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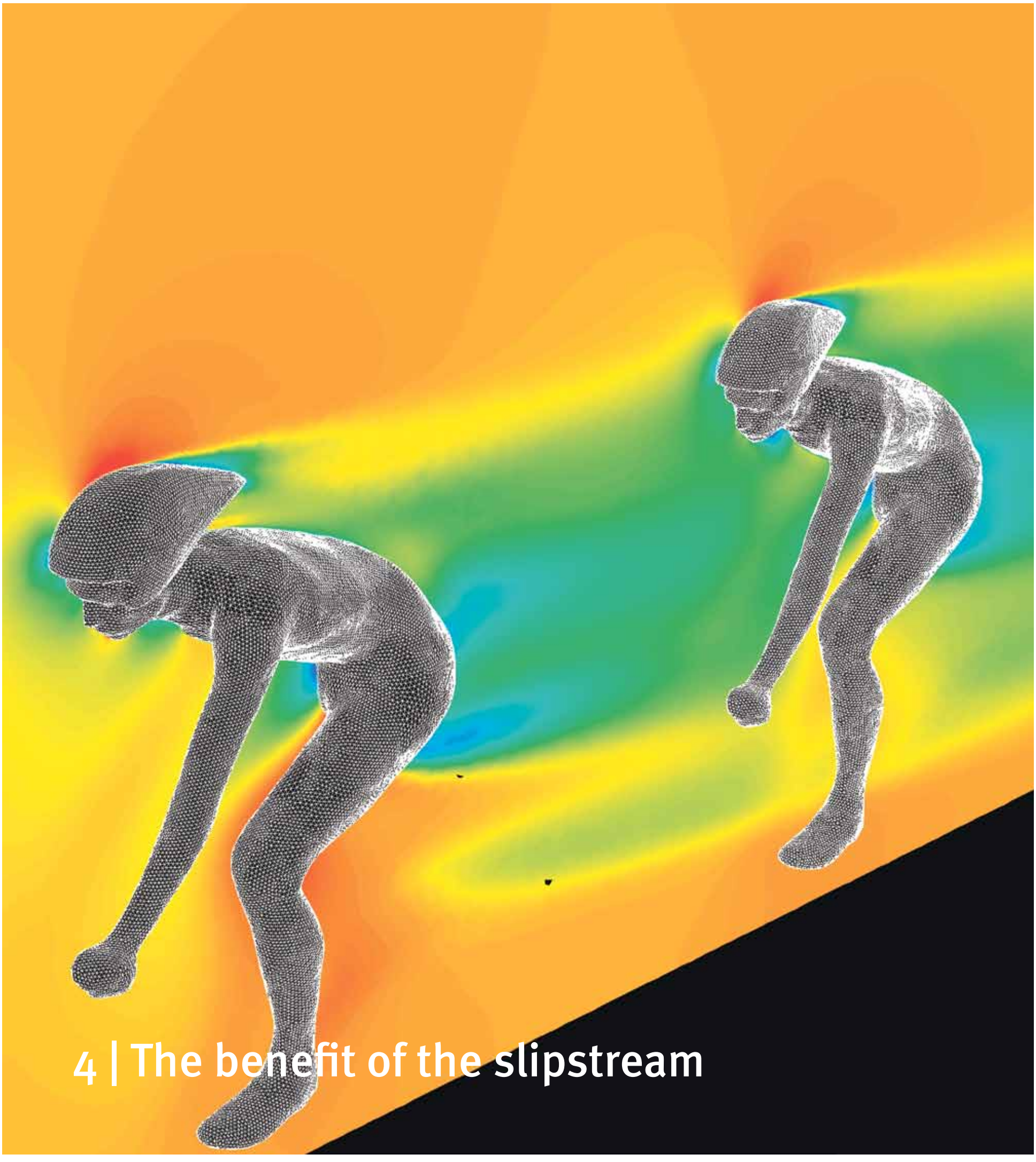

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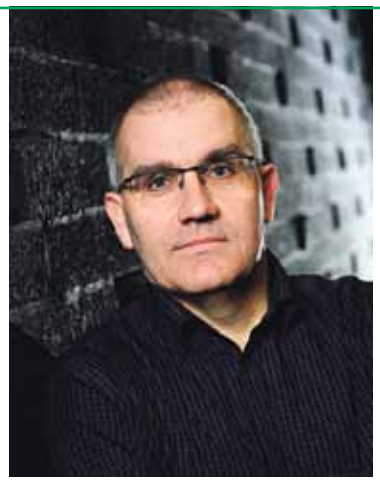


Leg up

'Behind every strong man is a strong woman.' If I were to translate this wisdom to our university, you could say our strong - chiefly male - scientists are mainly backed by strong women. Five women are currently in charge of the services responsible for communication, housing, personnel, and library and student affairs. And on June 1, a woman might come to do our bookkeeping, since that's when our head of Finance Paul Berg will be leaving us.

One thing's for sure: there will be at least one woman who'll be reinforcing this elite club. Mid-June, Nicole Ummelen, currently working at University of Amsterdam, will be succeeding university secretary Harry Roumen. It's obvious that in the services department people are doing a great job putting women in top positions. The Executive Board even gave our future secretary a leg up in the selection procedure.
The profile stated they preferred appointing a woman, although male candidates weren't ruled out per se.

Even our scientific staff seems to be making some progres. Last year, TU/e was treated to the first-ever female dean, and we managed to appoint the youngest female full professor of the Netherlands. Makes me wonder if deans will now start giving excellent females a leg up as well.

Twittersearch

"Considering you never cover politics, it's odd to suddenly retweet all #martijnvandam factoids. Alumnus or not." Tweeting away, we're still trying to determine what it is our varied readers expect from us. In our quest, it's nice to know readers will keep you on your toes, and it certainly helps we're all so close through digital communication.
It has been a journey of trial and error: in June of 2011, Cursor deliberately entered the world of Twitter (in the three years prior to that, the account quietly streamed a news feed from the Cursor website via RSS). Today, having eleven hundred followers, we're still searching: for news, great stories, the fun side of science – but we're also figuring out where we belong in Twitter Town.
Much like our fellow townspeople, we

imagine, including all TU/e folk crossing our digital path on a daily basis. This week, we talked to three of them – in 48 times 140 characters, give or take. **See page 4/5 in the Dutch section.**

Rewwwind
www.tue.nl/cursor

Our Rewwwind feature provides you with snippets of last week's news. What happened online after the previous Cursor magazine was published?

Philips top researcher Emile Aarts vice-Dean W&I

March 2, 2012 - The Executive Board and TU/e have appointed prof.dr. Emile Aarts as vice-Dean of the Department of Mathematics and Computer Science (W&I). He is to start May 1. Currently, Aarts is Chief Scientific Officer and a member of the Philips Research Laboratories management team. Aarts is also a part-time professor at TU/e's Department of Industrial Design. He's expected to succeed Arjen Cohen as Dean of the Department of W&I in 2013.

Relatively many Proof-of-Concept grants for TU/e

February 29, 2012 - Of the 22 proposals the European Research Council has accepted, five grants are going to the Netherlands. Compared to other countries, Dutch universities have acquired the most Proof-of-Concept grants. Of all proposals submitted in 2011, 52 received a grant, and three of those proposals came from TU/e.

TU/e meeting place website calls it a day

February 29, 2012 - After more than 3.5 years, the online community 'TU/e meeting place' will be shut down. The website for international faculty and students has hardly seen any online activity recently. According to Willem van Hoorn, Advisor of Internationalization at DPO and the site's webmaster, the website used to meet certain needs. "Back then, there weren't all that many alternatives so a lot was shared. Today, international faculty and students are found on Facebook and LinkedIn mostly, and the HUB Eindhoven community for expats is rather popular as well. The web's saturated, we had a good run." **www.tuemeetingplace.nl** will go down in April, but until then users can still download pictures and/or documents from the site.

Photo | Erik Geelen via IEC

Flashback

Computing equipment 1962 vs. 2012

Back in 1962, this mechanical calculator, the Facit CI-19, was used at Jos Jansen's Numerical Mathematics lab. A beautiful device that unfortunately made your arm ache. "A student, who had to solve five equations with five unknown numericals could do so with the help of this small calculator. He would have to punch in a number, spin the handle nine times, press the next number, turn it five times, etcetera."The TH had a room chockfull of these devices that were impossible to steal unnoticeably.

Jansen has worked at TU/e for forty years and can still be regularly found at Avondrood today. He remembers the phase the computing center purchased a Burroughs machine. "The floor had to be free of vibrations, temperature and humidity had to be constant, and the thing cost over ten million guilders. Today, students have a 400-euro laptop they strap onto the backs of their bikes. And those things can do a million times more than that wall-to-wall Burroughs." (NS)

Clmn Netherlands? No, Naturelands!

My friend was excited when I told him that I live in the smartest region of the world. He's never been to Eindhoven and soon his imagination had created a surprisingly crowded, post-industrial city with tall skyscrapers lit by neon lights, just like Hong Kong. He had created a concrete jungle suffocated by traffic jams and pollution, like Moscow, an entire city to be traveled through a network of high-speed trains, like Tokyo. In a nutshell: Eindhoven is thought to symbolize human's total domination over nature because, stereotypically, in a modern society, being smart often means being technologically developed and therefore environmentally unfriendly.
Let's go back to real Eindhoven. Strolling around TU/e campus you'll see rabbits hopping on green grass among tall trees. In the Dommel you'll see ducks swimming peacefully, ignoring people walking by. Riding your bike towards the Beukenlaan train station you'll happen upon a beautiful park located nearby. At night, enjoy the amazing star-spangled sky seen through clean, transparent air. On Saturday morning, have a walk and be surprised by empty roads and streets. Catch a train towards Roosendaal and look at the fields, small forests and windmills alongside the tracks. Of course, there are plenty of industrial plants in Brabant. However, you'll barely notice them because they're not spoiling the overall scenery of the natural landscape.
I don't know how the local government managed to develop a knowledge-based economy without harming nature. However, this Naturelands experience in the Netherlands is especially important now, as environmentalists are alerting everyone to the depletion of natural resources and are predicting a gloomy future for us all.

Sultan Imangaliyev, from Kazakhstan, is a student of Systems & Control, Department of Mechanical Engineering

Vox Academici

Dr.ir. Servaas Kokkelmans, assistant professor of Coherence and Quantum Mechanics, Department of Applied Physics (TN)

Has the Majorana fermion finally emerged?


Servaas Kokkelmans. Photo | Bart van Overbeeke

At a major physics conference held last week, Delft physicist Leo Kouwenhoven caused quite a stir. His research group seems to have managed to create a new particle: the Majorana fermion. It's been searched for ever since the late thirties. The exotic particle might be used as a data carrier in future quantum computers. What kind of particle are we looking at, exactly? And are quantum computers within reach thanks to this discovery?

"It's important news for quantum physics – the particle appears to have been finally found", says a beaming Servaas Kokkelmans, assistant professor of Coherence and Quantum Technology at the Department of Applied Physics. "And it's not just the particle that's surrounded by mystery, it's the name giver as well. The brilliant Italian physicist Ettore Majorana vanished without a trace in 1939, three months after he had been appointed as professor, leaving behind an entire theory on the new fermion. It really is a special particle in many respects. Theoretical discoveries of particles don't automatically lead to actual findings. And the Majorana fermion is two-headed: it's a particle and an antiparticle at the same time, and because of its characteristics it's considered the perfect building block for quantum computers."

"The researchers in Delft haven't actually seen the Majorana fermion, but they were able to prove its presence as a quasiparticle. At the tips of superconducting nanowires they managed to conduct measurements in a magnetic field that indicated they had created the Majorana particle. Some skeptics are still not convinced, but you can't show up with these results and stand in front of all these brainiacs at a conference of that magnitude if you're not dead sure about your findings."

"The Kavli Institute of Nanoscience, of which Kouwenhovenhoven's group is a part, is conducting a lot of research into quantum computers – smart computers that are able to quickly calculate complex parallel computations. However, standard data-carrying bits consisting of zeroes and ones aren't good enough for that. What these computers need are qubits, consisting of zeroes and ones at the same time. The problem is that qubits are very unstable and they can easily return to being ordinary bits through interaction with their surroundings. As long as we don't have stable qubits, we won't have quantum computers on a large scale either. The good news is that a pair of Majorana fermions can also form a qubit, which is quite stable because of the pairing."

"More and more systems allow making qubits for quantum computers. Beside the Majorana fermion one might also opt for Rydberg crystals, which our group is currently trying to create. The crystals consist of several excited atoms in rarefied rubium gas, which can form a crystal structure when close together, and they too can be used to create stable qubits. So in fact, this new discovery isn't great news for us at all. Besides, the chip Kouwenhoven is using to create his Majorana fermions works a lot better at your desk than in our huge vacuum room. Then again, there are several paths that will eventually lead to the same goal, and right now we're not sure which one is the best. Another potential benefit is that quantum computers based on Rydberg-crystal qubits know no limitations. Computers made with Majorana particles will be so-called topological quantum computers, which cannot carry out all necessary operations."

"Obviously, we won't be able to start working with the quantum computer right away. First, we have to use the Majorana particles to create numerous qubits that can work together, and then we have to make that into an operational device. Still, I think this find is a giant leap forward. And since they're relatively small experiments – a chip is hardly a particle accelerator – results come in fast and the competition is more serious. As soon as the recipe is out, anyone can get cooking. Leo Kouwenhoven does have the dough, though: a Spinoza Prize, an ERC Advanced Grant, and Microsoft funded him, too. It allowed for more expensive systems; they didn't have to build it all by themselves. Add a smart and skilful team, and surely something beautiful should be the result…" (NT)

A dream of a campaign

Last Monday- and Tuesdayevening, some **300 dreams** were projected on buildings and clouds in light of the nationwide student recruitment campaign Beam your dream. Up until Wednesday morning, **530 dreams** had been sent in, but dreams won't be beamed if they contain ads or offensive language.

This week and the next, the dream team will be visiting **30** to **50 schools** in **14 Dutch cities** to inform secondary-schoolers about the campaign.

The aim is to project about **3000 dreams** in **2 weeks**. From February 28 through last Wednesday morning, beamyourdream.nl had **6000 unique visitors**.

Until March 18, the campaign commercial will be broadcast **105 times** on MTV, Comedy Central, and Teen Nick. The commercial lasts **15 seconds**. (JvG)

Photo | Rien Meulman

A new perspective on riding within inches of the wheel and pacelines

He knows all about airflows in the built environment, but prof.dr.ir. Bert Blocken, professor of Building Physics at TU/e, is also a cycling enthusiast. His latest research joins his two passions. How to take advantage of the rider who's within inches of your wheel.

On level ground, road bicycle races are mostly about overcoming the air resistance; riders wear those tight outfits for a reason, after all. It's a well-known fact that following closely to the rider in front of you to experience the benefit of his slipstream is a clever way of making things easier for yourself. However, saying a rider actually benefits from having someone within inches of their back wheel as well may sound strange to many a sports enthusiast.

> A rider having someone within inches of their back wheel experiences less air resistance

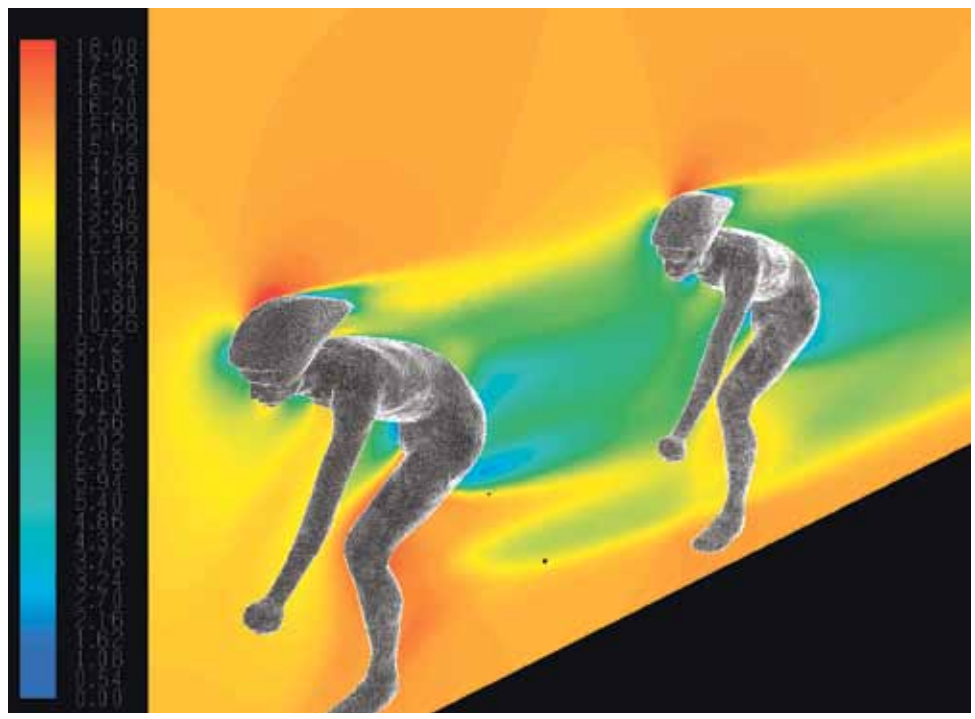
The topic was still being debated in scientific literature, but Bert Blocken now has indisputable proof: a rider having a 'limpet' onto their back wheel will experience 2.5 percent less air resistance. Simply put, that's because the braking underpresssure arising behind the rider is partly compensated by the overpesssure caused by their follower: as a result, the air doesn't 'suck' at the rider in front. "The existence of that overpressure is called subsonic upstream disturbance," says Blocken. "It's a well-known phenomenon in physics, but its effects sometimes turn out to be counter-intuitive."
Said 2.5-percent gain occurs when there's a 15-centimeter gap between riders at a speed of 54 kilometers an hour – a normal speed for team time trials or sprints on rising hidden gradients. The 'push effect' drastically decreases if the follower doesn't literally get onto the back wheel: a meter's distance between the wheels yields a mere 0.6-percent gain, simulations carried out by Blocken have shown. Still, it might just be the difference between winning and being overtaken by the peloton right before crossing the finish line. Of course, there's a much more substantial benefit for the follower: they experience a reduction of air resistance of 33 percent compared to cycling alone.
These striking results were found during a project Blocken, who used to be an avid road cyclist himself, has been involved in for the past few years. With colleagues from the Departments of Biomedical Kinesiology and Biosystems of KU Leuven and ETH Zürich, the Flanders-born Blocken researched the optimum cycling position for road cyclists, a study commissioned by the Flanders Cycling Federation. "It involved more than mere aerodynamics. You aim at finding an optimum, being a good aerodynamic position that still allows for exerting power. The latter is what my Leuven colleagues specialize in."
In order to determine the cycling position's effect on air resistance, Blocken and his colleagues conducted elaborate tests at the National Aerospace Laboratory's wind tunnel in Marknesse. A trained road cyclist was fitted with some thirty sensors (see left picture below). While the athlete was on a bike in the cycling position on a balance platform in the wind tunnel, these sensors measured the air pressure close to his skin. The total horizontal force on the platform carrying the test rider – the actual air resistance – was measured as well.
It was then decided to create a plastic replica of the rider in order to be able to map the airflow around the body even more accurately. To this end, the researchers scanned the subject's contours, and that information was used to create a hollow, polyamide copy. This 'statue of a cyclist' had 115 holes pierced into it that were fitted with pressure sensors. The picture shows the pressure tubes protrude from the replica 'just above the saddle'. It's right there, in the rider's wake, that the effect on air resistance is the slightest.
The wind tunnel measurements have resulted in a computer model that can map the airflows around the cyclist - and so the air resistance - to the tiniest detail. But the calculations aren't limited to the replica's specific posture: using a laser scanner, researchers can simply record someone's body shape and virtually adapt it to their exact position on the bike. Blocken: "That means the test riders don't have to travel all the way to Eindhoven or Leuven for tests."
The air resistance is largely determined by the fluid dynamics in a several-milli-meter boundary layer on the subject's skin/clothing. For the simulation, this crucial zone is divided into grid points that are only 0.014 millimeters apart - in total, the model contains anywhere between twelve and eighteen million points. For the best results, Blocken works with 0.3-second intervals.

> A laser scanner determines the body shape; the cycling position can then be virtually adjusted

A highly-detailed model like that takes a while to compute. Even at the special computer cluster at Vertigo – boasting 144 processors – it takes about twelve hours to compute a single simulation. The project described above was meant especially to analyze individual riders.

Bert Blocken. Archive photo | Bart van Overbeeke

But since he now had a working simulation anyway, Blocken couldn't resist seeing what were to happen if he put two riders in a line. "I did that because I was curious, it wasn't part of my assignment anymore", says the cycling enthusiast.
Blocken's private project provides a decisive answer on a rider's benefit of another rider getting onto their back wheel. Extra measurements done several weeks ago, with two riders this time, confirmed the simulation results. Some of the result could have a significant impact on the world of cycling, Blocken thinks. "Simulations show that in a paceline, during a team time trial for example, it's not the last runner who experiences the least air resistance, but the second last." The 37-year-old full professor thinks teams might want to change the order of their riders in team time trials when taking into account the build of their riders.
In the future, Blocken wants to do paceline simulations with riders of different builds. Whether or not riders will listen to his advice is an entirely different matter: "One of the riders participating in the study already told me he thinks the negative psychological effect of someone within inches of your wheel is much more powerful than the advantage of a reduced air resistance. Of course, there's no way for me to rule that out for a regular race, but my research results are especially interesting for team time trials."
Blocken's cycling research has not gone unnoticed. Yesterday, March 7, TV show Labyrint (VPRO/NTR) discussed Blocken's findings. The program also covered the study his group carried out at the Rotterdam harbor. Commissioned by the Port of Rotterdam Authority, Blocken and his PhD student ir. Wendy Janssen mapped the complete wind field within the harbor area. The results help Rotterdam pilots to safely maneuver giant containers into the harbor. The show can be watched on the Labyrint website **(www.labyrint.ml).** (TJ)



Better view of water in coatings

Victor Baukh. Photo | Rien Meulman

Water that permeates coatings of cars and airplanes may give rise to damage as years go by. The expansion and contraction of the coatings caused by the alternate wet and dry weather, or even frost and thaw, leads to accelerated aging. Dr. Viktor Baukh, born in Russia and raised in Ukraine, devoted his doctoral research to this subject. He obtained his PhD on March 5.

As a result of international regulations intended to protect the environment more and more water-based coatings have come onto the market. As these coatings are by definition water-soluble, they are also more vulnerable to water from the environment. The doctoral research conducted by Viktor Baukh in the Transport in Permeable Media (TPM) research group was intended to reach a better understanding of water absorption and transport in multilayer coatings, so as to be able to say more about the effects of water in these paint films.
Baukh studied a coating that is representative of the multilayer coatings that are used for cars - consisting of a top coat on solvent, applied on a water-borne priming coat. He conducted this research in cooperation with TNO and AkzoNobel, one of the world's largest coating manufacturers.
In order to visualize the water in the coatings, Baukh used a 'home-made' MRI scanner. "The scanners that are used in the medical world have resolutions of a couple of hundred micrometers. For our research that is not adequate, since each the films of the coating are merely several dozens of micrometers thick." That is why a special MRI scanner was constructed in Baukh's research group, with a resolution of just a few micrometers.

Environmentally friendly water-based coatings are by definition more vulnerable to water

This has resulted in a unique device, as the researcher explains: "Only in Surrey do they have a similar MRI scanner. Ours is better, though: we can distinguish all the four main components of the coating - the pigment and three types of polymer- and make the water transport within them visible. You can see, for example, that the absorption of water makes the priming coat softer. I'm actually quite proud of having been able to make that process visible."
Baukh, who after his PhD will continue his research as a postdoc in the TPM group, is also proud of the model for water transport in multilayer coatings that he has managed to draw up as a result of the measurements. "My model shows that you can predict all relevant effects once you know two parameters, notably the permeability of the top coat and the so-called sorption isotherm of the priming layer, which describes the water contents of the coating at a certain humidity degree."
From now on it will be simple for manufacturers to measure the effects of water on coatings, says Baukh: "By means of our model you can determine the water resistance of these types of coatings by means of simple scales that enable you to measure the increase in weight resulting from the absorbed water."
Baukh has already used his model to scrutinize the procedure for weathering tests for coatings. His conclusion: due to their relatively short duration the tests are not indicative of long-term effects. "The influence of water absorption on the weathering of coatings works on a much longer time scale; the mechanical process of expansion and contraction requires time. While the tests may give a good idea of the influence of temperature and UV light, I do have some doubts regarding the exposure to moisture."

From now on measuring the effects of water on coatings is simple

Although Baukh concentrated mainly on coatings for the automotive industry, one of the most striking results from his dissertation pertains to the aviation sector: his measurements show that a widely used hydraulic liquid - for the brakes and the landing gear - affects the top film of coatings on airplanes. The result is that the permeability for water of these essential coatings is increased. "You don't have to be afraid that those liquids will cause the coating to flake overnight", the researcher adds, putting this into perspective, "but it will definitely have a negative effect on the lifetime of the coating."
Possible adjustments, if any, of coatings as a result of his research will not be highly visible, Baukh expects, but that does not mean that they do not have an impact. "I explain this to friends so often: if you come up with an idea for the automotive industry that would save one screw per car, you are in fact talking about forty million screws per year that cannot corrode or break due to another cause. If you add that up, that is an enormous economic impact."
The same is true for minor improvements of coatings used in aviation. "If coatings on airplanes last six years instead of five, that would result in huge savings. Even more so if you consider that the first new film is often applied on top of the old coating. This adds about five hundred kilos to the plane's weight, which means that you can take five passengers less on board. Therefore it is essential to understand properly how influences of the weather such as temperature fluctuations, UV radiation, and, as explained before, the exposure to humidity, affect the aging of these coatings." (TJ)