# Portraits of science

TU Delft

2017

# Foreword

Excellence is a key word in everything we do at TU Delft. Hence, in this Portraits of Science you will be able to read a selection of outstanding achievements by eminent researchers, students and support staff. However, excellence is in itself not a goal worth pursuing. We aim to excel in our research because the best results will ultimately lead to the most effective solutions to society's problems. We strive for high-quality education because that enables us to train exceptional engineers, who can tackle tomorrow's challenges. Viewed from that perspective, the students of Project March, who try to give back paraplegic patients their quality of life, can only fill you with optimism for that future.

Excellence is therefore primarily a means to achieve impact. After all, we can be good *at* something, but this should also be good *for* something. To achieve that, we do not only need the best people – even though that is where it all starts – they must then have access to the most modern research facilities. In this edition, you can read all about such facilities. Take for example the Hexapod, Mirek Kaminski's fantastic fatigue machine. In our brand new Teaching Lab, Tessa van Puijenbroek discusses what you can learn from experimenting with education, while Marileen Dogterom uses the ultramodern labs of the Bionanoscience department to find out if we will be able to make synthetic cells.

That is still not all, because outstanding work is seldom done in isolation, and cooperation is actually just as important as excellence. In this publication you will find some good examples of that. See for instance, how Bart van Arem and Dariu Gavrila work together with government and industry to introduce the self-driving car. Or how Bartel Van de Walle and Kenny Meesters ensure that people from all over the university gather around a topic like disaster relief. I could continue, but I would rather recommend you take a look at this excellent booklet.

Full versions of the stories can then be read on www.tudelft.nl/pos2017.

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


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Plug-in and
spark out!

Read the full interviews
in the online magazine:

**www.tudelft.nl/
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*‘I am grateful to the organisation for all the opportunities I’ve had. In my most recent roles, as dean and Rector, my knowledge and experience have enabled me to give back a lot.’*

Karel Luyben

# Karel Luyben

Rector Magnificus Karel Luyben may be hanging up his chain of office on 1 January 2018, but plans for retirement are the last thing on his mind. Luyben prefers to focus on his future roles within the region and Europe. “I’m very satisfied with my time as rector, but am not going to dwell on that now. They can do that at my farewell do.”

Although there is no rule that stipulates that a Rector Magnificus must stand down after two terms, Professor Karel Luyben feels it is a good convention: “It’s not that I’m bored of the administrative circuit, but the time is right. When I see how things sometimes work elsewhere in the world...” Luyben is mentioning no names, but in his view, university executives should not be too keen to cling on to office. He may have put his executive responsibilities behind him, but Luyben will still be spending a day and a half every week working for TU Delft, with a special focus on Europe.

After four years as president of CESAER, a network of European universities of technology, he will remain involved as Vice-President. “Here I’ll be chairing the Science & Technology domain and leading the Open Science task force.” The latter links in well with one of his other roles, because since 2016 Luyben has been a member of the Open Science Policy Platform, an EU advisory group with 25 members. “The great thing is that the members don’t represent countries or ministries, but bodies that can benefit from Open Science, such as libraries, universities and publishers,” he says.

Luyben explains the importance of Open Science by citing a completely different example. “If farmers in China have a good harvest, they can sell it via the internet even in the smallest village. In the past, they were stuck with it, because the logistics just weren’t there. It’s amazing what a difference modern technology can make.” In his view, the same applies to Open Science. “If you quickly open up the results of science – obtained with public money – to a wider public, the results can be used immediately by someone anywhere in the world to verify their own work or to pursue the next steps,” he explains. “At the moment, you have to do it through journals. It takes time, costs a lot of money and all you have is the article and not the data it’s based on.”

In Brussels, Luyben is representing TU Delft, the VSNU (Association of Universities in the Netherlands) and CESAER, all of whom supported his candidacy. Closer to home, he is a member of the Economic Board Zuid-Holland (EBZ), the former Zuidvleugel Economic Programme Board. Within the network, knowledge institutions, businesses and government agencies try to stimulate the economy and employment in the region. “We call it the Board of Boards, because all of its members are on the board in their own organisation,” says Luyben. “Of course, we have no influence on all of those businesses and institutions, but we consult together on issues such as living labs that we would like to see in the region, the development of the ‘heat roundabout’ or other large-scale projects.”

*Read the full interview at www.tudelft.nl/pos2017*

*'The idea is: things can be a bit more 'us' than 'me'. This goes for workplaces, laboratories, catering facilities: you can see that territoriality is shifting.'*

Alexandra den Heijer


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# Alexandra den Heijer

Alexandra den Heijer has been researching campuses for more than twenty years. The campus has never been more popular as a place of work, but there is a noticeable shift from private to public space: campus and city are increasingly merging. “That has its advantages, but ‘balance’ is a key word here,” says Den Heijer.

Since 2016 TU Delft and the city of Delft have strengthened their collaboration. A logical step, as city and campus share similar social, economic and spatial responsibilities. In November last year an agreement was signed to formalize this cooperation. Dr Alexandra Den Heijer, Associate Professor in Management of the Built Environment at the Faculty of Architecture and the Built Environment, was asked to explore the theme ‘the city as campus, the campus as city. “In Delft, the physical relationship between city and campus has always been very good. A campus too far outside the city is not advisable, but you have to make sure that you each keep your own identity,” she says.
In general, the interrelationship between city and campus is a highly desirable one. “Student cities like Delft have long been accustomed to the buzz that students bring with them. Students spend a lot of hours each day on campus, but they do their shopping in the city, go to the movies there, visit the sidewalk cafes and so on,” Den Heijer sums up. This is especially true at the weekend, when many campus facilities are closed. Due to the enormous growth in student numbers, it has become important to find a new balance. “We have to figure out together how to maximise the joys and minimise the burden. For example, we may not want to house students in every part of the city. Students often have a very different day and night rhythm than other groups of residents.”
If there would be no students at all anymore, many facilities and catering establishments would have to shut up shop. The university’s economic impact is considerable in any case. “TU Delft is a big employer, and many residents are either directly or indirectly dependent on it.” Start-ups also bring jobs, but here too the question is: city or campus? “TU Delft would like to keep them clustered on campus, close to the research. But the start-ups themselves may also want to share their work with the outside world.” According to Den Heijer, you cannot easily overestimate the university’s economic significance. “Just see how much media attention was generated by the news that the European Medicines Agency with its 900 employees is moving to Amsterdam. TU Delft is many times larger and we also receive a lot of international visitors, people who are not in permanent employment, but stay in hotels, go out to eat and so on. That’s an economic factor of significance.”

*Read the full interview at www.tudelft.nl/pos2017*

*'The forces that act on the installation itself are very small; each component has been specially designed to this end. In fact, it's what motivated me: I wanted to be able to do fatigue testing without destroying my test installation.'*

Mirek Kaminski


F G B

# Mirek Kaminski

Professor Mirek Kaminski is the brain behind the Hexapod, a new research installation that uses a unique method to test fatigue phenomena in structures. The design by the professor of Ship & Offshore Structures has won grants from government, industry and TU Delft itself. “Everyone realised straight away that this was something special.”

Kaminski often wondered if there was a way to test the load-bearing capacity of structures that are subject to complex multiaxial forces. “On the one hand you need to know which forces act on the structure, while on the other, you need to know how the structures’ load-bearing capacity respond to these forces. By combining the two you can say something about the risk of failure.”

Normally, you would build a new test installation for each force you want to measure. “When you have finished one test, you pull the installation apart and reassemble it for the next measurement. In civil engineering they call this a Meccano system,’ explains Kaminski. “However, this is a difficult and impractical way of doing things for multi-axial loads. What’s more, it’s expensive too, because you are not only subjecting your test piece to various forces, but your test installation as well, which will eventually fail under the pressure.” Four years ago, Kaminski organised a brainstorm session with colleagues from the university and industry to try to solve this problem. “Suddenly I cried ‘Eureka!’ and drew a quick sketch of the test assembly - the Hexapod.” His idea was widely applauded. “Everyone realised straight away that this was a unique device that could be used to answer important research questions.”

The Hexapod, which literally means ‘six feet’, is a platform with six hydraulic cylinders that enable it to move in all six degrees of freedom. “The Hexapod can exert a force on the test piece using all six cylinders at once. This means that it can simulate any conceivable force.” And that is not all. “Normally, a structure will have a useful life of some dozens of years. We do not have that much time for testing, so we needed to accelerate this process.” The state-of-the-art fatigue testing machine can increase the test frequency so that only a month is required to simulate a period of 20 years.

Moreover, the Hexapod is also very powerful and very accurate. “We can adjust the position of the cylinders to two micrometres accuracy and the device can generate a force of 100 tonnes,” says Kaminski. It is precisely this combination of great strength and small displacements that makes the installation suitable for testing the complex forces that ships and offshore constructions have to deal with. It could even simulate the forces generated by a tsunami. “But at 100 times the speed,” says Kaminski. The only limitation is that the test piece must be able to fit in the device. “It is primarily designed to test full-scale models. Among others, this is because defects in glued or welded structures cannot be simulated at smaller scales, while these are precisely the weakest points.”

*Read the full interview at www.tudelft.nl/pos2017*

*'Aviation is not only about the product, but also about managing relationships'*

Marlie Koekenberg

# Marlie Koekenberg

Alumna Marlie Koekenberg can still regularly be found on campus as a member of the Advisory Board in the Aerospace Engineering (AE) faculty and a mentor to AE students. She also often meets people from Delft on her many trips as Director of Commercial Aerospace Programs at TenCate Advanced Composites: “There’s always someone with a connection to TU Delft.”

The name Ten Cate is not something you would automatically associate with aviation, but rather with textiles. But TenCate is also the parent company of one of the world’s most successful manufacturers of composite materials for aviation and aerospace, TenCate Advanced Composites. “Composite materials are glass or carbon fibres that are combined with a plastic. The specifications can vary depending on the application,” explains Marlie Koekenberg. “For aircraft exteriors, strength and fatigue resistance are of course the most important factors, but the requirements set for interior applications are also high, take fire safety, for example.”
Koekenberg can still often be found at TU Delft, partly in her role as a member of the faculty Advisory Board. “AE aims to bring the education it offers more into line with the ambitions of Dutch companies. As well as TenCate, you also find such companies as Fokker, NLR, Boeing and Airbus on the Board; the whole sector is represented,” she says. “In the faculty, I’ve noticed that they really want to prepare people for a career in industry.” To show how important this is, she cites an example from practice. “When you consider how TenCate was able to supply materials for the A350, it involves a pre-qualification process that takes years. You have to manufacture and test and then repeat that over and over until you’ve proved that the product is suitable, safe and robust enough for the aircraft,” she explains. “When I was studying, I was never told what a supplier qualification was, let alone how to approach it. More recently, lecturers have been training students to do this by having them go through mini-qualifications to find out what’s involved. That’s a very good thing.”
As an alumna, she has first-hand knowledge of how the programme can be improved. She recently started working as a mentor for AE students. “I now have a mentee for the second year in a row. They are highly motivated women who excel in their subject. But I feel they stil lack some all-round capability,” she says. “When you start applying for jobs, it’s less about what subjects you are good at and what your marks were, than about your ability to put yourself in the shoes of the person on the other side of the table. What is their role in the company and the position of the company in the sector, that kind of thing. You need to realise that aviation is not only about the product, but also about managing relationships. They still need to grow in that area.”

*Read the full interview at www.tudelft.nl/pos2017*

*‘As an engineering student, it’s great being able to use your knowledge for a higher purpose, such as giving people some quality of life back.’*

Donald Dingemanse  en Marise de Baar

# Marise de Baar and Donald Dingemanse

In October 2017, paraplegic Ruben de Sain took less than seven minutes to complete an obstacle course using a special Project MARCH exoskeleton. This is a major triumph for the student project, explain Marise de Baar and Donald Dingemanse. “Overcoming the four obstacles was much more important than coming first,” says De Baar.

Sitting is the new smoking, is something you often hear people say. But people stuck in a wheelchair because they are paraplegic have no choice in the matter. Or that was the case until recently because, in the last couple of years, exoskeletons have become available, external aids that paraplegics can use to stand and walk again. However, they still need some technical improvements and are very expensive because of the lack of competition. “To put it bluntly, it’s a very small market and businesses are reluctant to enter it,” says spokesperson Marise de Baar. “But why would you not want to help these people?”

Project MARCH has been doing just that since 2015. That was when a team of 33 students developed the first version of their self-designed exoskeleton, the MARCH I. They intended to use it to participate in the Cybathlon 2016, a kind of bionic paralympics for people who rely on assistive technology to get about. Unfortunately, this first team were not quite ready to complete in the Powered Exoskeleton Race for which they had signed up. But they learnt an amazing amount and the next team of students were able to build on that knowledge.

In 2016, the team headed up by Dingemanse and De Baar decided to embark on a completely new design. Although the first version proved in practice to be good for standing up, it was less effective for walking and running. “The problem was to do with the mechanism on the hips and knees, in other words the exoskeleton’s joints,” explains team leader Donald Dingemanse. But modifying the joints was not an option. “The joint mechanism actually forms the basis for the whole device, so if you change it, you have to change everything.” This meant changes including the development of new electronics and the writing of new software to control the walking movement.

That meant finding out lots of new things, but there was also plenty of help available. Some of this came from the other student teams in the D:DreamHall, the homebase for TU Delft’s dream teams that participate in international student competitions. Project MARCH has taken its place there alongside teams that vary from rocket builders to solar car racers. “The atmosphere in the hall is extremely upbeat. There is no competition between the teams, because each one is unique. But at the same time, you can also find that you encounter similar problems. That’s when you see how your colleagues resolve the issue,” says Dingemanse. “The first time we started walking with the MARCH II, the place was full of people who wanted to watch. It was great. We also used to go and watch when a vehicle was completed,“ adds De Baar.

*Read the full interview at www.tudelft.nl/pos2017*

*“Car sharing can become a real game-changer. You can then close down all the parking spaces, removing all the dead space where unused cars are parked.”*

Dariu Gavrila en Bart van Arem

# Bart van Arem and Dariu Gavrila

In June 2017, Transport Minister Melanie Schultz van Haegen opened the Researchlab Automated Driving Delft (RADD) on the TU Delft campus. In the lab, automated driving experiments are being conducted under the supervision of Professors Bart van Arem and Dariu Gavrila. Because the self-driving car is on its way. Or is it in fact already here?

In 2011, there were an estimated one billion cars worldwide and that figure is expected to have doubled by 2035. These huge figures encapsulate a number of reasons why automated driving seems to be a good idea. First of all, for safety reasons. Every year, there are 1.2 million traffic fatalities worldwide, most of them caused by driver error. “There is an awful lot that can go wrong behind the wheel,” says Dariu Gavrila, Professor of Intelligent Vehicles in the Faculty of Mechanical, Maritime and Materials Engineering (3mE). Then there are the congested roads and city centres grinding to a halt. “A great many cities would benefit from a combination of car sharing and automated driving in order to improve quality of life in city centres,” adds Bart van Arem, Professor of Transport Modelling in the Faculty of Civil Engineering and Geosciences (CEG).

But the question is when exactly this will happen. Rather than a revolution, it will be an evolutionary process, which has in fact already started, albeit slowly. “There are lots of people who don’t yet realise that automatic systems already exist for your car,” explains Van Arem. “For example, there is adaptive cruise control that ensures you maintain sufficient distance from the car in front. Although it was introduced by Mercedes and Jaguar back in 1999, only 10% of all new cars have it so far. We expect the introduction of systems of this kind to accelerate, partly because insurers have noticed they result in reduced involvement in accidents and related damage.”

In any event, a lot of hard work is being done in Delft to make it possible. Van Arem is working at the level of the entire transport system: “We are looking at how automatic vehicles can develop within the existing system. What impact will they have on traffic congestion, for example,” he says. Gavrila is focusing on perfecting the vehicle itself. “Currently, people are still better at judging situations than vehicles are,” he says. “Machines need to learn to anticipate instead of just react.”

This is where both specialist fields converge: in the Researchlab Automated Driving Delft (RADD) on the TU Delft campus, experiments are being conducted with automated transport in real-life situations. “There is a limit to what you can do on a computer,” says Van Arem, one of the initiators of the lab. The RADD has access to two Toyota Prius and a WEpod shuttle vehicle from the Province of Gelderland. As well as on the designated test site on campus, pilot projects can also be conducted on public roads and on and around the campus. “We can use these to investigate how vehicles interact with cyclists and pedestrians, for example.” The campus will also be equipped with sensors that can test communication between vehicles and infrastructure.

*Read the full interview at www.tudelft.nl/pos2017*

*‘I try to involve my graduating students as much as possible in my research. If that results in something great, then they also take the credit.’*

Mark Voskuijl

# Mark Voskuijl

Attempting to lower fuel consumption and fewer emissions in a growing aviation sector is quite a task – and one which requires significant innovation in the industry. The European funding programme Horizon 2020 has awarded grants to three sustainable flying projects in which TU Delft has an active role. Dr Mark Voskuijl at the Faculty of Aerospace Engineering (AE) is involved in all three.

The idea behind PARSIFAL is to fly with a box wing configuration; in other words, a closed wing. The name of the project stands for Prandtlplane ARchitecture for the Sustainable Improvement of Future AirpLanes. Prandtl was a famous aerodynamicist who, back in 1924, demonstrated that in theory a box wing configuration has the lowest level of induced drag. At that time, however, they had so many other problems to solve in aviation that saving a few per cent on fuel wasn't so much of an issue. Aerodynamically speaking, a box wing configuration is very efficient but it does have implications. A box wing doesn't have a stabiliser, so you have to redesign the steering and controls. You need make sure that you use the control surfaces on the lower and upper wings effectively. The interesting thing is that, with this configuration, we can carry out new types of manoeuvres which you can't do with normal aircraft.

A helicopter should be able to hover well so that it can land and take off vertically. However, it also needs to be able to fly forwards efficiently, and these are two very different things. When designing a rotor, you always have to make compromises; a helicopter that is very good at vertical take-offs is poor at forward flight and vice versa. This is precisely the problem we are trying to solve in the SABRE project. SABRE stands for Shape Adaptive Blades for Rotorcraft Efficiency. Blade morphing technology – a bit like Transformers. We are working on six different concepts which will allow us to adjust the shape of the rotor blade mid-flight. With intelligent constructions like these you can adjust the shape for take-off, landing or flying. I am currently researching the effect of this on the helicopter as a whole.

Centerline is another completely different project. This revolves around the idea of installing an extra engine in a standard commercial airliner, which is integrated in the hull – a bit like a torpedo. The air behind an aircraft is always in motion, which translates into energy loss. When a lorry passes by, you feel the air rush by. That happens behind a plane too. You can eliminate that movement by giving a little boost with a small engine. To make that work, you have to blow just enough so that nothing moves. This can improve propulsion efficiency by five to ten per cent. We have already demonstrated that principle in the wind tunnel. You really don't want to build an entire engine in your hull, so you power the system electrically through the normal engines.

*Read the full interview at www.tudelft.nl/pos2017*

*'The students learned new data-analysis methods in a very practical way, outside the lecture hall. I think that skills that are learned in this way sink in better, not least because they were really motivated to learn something.'*

Kenny Meesters en Bartel Van de Walle

# Bartel Van de Walle en Kenny Meesters

Professor Bartel Van de Walle and researcher Kenny Meesters are investigating the role played by information in emergency relief efforts. In the aftermath of Hurricane Harvey in Texas, they collected data during a special hackathon for students. One conclusion could be drawn straight away: Delft students are keen to help.

In August 2017, Hurricane Harvey raged over Texas. The consequences were extreme rainfall in Houston, 48 fatalities, tens of thousands of evacuees, and what is estimated at more than 100 billion dollars of damage. Researchers from TU Delft set up a Harvey Texas Research Team to analyse what could be learned from this massive disaster for water security and emergency relief efforts in both the US and the Netherlands. The project began with a quest for information, in the form of the Harvey Hackathon. Around a hundred students signed up from across the entire campus and beyond. “People around here wanted to do something, and our aim was to reach as many of them as possible,” explains Professor Bartel Van de Walle, professor of Policy Analysis at the Faculty of Technology, Policy and Management.

Van de Walle and his doctoral student Kenny Meesters were able to make good use of this help. Hurricane Harvey was what is known as a data-rich event. “A great deal of information was available: on social media, on news sites, in organisations’ reports, you name it. That is a huge amount of work for the two of us. By outsourcing it to people who were keen to help, we got lots of information that we might not have found ourselves. It was a win-win situation,” says Van de Walle. Nor did the students need any special expertise. “The idea was that you could get going in five minutes. If you got the hang of it during the day, or if you had experience in areas like GIS or mapping, you could do more challenging things,” says Meesters. “In this way, a form of multidisciplinary cooperation emerged in a very organic way.”

The participating students were divided into groups, based on themes and accompanying research questions. “I coordinated the airports theme: which airports closed when and why, and what effect did this have? Another theme was ‘communities’: how did they respond and how did they organise themselves?” says Van de Walle. One finding, for example, was that Airbnb encouraged hosts to make their homes available to evacuees and relief workers for free, by waiving their own service charges; a nice practical example of how sharing information online can support relief work. This and other data resulting from the hackathon will serve as input for follow-up research, but for Van de Walle and Meesters, there were additional results.

*Read the full interview at www.tudelft.nl/pos2017*

*‘Bioinformatics was a bit like coming home. Biotechnology deals with natural phenomena and it was because of this that I had decided to study physics in the first place.’*

Marcel Reinders

# Marcel Reinders

In 2017, for the first time in thirty years, a new gene was discovered that can cause Alzheimer's disease. Professor Marcel Reinders was closely involved in the research. He is Professor of Bioinformatics at the Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) and is working on methods for utilising the increasing amount of information found in DNA.

The fourth Alzheimer gene forms part of the research we are carrying out with the VUMC, the academic hospital of Amsterdam's VU University. I am working on it together with my wife, who works at the VUMC. She heads a study into people who are over a hundred years old and remained mentally healthy, so they do not have dementia. In the past, we used to think that sooner or later everyone would get dementia. The incidence rises with age and, if you look at a graph, you'd think that everyone would get it, but that's apparently not the case. The oldest Dutch woman, Hendrikje van Andel, lived to the age of 115 and remained completely lucid. Evidently, there's a small group of individuals who are protected against it and they form a very interesting group to compare with people who get dementia. They seem to have something that dementia patients lack, or vice versa. But what?

Variations in genes are very important. DNA is made up of four building blocks, the nucleotides: adenine, cytosine, guanine and thymine; or A, C, G and T. It might be that at a certain place in a gene, you could have an 'A' where those centenarians have something else. Sometimes a variant like this is found at a place where the protein that is being made no longer functions. We discovered that some patients with Alzheimer's disease, the most common form of dementia, had a dangerous mutation in the SORL1 gene. This gene makes a protein that ensures that not too many harmful Alzheimer's proteins can accumulate in the brain. We suspect that if the SORL1 protein does not function properly due to a mutation in the SORL1 gene, these harmful proteins will accumulate more quickly, eventually leading to dementia.

This discovery is clinically very promising, because you can screen for it. We might not have developed a medicine yet, but it does mean you can offer people ongoing monitoring and counselling. In addition, if your carrier status is confirmed, you may be able to take part in clinical trials in which the efficacy of new drugs is tested, which may delay the disease process. We had already identified three Alzheimer genes, and now the SOLR1 gene has been added to these.
While dangerous variants of the previously discovered genes are very rare, a dangerous variant of the SORL1 gene occurs in about 2% of Alzheimer's patients. We are now expanding the research into other genes and are using the same kind of algorithms. In this way we want to further extend the set of Alzheimer genes.

*Read the full interview at www.tudelft.nl/pos2017*

*‘For humanity, this is a big, important and open-ended question: how does life work? ’*

Marileen Dogterom

# Marileen Dogterom

A Dutch consortium of researchers from six universities and institutes is trying to build a synthetic biological cell and has received a grant of €19 million to support its work from the Gravitation Programme of the Netherlands Organisation for Scientific Research (NWO). The project leader is Professor Marileen Dogterom of the Faculty of Applied Sciences.

The physical processes taking place in cells have always interested me. I am particularly fascinated by the cytoskeleton, the system of protein polymers that defines the spatial structure and rigidity of all living cells. The skeleton of a cell is a much more dynamic system than that of a human. It is a structure made up of polymer threads, such as microtubules, that constantly renew themselves, disintegrating and rebuilding to form other components depending on the needs of the cell. For example, a dividing cell needs a different type of skeleton compared to non-dividing cells. During the cell division process, these long threads push the chromosomes into the right place and pull them apart.

In the course of our experiments, we shifted our focus from a few polymers to entire networks of polymers in enclosed spaces, such as inside a cell. We would like to understand how they organise themselves under the influence of all these dynamic processes and what kind of forces they generate. We started off using tiny glass containers in which we enclosed the polymers. Today, we use microfluid techniques on droplets that have membrane-like exterior walls. This approximates a real cell more closely. We can now simulate increasingly complex cell processes using natural components contained in artificial cells. My research group focuses on the spatial structure of the cell. In order to increase this complexity to the point where you have created a complete synthetic cell, you will have to replicate all fundamental intracellular processes. This means you also need to simulate cell metabolism and information transfer in the form of DNA.

In the Netherlands, a number of research groups are trying to simulate the different cell functions. We are now consolidating this effort in the Gravitation Programme. A total of seventeen research groups from six universities and institutes are involved. Five of these are located here at TU Delft. Christophe Danelon is studying how exactly the information contained in DNA is converted to proteins, a process known as gene expression. Cees Dekker is focusing on how cells deform during cell division. Nynke Dekker is studying DNA replication and Pascalle Daran, together with Wageningen University, is researching how large pieces of synthetic DNA can function inside natural cells. The University of Groningen is studying cell metabolism, while scientists in Nijmegen and Amsterdam are examining information transfer processes and regulatory networks inside the cell. Any module that can do what it is supposed to do for a few hours is a milestone for the project. We will join the modules together at a later stage, when we should be able to build an autonomously functioning cell. I am convinced we will succeed, but I am not sure exactly when.

*Read the full interview at www.tudelft.nl/pos2017*

*‘The Aeroplane Lab works really well. People actually believe they are in an aircraft, trying to turn the ventilation on if it’s warm.’*

Sicco Santema, Suzanne Hiemstra en Katinka Bergema

# Katinka Bergema, Suzanne Hiemstra en Sicco Santema

A one-hour reduction in door-to-door journey time when travelling by air within Europe – that is the ambitious goal of the PASSME project. Post-docs Katinka Bergema and Suzanne Hiemstra and their head of research Sicco Santema believe that this can easily be achieved by measures like door-to-door luggage transport and more effective organisation of hand baggage in the cabin.

PASSME is being funded by the EU's Horizon 2020 programme. It was selected from some 75 research proposals in 2015. "The EU envisions reducing the average journey time within Europe to four hours. The average is currently eight hours," says Sicco Santema, Professor of Business to Business Marketing in the faculty of Industrial Design Engineering (IDE). Santema and his colleagues believe that they can achieve a one-hour reduction in the journey time. But how? "Information about that passenger is available in the system of the airline's ticket sales department, but not much happens with it," explains Santema. "If that information from and about passengers is shared with chain partners, we'll have a much better idea of how many people there will be and when they'll turn up. Then you can, for example, adjust capacity in the luggage and customs checks accordingly."
A lot of time can also be saved if passengers do not take their luggage to the airport and check it in themselves. This is a topic in which postdoctoral researcher Katinka Bergema has taken a particular interest. "If you look at the passenger's journey, the process of dropping off and reclaiming luggage involves a lot of time and a fair degree of tension", she explains. "Door-to-door solutions remove that stress in one fell swoop." It is already possible: start-up Travel-Light collects suitcases at home and transports them by road. For the purposes of her research, Bergema even tried it out for herself. "Actually, it's very pleasant, because the stress of packing is behind you, although I did forget what I'd put in my case."
Even if the suitcases travel from door-to-door, there are other problems that can prevent a fast journey. Postdoctoral researcher Suzanne Hiemstra is concentrating on the interiors of airports and aircraft. "My main focus is on boarding and leaving the aircraft," she says. "We have conducted observations during flights to see exactly what people do." This revealed that taking too much hand baggage is a real problem. "Even if everyone has exactly the permitted dimensions, only 60 to 80 percent of the hand baggage, depending on the type of aircraft, actually fits in the overhead locker." A baggage-booking system could be the solution. For testing such ideas PASSME has access to its own Aeroplane Lab, the fuselage of a Boeing 737-500 including doors, purchased especially for the project.

*Read the full interview at www.tudelft.nl/pos2017*

*‘If the new vision on education states that we have to teach students more ‘digital skills’, how are we going to embed that in our education? We try to substantiate this vison with the help of ideas from lecturers.’*

Tessa van Puijenbroek

# Tessa van Puijenbroek

September 2017 saw the opening of the Teaching Lab, the headquarters of the Teaching Academy, TU Delft's community of lecturers. Lecturers are always welcome in the new lab where they can experiment, share experiences or brainstorm with colleagues. Tessa van Puijenbroek, programme manager education and innovation, is closely involved in the new lab.

"We are just dropping by." A few colleagues enter the building. There is a steady stream of visitors to the newly opened Teaching Lab, which has clearly created a buzz. Lecturers come in for workshops or just to have a look around. The door is always open; not literally, but with their staff pass lecturers can come and go as they please. "This is still a relatively quiet day," says Tessa van Puijenbroek, who is host for the day. "Everyone is welcome, even if you just want to come and read a newspaper or talk to any colleagues who happen to be there. 'May I come and have a look?', lecturers often ask. '"Yes, of course, the Lab is here for you,'" I tell them."

A small tour of the building shows that the Teaching Lab is very flexible. The two sizeable rooms on the ground floor can be merged into one large hall. "You can receive groups here, but you can also create smaller corners. All in all, the hall can hold 150 people." Or with a bit of effort 200, the number of people who recently visited the opening of the lab, even though that meant the staircase was full too. Said staircase leads to a pantry with of course good coffee, laptop spaces, seating areas and again some flexible rooms. "Up here we have a digital brainstorm room ,and spaces for workshops and conferences. And at the mini studio you can just walk in to record your educational video – very low-threshold," says Van Puijenbroek.

The lab is all about meeting, inspiration and exchange. Van Puijenbroek points to a wall full of post-its. "That is our 'tree of educational needs'. We ask people who come in for workshops to write down what they need in terms of educational innovation," she says. For example, a visitor recently suggested that colleagues should visit classes of those who are voted 'best lecturers' etc. and see for themselves what the secret of their success is. "I think it's great fun to get these kinds of initiatives off the ground. Teachers often have very good ideas but don't have the time to implement them. I want to make sure that people who visit us leave with the feeling that we are really helping them," says Van Puijenbroek. "The Lab also makes it easier to see what teachers are working on, so that in the future we can better tailor our support and innovation agenda to their needs."

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