During her Bachelor's, she set up an organisation for rural development "I gathered a team of some 40 students who wanted to work with me on giving people in rural areas access to resources like water purification systems and emergency transport services", she explains. It opened her eyes to a common problem with such endeavours: "Even if you have a working technology, getting it implemented is an issue, because of government policies, local contexts and varying stakeholder interests and so on. I had no idea how to deal with that."

After obtaining her Bachelor's degree, she decided to embark on a Master's course to fill that gap in her knowledge. "I was looking for a programme in technology and policy management, but these are rare." One of the few places that did offer one was TU Delft. Shinde applied and was accepted for a Master in Engineering

and Policy Analysis (EPA) at the faculty of Technology and Policy Management (TPM). It was not her first encounter with TU Delft. She had also been part of the IIT Bombay Racing team that took part in the 2014 Formula Student UK, a competition for electrical cars held annually at the Silverstone racing circuit. There, she was blown away by the DUT team from TU Delft, who won. "I was really impressed, and when I researched TU Delft and found out about the programmes on offer, I started thinking about going there."

Before coming to Delft, she first spent a month travelling in India. "I wanted to find out what the most pressing societal problems were. Lack of access to a power system is still a huge issue in India, with more than 100 million households having no access to electricity whatsoever", she says. "I stayed in villages and talked to the locals. Often, people do not have enough income to afford a full connection to the grid, but they would like to be able to buy electricity for a few hours in the evening, for example." Shinde saw many communities where the richest inhabitant would live in a fully air-conditioned villa, when the huts right next door had no facilities whatsoever. That is how she came up with the idea for peer-to-peer energy sharing. "If someone has excess electricity, from solar panels for example, they can trade that. That gives them an economic incentive to take part in such a scheme." She has been working on that concept ever since.

Read the full interview at www.tudelft.nl/pos2018

“My combination of skills and knowledge, covering both the technological and criminological aspects, is still quite rare. You can count people like me on one hand.”

Rolf van Wegberg





Rolf van Wegberg

How does someone start out and operate in the field of cybercrime? And what can we do to prevent this? These are questions that preoccupy criminologist Rolf van Wegberg in his work at TU Delft. He is attempting to forge a link between the technical side of cybercrime and its more economic and social aspects. He is one of very few in his field.

For Rolf van Wegberg, 2018 was almost totally devoted to his research into the commoditisation of cybercrime. The PhD candidate at the Faculty of Technology, Policy and Management, presented his results at the USENIX Security conference in the US city of Baltimore. Cybercrime is a growing problem and can take many forms, including credit card fraud, online blackmail and spyware. In this context, commoditisation means the offering of skills and services by specialised parties in the underground economy, which end users can buy 'off the shelf'. This makes it possible for cybercriminals to outsource certain activities, so it is easier for them to start to commit cybercrime. "Being able to buy a certain service means you don't need to understand how it works to get down to business. You can go to a 'cybercrime IKEA', as it were, to buy the package of your choice and put it together yourself," explains Van Wegberg.

Crimes such as online blackmail and credit card fraud become significantly easier if criminals can purchase the commodities they need for it on underground markets, on

the dark web. Or at least that is the theory. Researchers are also noticing an increasing commoditisation of cybercrime, but Van Wegberg wondered how serious the problem really is in practice. "Together with colleagues from Carnegie Mellon University (CMU) in the US, we therefore examined whether this commoditisation really is growing at the rate which was feared. We looked at six years of transaction data from eight online anonymous market places, from Silk Road to AlphaBay. Together these cover a major part of this market. This is the first time that such a large-scale analysis of this underground online economy has been undertaken."

"We did in fact see indications for commoditisation of all kinds of products and services, but certainly not for all. Not everything is for sale; as a cybercriminal there is still a lot you have to do yourself. Moreover, the volume of trade is very limited, compared to the volume, for example, of the drugs trade on these markets. There is growth, but it is far more modest than we had anticipated. We estimate the total volume of cybercrime commodities on online anonymous market places between 2011 and 2017 at around eight million dollars." 'Cash-out' services are the most frequently traded. Ultimately, the question behind every criminal business model is: how can you channel your victim's money away in a 'responsible' way? This is something every criminal entrepreneur needs to do, so it's only logical that the demand for this is high. It's all about go-betweens, money mules, bank accounts, Bitcoin exchange services and suchlike.

Read the full interview at www.tudelft.nl/pos2018

“It is expected that the problem of antibiotic resistance will only continue to grow. We need to develop all kinds of alternatives, and research into bacteriophages fits in well with this.”

Stan Brouns



Stan Brouns

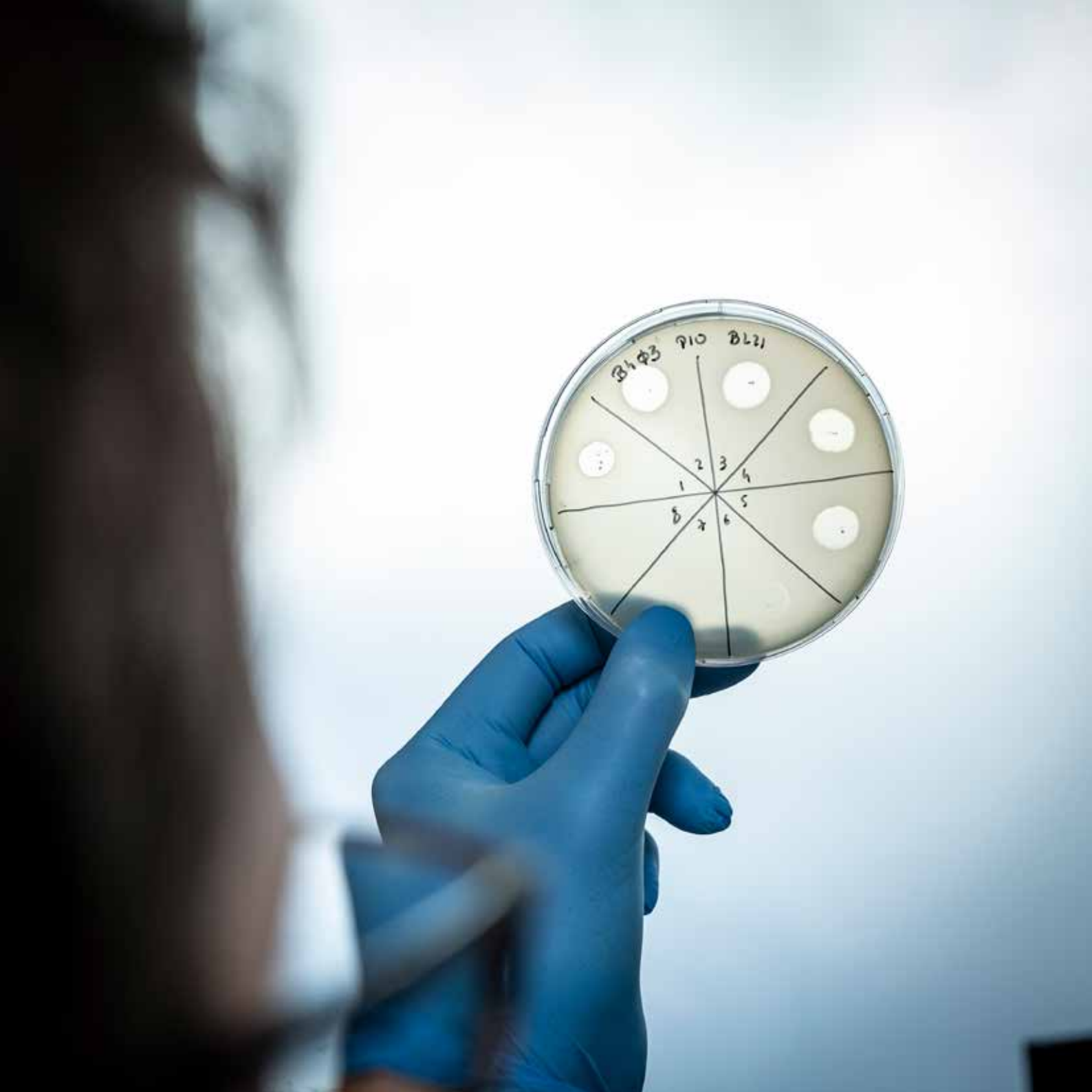
Bacteriophages have been the natural enemies of bacteria for billions of years. Microbiologist Stan Brouns conducts fundamental research into these bacteriophages and the way they interact with bacteria. This research recently took a new turn: he received a large donation from the Delft University Fund to set up a bacteriophage bank to investigate whether they also offer an alternative in the fight against antibiotic resistance.

The phage bank fits in nicely with our own research. On the one hand, we are interested in bacteriophage resistance, and on the other, we want to find out how bacteriophages circumvent this. During treatment, you want as little resistance as possible and you want these bacteriophages to be able to kill the bacteria as much as possible. But how do you get a collection of phages and who will pay for it? The University Fund provided a solution: thanks to a generous donation from alumni and the fund itself, we can make a start. We have now hired an analyst who is working full-time on setting up a phage bank. We want to build up a collection of the most common pathogenic bacteria, which are difficult to combat with antibiotics, meaning that people can't be cured by antibiotics. There are more and more resistant bacteria, which is why there are more and more people with infections featuring persistent symptoms. That's the crux of the problem.

We're going to harvest the necessary bacteriophages from nature ourselves, from waste water to be exact. After a billion years of evolution, there are bacteria and bacteriophages all over the world, but we are mainly looking for places where you will find a lot of variety. There are many different types of bacteria and their phages in our intestines and from there they end up in the sewer, so that's a great place to collect them. Many people are shocked by that, but it's the best place for bacteriophages. To start with, we're mainly working on building up the collection. As soon as it is reasonably complete, we want to work with doctors to treat patients. I really hope that this will be in a few years' time.

Some doctors are certainly open to this. And there are ways it could be legally possible. Pharmaceutical compounding, the creation of unique medicines, could be a usable model. This would mean that if a patient had a bacterial infection that was difficult to treat, the doctor would send us a sample of the bacteria. We would then look for the right phages in our collection that can kill the bacteria. These bacteriophages would then be sent to a hospital pharmacist, licensed to make pharmaceutical compounds for individual patients. Many medicines come directly from the pharmaceutical industry, so at the moment pharmacists don't really make much use of pharmaceutical compounding. But if we can bring the right doctors, pharmacists and hospitals together, this should succeed.

Read the full interview at www.tudelft.nl/pos2018



“We have just the right spread of knowledge and abilities. Together, we cover every piece of the puzzle.”

Team Bruno Santos





Team Bruno Santos

Condition-Based Maintenance (CBM) is a new approach to aircraft maintenance that could save hundreds of millions of euros. The ReMAP project proposal to explore the issue has received a European Horizon2020 grant worth 6.8 million euros. Remarkably, the four successful project applicants from the Faculty of Aerospace Engineering are all still assistant professors.

“Securing this project has been very much a team achievement”, says project manager Bruno Santos immediately, “which is why all four of us are doing this interview together”. In addition to Santos, we also spoke to Wim Verhagen, Mihaela Mitici (all three are from the Air Transport and Operations group) and Dimitrios Zarouchas (Structural Integrity and Composites group). Both groups are part of the Faculty of Aerospace Engineering. ReMAP (Real-time Condition-based Maintenance for Adaptive Aircraft Maintenance Planning) is the first research proposal for which Bruno Santos has served as project manager and it was immediately approved. This is despite the fact that only 10% of the proposals submitted for the specific Horizon 2020 call for proposals were rewarded with a grant. This is all the more remarkable because there are no professors among the four people involved – all of them are on tenure tracks and are assistant professors.

Santos: “That’s very unusual for a project of this size. In principle, it’s not even within our remit to manage a project

like this and that was not the original plan either. It ended up with us as a result of circumstances, in response to which our professors said: ‘If you want to try it, go ahead!’” Did the four of them originally see this as an disadvantage? “No, absolutely not”, says Mitici. “We have just the right spread of knowledge and abilities. Together, we cover every piece of the puzzle.” Verhagen adds: “We were also given the responsibility, freedom and flexibility by our professors. If we had any questions, we could always turn to them and their experience.”

Exactly what are the ReMAP researchers aiming to achieve? The concept is this: most maintenance in aviation is still preventive in nature; many systems and components are inspected even though they are still working perfectly. The researchers therefore aim to develop diagnoses and prognoses to switch to real-time interventions based on the actual condition of components. An improved understanding of how systems and structures degrade can also result in a substantial reduction in the weight of the aircraft and complexity of the systems. This is the transition towards what is known as Condition-Based Maintenance (CBM). Experts believe that the thousands of sensors in a modern aircraft, the accessibility and rapid transfer of the huge amounts of data obtained from these sensors and the ever-growing potential of data analysis instruments create the right conditions for implementing CBM.

Read the full interview at www.tudelft.nl/pos2018

“Research has to be driven by curiosity. Something happens that you did not expect or your experiment just won’t work, and that really gets you thinking. Nothing is more boring than when you can predict what is going to happen in advance.”

Jerry Westerweel





Jerry Westerweel

In 1918, the physicist Johannes Martinus Burgers was made the first professor of aero- and hydrodynamics at TU Delft. A century later, a celebration of 100 years of fluid mechanics in the Netherlands has been organised by Professor Jerry Westerweel – someone who has also been working in the field for quite some time.

Although we are rarely aware of it, we are surrounded by flows of gases and fluids. From the air flowing around planes and wind turbines to the breath in your lungs, and from the water in rivers to the blood in your veins. The term ‘fluid mechanics’ describes all these phenomena. “100 years ago, the accepted way to measure a flow was to use a filament that is heated up. The filament is then cooled by the air flowing past, and that cooling-off allows you to say something about the speed of the air flow”, explains Jerry Westerweel, Professor of Fluid Mechanics at the Faculty of Mechanical, Maritime and Materials Engineering (3mE). That was how Professor Burgers did it a century ago, too. “The signal that you measure looks like noise, so for many years turbulence was seen as noise in a flow.”

Fast-forward to the 1990s and we find Jerry Westerweel doing his doctoral research on the visualisation of flows. “If you want to measure something in a flow, you can do this for a single point, just as with the filament in the past. You can also add smoke or pigment to get a qualitative

impression of the flow. If you do that, you see that it contains all kinds of structures; it is not noise”, Westerweel explains. With the aid of traceable particles in the flow, you can also extract quantitative data. “By using laser light and cameras, you can follow the particles over time, which allows you to extract speed information from the images.” Back then, this technique, known as Particle Image Velocimetry or PIV, was still brand-new. “Now we use multiple high-speed cameras and larger volumes. These days, we can measure almost anything you would want to know in order to understand turbulence.”

Over the years, increasing computing power and better measurement and analysis techniques have ensured that on the one hand, we are better at visualising flows, and on the other, we are more able to solve the mathematical formulas that describe them. “It has taken a long time, but now we can draw a link between the flows and how they are described mathematically. That is a huge leap forward,” says Westerweel. “If we are able to use mathematical formulas to predict the structures in a flow, then perhaps we can also manipulate them.” This is extremely interesting for industry, because more turbulence means greater resistance and thus also higher fuel consumption, for example. “We would like to have active elements that reduce the development of turbulence structures around objects such as aeroplane wings, for instance. Then we would need less fuel and we could manufacture quieter aircraft.”

Read the full interview at www.tudelft.nl/pos2018

Delft University of Technology

T: +31 (0)15 27 89111

E: info@tudelft.nl

www.tudelft.nl

www.tudelft.nl/pos2017