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RESEARCH NEWS FROM NTNU AND SINTEF

GEMINI

AN ENGLISH EDITION OF GEMINI IS PUBLISHED TWICE A YEAR. THE NEXT EDITION IS SCHEDULED FOR SPRING 2010.

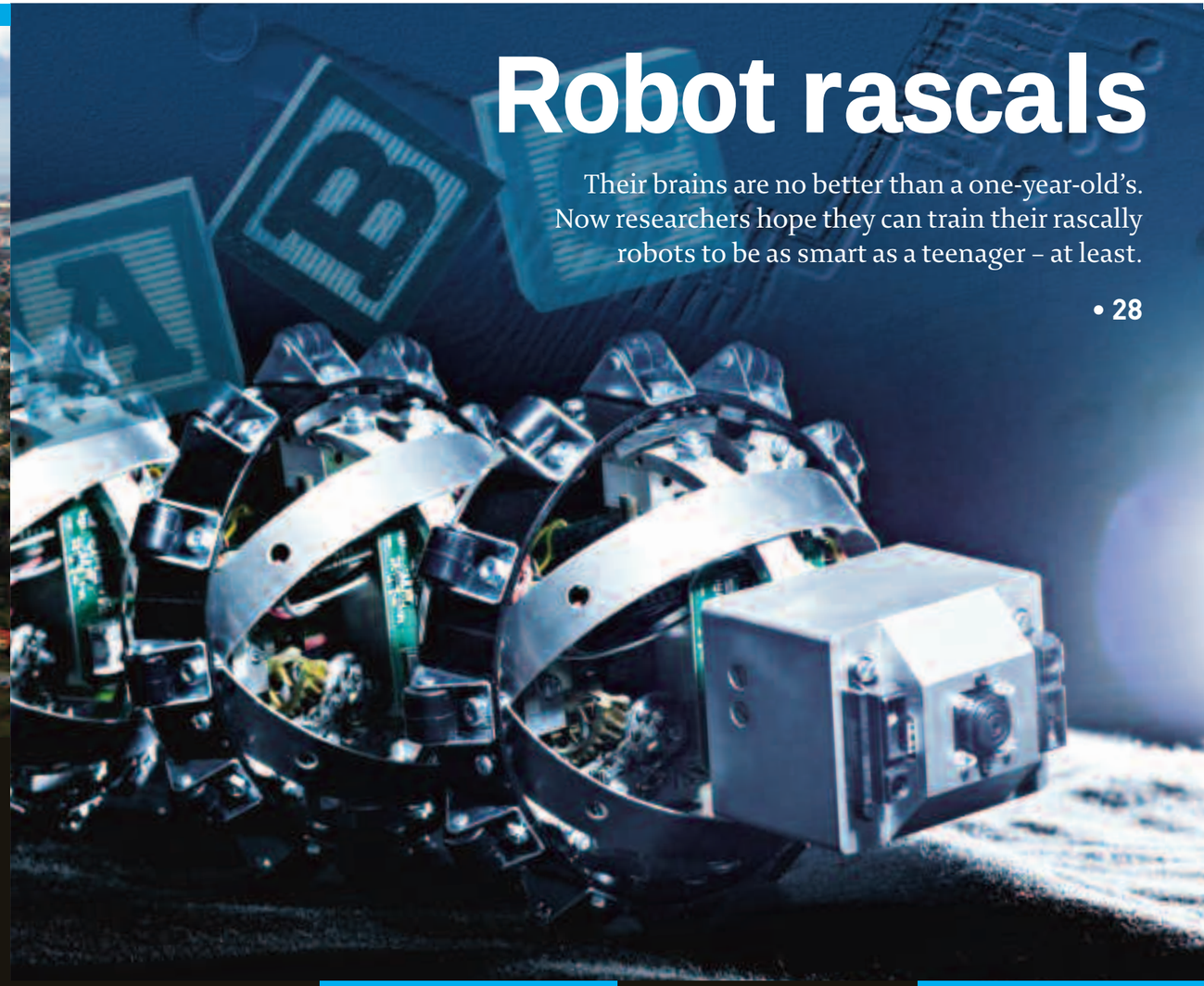
Photo: FW AS/NTNU Info

SINTEF and NTNU have projects related to CO_2 capture and management worth more than 100 million euro. This makes us one of the major international centres of R&D in this field.

NTNU's Kavli Institute is solving the brain's enigmas by mapping out the hardware of our memories.

SINTEF is in charge of EU's largest bioenergy research project with a budget of 29 million euro over a 4-year period. Seventeen partners from 7 countries are participating in this effort.

GEMINI
www.ntnu.no/gemini/english
SINTEF NTNU



Robot rascals

Their brains are no better than a one-year-old's. Now researchers hope they can train their rascally robots to be as smart as a teenager – at least.

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VULNERABLE TO HACKERS
Oil platforms at risk

STOLEN IDENTITY
Someone might steal you

LUXURY GOODS
Clean water a scarce resource

KELP IN THE TANK
Green fuel from the sea

Super bed sheet

A specially modified, millimetre-thick, super-absorbent bed sheet solves delivery-room problems.

HEALTH **POLYMER MATERIAL • ABSORPTION**

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Photo: Beate Zahl

MOTHER OF INVENTION: Astrid Skreosen (left) used to work in the maternity ward in Skien Hospital. Now she is developing medical aids for her former work-place. The photo shows her together with colleague Elin Tollefsen.

Astrid Skreosen has worked for many years as an auxiliary nurse in the maternity ward. She became fed up with the little mats that were supposed to lie under women who were giving birth to soak up waste products and fluids.

"Restless women in labour and unstable mats caused problems for everyone. None of these underlays fitted the delivery beds, and we were wading in foetal fluids and blood. I was just as irritated by people who said that we shouldn't complain, but just make the best of things", says Skreosen, who decided to do something about the problem herself.

She began to look into the possibility of producing a specially modified super-absorbent bed sheet, and after stumbling around in the dark for a while with inventors' consultants and patent offices, she rang SINTEF.

Skreosen was put in touch with Per Stenstad in SINTEF Materials and Chemistry. After a few meetings they signed an agreement to cooperate. By Christmas 2007, the plans were so advanced that she applied for funding and set up a company: ASAP Norway.

TRIPLE-LAYER, MILLIMETRE-THICK SHEET • "The principle of an absorbent polymer material is well known", says Stenstad. "It functions rather like a nappy. In this case, the challenge was that the sheet must be only a millimetre thick, without letting dampness pass through it. The set of sheets also had to consist of two parts in order to be suitable for a labour bed."

SINTEF scientists have already developed two prototypes and a number of other textiles that have been tested, and now Ullevål Hospital in Oslo is interested. The products are made of three layers: the bottom layer acts as a humidity barrier while the mid-layer is a superabsorbent polymer, topped by a gauze-like layer in contact with the skin. This top layer is intended to allow fluids to pass rapidly through it.

"We carried out a survey of damp-absorbent polymers in use today; for example in nappies. Most of these are based on polyacrylic acid, which is what we decided to use. We have managed to produce prototypes that are only 0.1 mm thick by fixing a thin layer of absorbent powder directly to the base layer," says Stenstad.

SINTEF health researchers have been responsible for concept development and prototype development.

SAVINGS • Astrid Skreosen has applied for a patent, and is now looking for a company to produce her sheets.

"This bed sheet can be used in maternity wards and in field hospitals anywhere in the world. Another option would be to use it in operating theatres and ambulances", she says.

The aim is to enable hospitals to save time and money by using the new sheet. Clearing up and laundering after a delivery is a major, time-consuming job, and lack of time for such tasks can lead to infections. Replacing the mats with a sheet of this type will also mean less waste.

Åse Dragland

Photo: SINTEF Materials and Chemistry

HIGHLY ABSORBENT: Tests of how much the sheet swells up show that it can rapidly absorb ten litres per square metre without the surface feeling wet to the touch. Photo: SINTEF Materials and Chemistry

Virtual car crashes

Virtual testing of safety barriers will save Norway a great deal of money – and will mean fewer injured and killed in traffic accidents.

TRAFFIC **MATERIALS • SIMULATIONS**

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Virtual testing of safety barriers will save Norway a great deal of money – and will mean fewer injured and killed in traffic accidents.

Each year between 200 and 300 people are killed in traffic accidents on Norwegian roads, while another 40 000 are injured. Almost 70 per cent of all traffic accidents that result in death or serious injury are caused by collisions or when cars accidently leave the roadway.

Safety barriers installed alongside or on the central reservation of a road reduce the risk of such accidents considerably. And against the backdrop of the government's goal of zero accidents, Norwegian authorities have focused largely on this kind of protection. More than NOK 1 000 million has been allocated in 2009 to install safety measures along the nation's present road network.

EXPENSIVE TO TEST • Improving road safety is not just about constructing guard rails and reservation barriers along roads, but also involves developing products that can provide the greatest possible safety. The materials and design used for barriers and dividers play a role here, as well as road conditions and the terrain where the road has been built. The design of the vehicle itself is also an important factor.

But testing different designs and types of safety barriers at full scale is an extremely expensive and time-consuming task. The barriers have to be manufactured, erected and then tested with different vehicles.

For the first time in Norway, researchers at SIMLAB, one of NTNU's Centres for Research-based Innovation, have developed a virtual test for crash barriers.

The simulations mean that a large number of full-scale tests can be replaced by just one or two.

CAR AND BARRIERS ON THE SAME TEAM • Inside Henning Fransplass's computer are found an infinite number of details about vehicles and safety barriers. Much of this knowledge has been developed by SIMLAB in other contexts. Researchers here have worked with crash tests for years in cooperation with the automotive industry.

Fransplass is working for the Norwegian Public Roads Administration while also working as a PhD candidate at SIMLAB. His goal, first and foremost, is to understand: Understand how a crash barrier behaves under different loading conditions. Understand what happens when a specific vehicle at a certain speed and angle hits a safety barrier made from a particular material with a specific design.

An optimal barrier should work like a hammock: When accidents happen, the barrier should gently guide the car back into the road again. All this without destroying the barrier, or allowing people in the car to be seriously injured, or allowing the car to swing into the oncoming lane.

"You can say that the car and rail are playing on the same team, for which different parameters can vary in infinite ways", he says. Fransplass uses a commercial computer program to create animations of how a vehicle behaves in collisions with different types of safety barriers.

HAPPY DIRECTOR GENERAL • Today's safety barriers are mostly made of concrete or steel mounted on wooden poles. They are not bad, but not necessarily optimal under all circumstances.

Now, the Norwegian road authorities – and manufacturers of crash barriers – have a tool to test a number of new barrier types – and for a fraction of what a single full-scale test costs. This makes the Norwegian Public Roads Administration Director General Terje Moe Gustavsen very happy.

"It is important that we now have a model based on Norwegian experience and expertise. In these situations simulation tools will be able to evaluate conditions that practical tests cannot. One example is collisions between motor cycles and safety barriers. When the technology is fully developed, it will be widely used by the Norwegian Public Roads Administration", says the director general.

Lisa Olstad

Photo: Dag Jenssen/Samfoto

ROOM FOR IMPROVEMENT: Today's safety barriers are not necessarily bad. But they do not always provide optimal safety.

Oil platforms vulnerable to hackers

Oil company data security is inadequate, and production systems are at risk of attack by hackers, viruses and worms.

INFORMATION SECURITY **PETROLEUM SECTOR**

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Once upon a time, offshore platforms were secure communities in which production was controlled by closed processes that were isolated from the external world. Today, the picture is somewhat different: in what are known as "integrated operations", offshore-onshore contact is transparent and many of the processes out on the platform are controlled by onshore personnel via networked PCs.

Although this has several advantages, one disadvantage is a decrease in information security. When onshore and offshore networks are linked, the chances of attacks by viruses and hackers increase.

THREATS • SINTEF scientists who work on system development and security believe that the oil companies and the supply industry have done a good job in offshore health, safety and environment (HSE), but have not been as good as far as information security is concerned.

The researchers have carried out in-depth interviews of key personnel in the petroleum sector to find out what conditions out on the field are like. The interviews confirm that the number of "safety incidents" on production systems (platforms) has risen during past few years.

"The worst-case scenario, of course, is that a hacker will break in and take over control of the whole platform", says SINTEF scientist Martin Gilje Jaatun. "Luckily, this has not happened yet, but we have heard of a number of incidents that could have turned into something quite dramatic. For example, virus attacks have led to process electronic equipment becoming unstable."

INCIDENTS • Platform managers are still able to deal with any incidents that occur on a platform, but the current trend is in the direction of unmanned robot-controlled platforms, which leave electronic equipment more exposed to attack.

"Our interviews have revealed that we lack a concise plan that would outline how people should deal with such specific events in their organizations. And while scenario training is often used by offshore companies to reduce risks, such training is seldom employed in the field of information security", says Jaatun.

"Some of our informants also told us that they were not certain that negative occurrences would lead to learning and changes in future behaviour. They were afraid that any such learning would soon be forgotten."

THE WAY AHEAD • The study of offshore information security has shown that there is still a need to measure the effects of efforts to improve security. We need to develop new measurement mechanisms that can demonstrate how different ways of dealing with security contingencies affect conditions such as earning capacity and uptime.

Åse Dragland

Computer system for dementia patients

A computer screen in the living room can help dementia sufferers to check the time and date and to remember appointments.

DATA **COMMUNICATIONS SYSTEM • THE ELDERLY**

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The health services labour force is shrinking, there are more and more old people, and a very high proportion of them are plagued by deteriorating short- and long-term memory. All this has created a need for computer-based solutions that will enable elderly people to live safely in their own homes, but at the same time, the technology needed to take special care of them is expensive. On top of this, different standards for home sensors create problems.

This situation formed the backdrop for the EU's decision two years ago to launch a series of projects to make it simpler for industry to develop new equipment in this field. One of these projects was called Mpower, which had the goal to create a computer platform that could be used for various purposes and meet a wide range of needs among its target group.

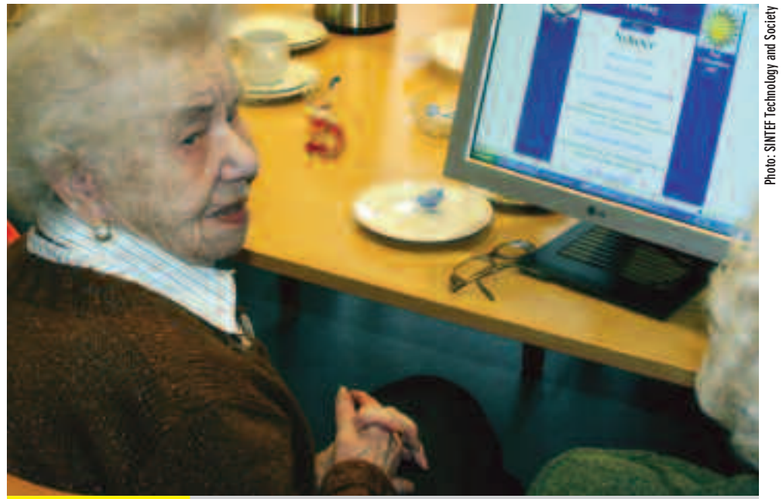

Photo: SINTEF Technology and Society

HELPFUL MEMORY AID: People who have tested the system have enjoyed the experience.

REMINDER BOARD • What is being tested in Norway today is a simple communication system based on a computer screen, aimed at elderly people who live at home but whose memory is failing. No keyboard is needed, only a touch on the screen, which displays the sun and the moon to indicate whether it is day or night, while a large clock-face shows the time.

"This is also a system for sharing information", explains project manager Marius Mikalsen. The families of these patients are often anxious about how their parents are getting on, and this allows both them and the home help to enter messages that will be automatically displayed by the system. On the screen, for example, the elderly person might find "Remember to drink some water", or "Take the number 52 bus". Or current messages such as "The home help will be coming at nine o'clock this morning to give you a shower."

Another useful feature is that family members can also access the system to check whether the elderly person's appointments have been kept. Has she been to the doctor? Has he remembered to go to the day-care unit today?

"SINTEF has been project manager here, and it is nice to think that what we are now testing in Norway was developed by the University of Cyprus in collaboration with two Spanish companies, and that it runs on a server in Austria", says Mikalsen.

TRIALS • Since last summer, a handful of elderly people have been trying the system in Trondheim and Grimstad. Meanwhile, a variant of the system is being tested in a nursing home near Krakow in Poland. This version uses sensors and GPS to offer smart solutions both in the house and outdoors to sound the alarm if an elderly person is moving around in an unsafe area.

Mpower ended in June 2009. SINTEF is trying to extend the project in collaboration with the local authorities in Trondheim.

Åse Dragland

A view into you

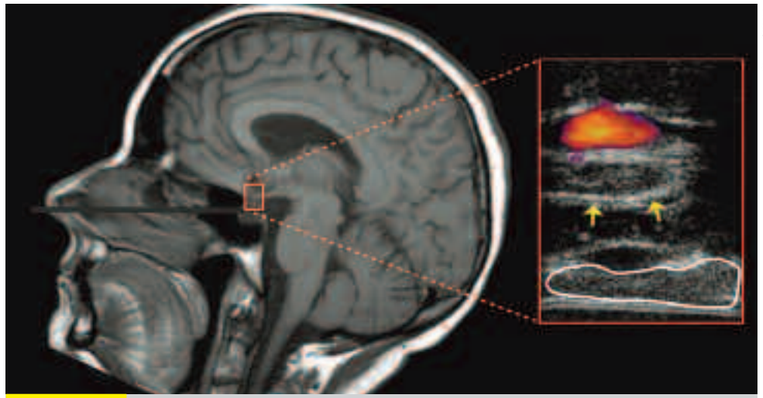

Photo: SINTEF

ULTRASONICS: Operating on the pituitary involves feeding an ultrasonic instrument in through the nose. On the ultrasonic image: remaining tumour tissue (white outline), route of the optic nerve (yellow arrows) and blood flow in an artery (orange and magenta).

Ultrasonics improves a surgeon's view in the removal of tumours from the pituitary gland.

MEDICINE **SURGERY • ULTRASOUND**

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Hidden in a little hollow in the skull, at about the level of the eye, we have a gland about the size of a black currant. This is the hypophysis, or pituitary, the body's centre for hormone manufacture. The gland produces a wide range of hormones which in turn control other organs that manufacture yet more hormones.

Every year, some 120 Norwegian patients are operated on tumours in the pituitary gland. Now SINTEF, NTNU and St. Olavs Hospital in Trondheim have joined forces to develop an ultrasonic instrument that give Trondheim's neurosurgeons an extra "eye" during interventions of this sort.

PROMISING METHOD • Assistant physician and doctoral candidate Ole Solheim describes the new operation aid as very promising.

"We are probably able to remove more tumour tissue than we would have been able to do otherwise, which reduces the chances of the tumour returning, and increases the likelihood of obtaining a nearly normal hormonal balance. The instrument also makes it easier to see where the tumour cells lie relative to the optic nerves and blood vessels – structures close to the pituitary that we must avoid damaging during the operation."

For the moment, use of the new instrument has the status of experimental treatment. The new "window" on the inside of the skull has been used on 15 patients at St. Olavs Hospital.

In earlier days, people afflicted with pituitary tumours might well end up in circus freak shows, because the cocktail of compounds that are produced by the pituitary includes growth hormones. Certain pituitary tumours may produce abnormal patterns of growth before the body is fully grown. If the illness develops later in life, it can result in a very heavy body shape, and in the worst cases, a lethal stress on the patient's heart. Tumours may also cause pressure on other brain tissue and produce damage there.

MORE STUDY NEEDED • Solheim emphasizes that large-scale comparative studies of operations on pituitary tumour patients are needed before the value of the ultrasonic instrument can be documented. However, he points out that even the best aids can never guarantee that an operation will not lead to complications.

In the development of the instrument, SINTEF's Tormod Selbekk, and Lasse Løvstakken and Tonni Johansen of NTNU were the main contributors on the technology side.

The 3D Ultrasound Centre of Expertise, the Research Council of Norway and the Central Norway Regional Health Authority have all helped to finance the development of the new surgical aid. SINTEF, NTNU and St. Olavs Hospital have joined forces with the Norwegian company Sonowand to continue the development of the instrument.

Svein Tønseth