A drone by Flyability, a start-up that has emerged from NCCR Robotics.

A 1,000 times digital

State-funded research is a driver of economic and social innovation. On behalf of the Swiss government, the SNSF provides funding for selected research projects – on digitalisation, for instance.

In 2019, approximately 1,000 SNSF-funded projects were carrying out research on various aspects of digitalisation. How could we reinvent architecture based on electronic computing? Philippe Block is looking for answers to this question. How do local media come to terms with the digital age? Nathalie Pignard-Cheynel is analysing some of their responses. How could movement disorders in children be diagnosed and treated more quickly? Stéphane Armand is developing an online simulator (pages 7 to 9).

NCCRs and digitalisation

Key knowledge about digitalisation is generated by the National Centres of Competence in Research (NCCRs) conducted by the SNSF. For example, the NCCR QSIT has been investigating technologies that rely on quantum-physical effects. The NCCR Robotics is developing drones and four-legged robots. Several start-ups emerging from this NCCR won a prize in 2019. The NCCR Digital Fabrication aims to give digital technology a key role in construction. All NCCRs of the 5th series, approved by the Federal Council in December 2019, will contribute to strengthening basic research in computer sciences (page 13).

These and a host of other examples illustrate how indispensable state funding is – whether for basic research or use-inspired research. SNSF grants enable scientists to conduct independent projects: that do not directly pursue any commercial purpose; on topics that are relevant to society and the economy; and at costs that most companies could not bear or justify economically.

Open to new ideas

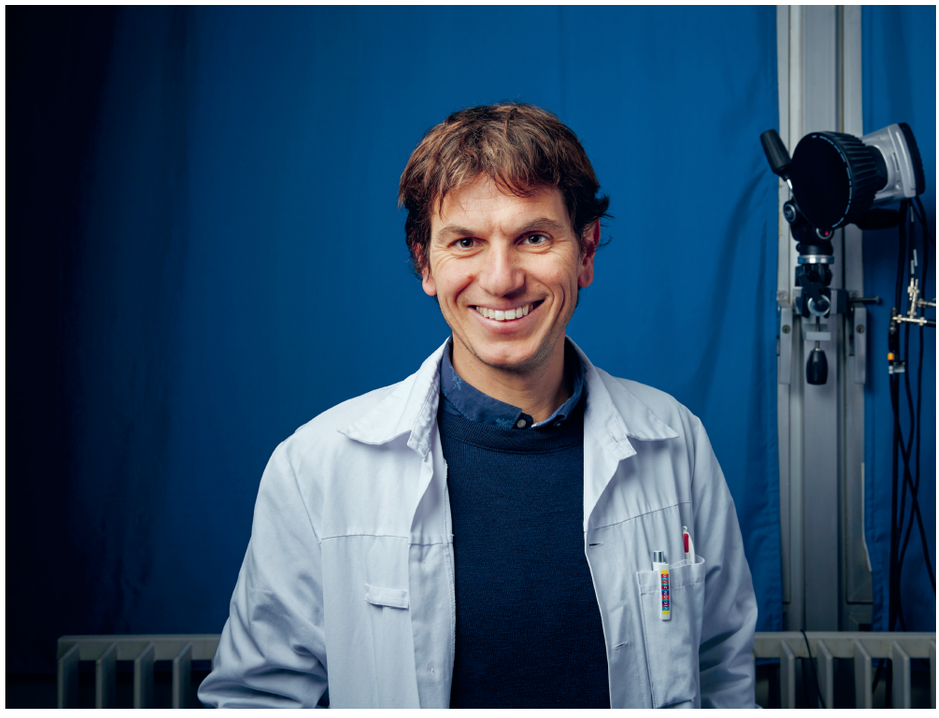
The SNSF allocates approximately 80 per cent of its budget to basic research. Such research, which does not aim to impress in the short term, is a precondition of innovation. "When doing basic science, you are more open to new, sometimes even revolutionary ideas," says Mathilde Bouvel, a mathematician at ETH Zurich, in one of the videos produced by the SNSF in 2019 (page 10).
In the 2021–2024 period, the SNSF will also provide more support specifically for use-inspired research (page 17). This research category translates scientific knowledge into innovation, thereby leading not only to new applications but also to start-up companies – a process that adds value and creates jobs (page 14).

Mastering challenges

Switzerland's competitiveness and standard of living are, to a large degree, founded on its strong scientific research. What is more, ecological, societal and technical challenges can only be met if science provides the necessary insights. This applies to climate change, public health or, as mentioned, digitalisation. The Swiss government has helped pave the way by giving the SNSF a mandate to promote Swiss science.

A simulator for better surgery

Cerebral palsy impairs children's ability to walk. Choosing the right treatment can be a challenge. Stéphane Armand is developing a simulator which doctors can use to test different surgical procedures.



At University Hospital Geneva, Stéphane Armand collects data on the gait of children with a walking impairment. The tools he uses include optoelectrical cameras.

Medical imaging is basically static. Our research aims to make it more dynamic. Armand's specialist field is the study of walking. Most people simply take walking for granted, but if you are affected by cerebral palsy, nothing is simple. Every year, approximately 200 children in Switzerland are diagnosed with the disease. "There are numerous motor systems and they cover a broad spectrum," says Armand, a biomechanist at the University of Geneva. "Some children walk on tiptoe, with knees bent and hips turned inwards. The precise reasons for this are very hard to discern. We hope that our research will lead to better diagnoses and help doctors choose the best treatment."

Modelling gaits

With this aim in mind, Stéphane Armand started developing an online gait simulator together with a biorobotics team at EPF Lausanne and an AI team from Haute école de gestion de Genève (HEG). His work is funded under the SNSF's Sinergia programme, which promotes interdisciplinary projects. In the future, doctors should be able to enter information about their patients' impaired mobility, simulate the effects of different operations and choose the most suitable intervention.

To develop the simulator, the researchers need data from children affected by the disease. Armand conducts his gait analyses in a corridor of the orthopaedic wing of Geneva University Hospital. Optoelectronic cameras record the patients as they walk and digitalise all their movements. Small circles attached to the skin reflect infrared light and facilitate a permanent and precise positioning – a technique also used by creators of special effects in films. Sensors at the muscles measure the electrical currents that indicate muscular activity. At the same time, a platform records how the patients' feet touch the ground while walking.

Need for large datasets

All of these data are combined to generate a profile of the patients' impairments. "We want to better understand how musculoskeletal problems affect walking and at the same time make it possible to diagnose motor deficits based on our measurements," says Stéphane Armand.

He is working with hospitals abroad to collect more data. A large volume of data is crucial for machine learning, a method of artificial intelligence. Creating reliable links between lab measurements and impaired movement is otherwise impossible. With this work, the Geneva research group is setting new standards that will enhance the analysis of impaired movement across the board.

Gothic pointed arches in the flooring

How can engineers make concrete floors lighter and more environmentally friendly? By taking cathedrals as their inspiration, says an ETH professor who wants to reinvent architecture.

The methods used in the building sector have barely changed in the last 100 years," says Philippe Block, Professor of Architecture and Structure at ETH Zurich. "Because of population growth, about as many buildings as there are in Manhattan will be built worldwide every month in the next 40 years." Therefore, raising productivity levels and, in particular, drastically reducing resource consumption are of central importance. "The building industry is responsible for more than a third of all carbon emissions. Until now, it has made only very limited use of the possibilities offered by digitalisation. Our work will help change this."

As an architectural engineer, Block specialises in concrete floors. That in itself may not sound very exciting – until one learns that floors account for 40 per cent of the total weight of a tall building. Philippe Block's team is creating floors with three times less concrete, and cement that is only half as pollutive. The carbon footprint is six times smaller.

Filled with voids

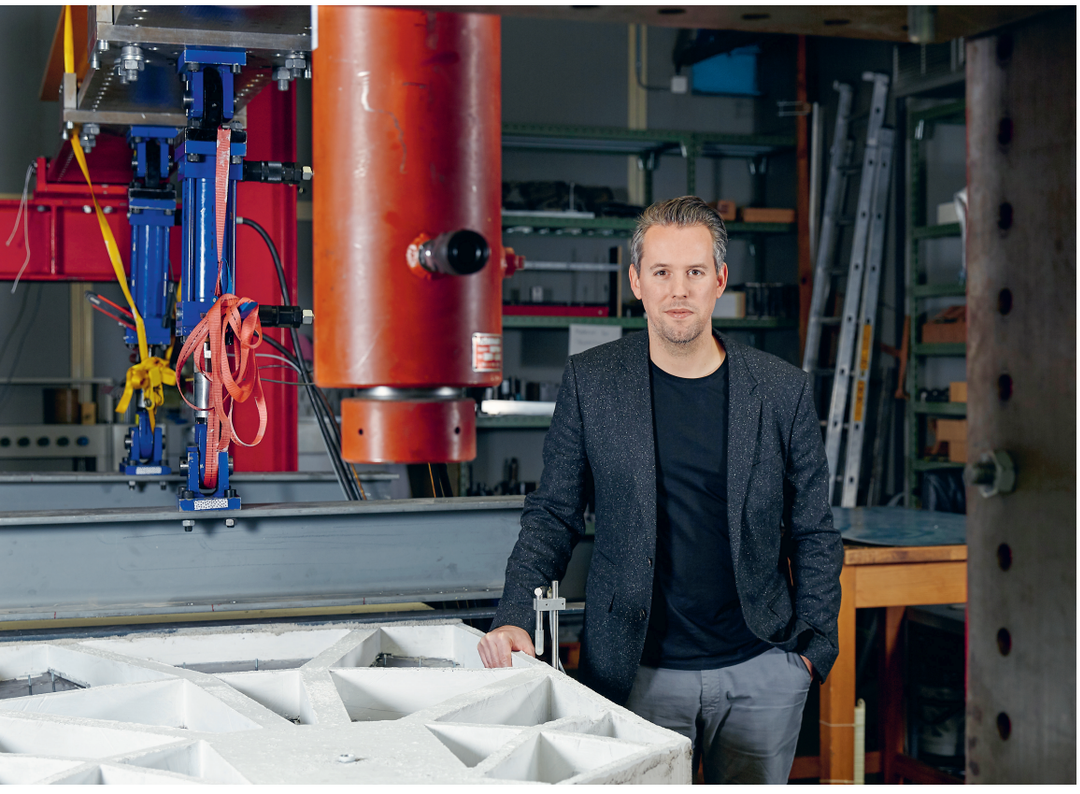
The secret behind it? The arches of Gothic cathedrals. A network of pointed arches stretches across the concrete floors, calculated and optimised by a computer. These arches spread the compression forces within the material more effectively. You could say that the concrete floors are "filled with voids" and therefore a lot lighter.

"A homogeneous floor always bends in the middle," Block explains. "This creates tensions in the concrete that can only be held in check through steel reinforcements. Thanks to the integrated arches, our floors are rigid. This reduces the pressure and we can achieve the same solidity using 70 per cent less material." In his laboratory stands a 3D-printed prototype that is two centimetres thick and can carry a load of 1,000 kilogrammes. Its thin arches, however, can be broken by hand.

400 visitors per year

Philippe Block is the director of the National Centre of Competence in Research (NCCR) "Digital Fabrication", launched by the SNSF in 2014. His work on concrete floors is being funded in this context. "This NCCR is a global first. It allows us to conduct long-term research which the building industry itself would never do." Together with his team, he is developing the COMPAS platform, which facilitates digitalised processes – from the architect's plan through to fabrication.

"We're getting more than 400 visitors per year, many of them from the industry. If we want it to adopt our solutions, we need to ensure they are affordable. This is the only way things can change. I'm confident we will succeed."



Thanks to computer-calculated arches, the floors devised by Philippe Block use 70 per cent less concrete.

Nathalie Pignard-Cheynel collected and analysed over 300 digital activities by local media. Many of these activities are combined with an analogue aspect.

Inventive local media buck the trend

The internet has plunged the press into a grave crisis. Nathalie Pignard-Cheynel investigates how local media use digital channels to get closer to their readers.

The researcher Nathalie Pignard-Cheynel is in no doubt: "The media are a key element in our democracy. They inform, but they also shape public opinion." However, these are challenging times for the press, as they face the combined threat of plummeting earnings, dwindling trust and competition from social media.

How are the local media using digital means to keep their readership on board? This is the main focus of Pignard-Cheynel's research project, which is funded by the SNSF within the scope of the initiative "Digital Lives". "Science has chiefly studied large media companies and neglected local media. Despite the fact that local media play an important role in shaping a shared identity. And some of them are very innovative," says Pignard-Cheynel, assistant professor of digital journalism at the University of Neuchâtel.

Digital and analogue measures

Together with other research teams, Nathalie Pignard-Cheynel has analysed over 300 activities by local media in Switzerland, France and Belgium since 2019. The editors themselves enter the details in an online form. All data are freely accessible. "This openness increases the project's visibility and gives the media an incentive to participate."

Some of the activities are purely digital, for example the chatbot launched by "La Liberté" in Fribourg, the hashtag #BalanceTonTaudis – a response by "La Marseillaise" to decaying buildings – or Facebook groups on the topic of zero waste.

However, the numerous traditional measures were a surprise: editorial board meetings in cafés, public talks or a mobile newspaper stall on the market square. In such cases, digital media serve as an add-on, a means of continuing the debate online.

Long-term strategy?

In the second part of the project, Pignard-Cheynel will analyse different aspects in depth, based on extensive conversations with a dozen local media outlets. Are their activities an isolated reaction? Or are they part of a sustainable change in editorial strategy? "I also want to find out if this is simply a new version of participatory journalism. Or are these media developing a socially responsible journalism that seeks solutions and wants to play an even more active role in society?"

Pignard-Cheynel's team have been presenting the results of their use-inspired research at scientific conferences. "We are mainly looking at the current situation and the effects of these actions," says the researcher. "But we also want to help develop some of the better ones and make them more widely known. Local journalism has scant resources at its disposal for innovation. If we can provide support and strengthen our democratic society at the same time, I will be delighted."