Willow Garage's PR2 robot learns to play billiards and to manipulate chopsticks. The control methods used here, which were developed by Kappens' group, are being implemented by Stefan Schaal at the University of Southern California.

Machines – now with intelligence

In recent years there's been a silent revolution in artificial intelligence and robotics, with the application of smart statistical methods to huge amounts of data. The Intelligent Machines Symposium, which was held on 17 November in Nijmegen, provided some inspiring examples.

Over two hundred people from academia, industry and government filled the concert hall of De Vereeniging in Nijmegen. They were attending a symposium called Intelligent Machines, organized by the Foundation for Neural Networks (SNN), which brings together researchers working on artificial intelligence in the Netherlands. "The goal is to put the field better on the map here," says Bert Kappen, a professor of machine intelligence and neural networks connected to the Donders Institute. Kappen is the driving force behind the symposium. "We want to show how machine learning techniques are used in practice."

Four top international scientists gave presentations. We saw movies of fully autonomous flying mini-helicopters performing rescue operations. Intelligent, driver-less cars that quickly turn the steering wheel to avoid colliding with pedestrians who suddenly appear in front of them. And we heard about the automatic translation tools that are currently offered by the major internet search engines.

A common thread ran through the symposium: a quiet revolution based on a paradigm shift in artificial intelligence. For decades, computer scientists have tried to build intelligent computers and robots by stuffing them with pre-programmed rules – as if life was a game of chess. That led to some modest successes, but far fewer than the fathers of artificial intelligence had dreamed about in the late fifties.

The engine of this quiet revolution in recent years has been a fundamentally new approach: smart statistical methods that rapidly distil meaning from a huge mountain of data. Thanks to the worldwide web, for the first time in history, vast amounts of data are freely available: text, images and sound recordings. The result has been successful machine translation, automatic speech recognition, image recognition and smart mapping of our spatial environment. The machines are not yet able to perform at a human level, but they are a lot more capable than they were a decade ago.

Of men and machines

In fact, robot designers and developers of artificial intelligence face much the same questions as neuroscientists. How does a brain – whether natural or artificial – solve problems that arise in interaction with the world around it? Issues such as perception, reasoning, language processing, speech production and how to act are relevant in both cases.

It's not therefore surprising that Kappen's research group is part of the Donders Institute. With his artificial intelligence research he aims to contribute to a better understanding of brain, cognition and behaviour. He gives three examples from his own research. First, there's the modelling of networks of neurons. "We try to understand how the changing strength of

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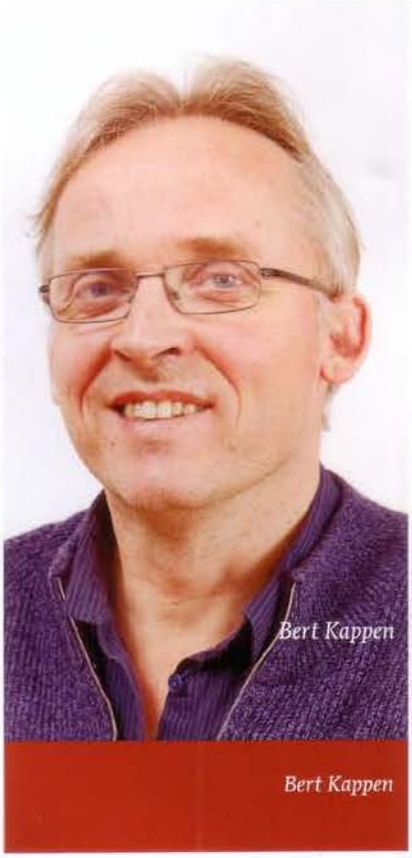

Bert Kappen

synapses affects the network behaviour of neurons. Our models describe the behaviour of some 100,000 to 1,000,000 neurons."

Kappen and his collaborators also use machine learning techniques for brain-computer interfaces, a second example. "We investigate how a subject, using his or her mind, can control a cursor on a screen. We record the thoughts of the subject – based on MEG or EEG signals – and we train a neural network to recognize patterns in these signals."

A third example lies in the field of robot motion. How does a robot know how to move its arms? A simple spray painting or welding robot in a predictable factory environment is programmed to move its arm at a certain moment in a precise way from A to B. But our everyday reality is full of unpredictability. Suddenly a cart appears. Over there a man emerges. How does a human - or artificial - brain deal with this? That's an important research question.

Kappen: "We've developed a new control theory which can help robots to learn in such unpredictable situations. The theory predicts, among other things, that the noisier the environment, the later the brain takes a decision. We've also measured this in the brains of human volunteers and we can now successfully apply this theory to robots."

Intelligent wheelchair

At the end of the symposium Professor Jaap van den Herik (Tilburg University and Leiden University) led the final discussion. "When will machines become smarter than people?" he asks in an attempt to challenge the four speakers.

None of them sees any evidence that this will be achieved any time soon – even within a few decades. As Nicholas Roy, a robot engineer at the Massachusetts Institute of Technology (MIT), one of the best artificial intelligence labs in the world, put it: "We have no experimental data that can tell us anything about the moment when robots might become smarter than people. We're engineers. Predicting the future is not what we do. We're interested in building models and machines based on what we know now."

And, referring to Ray Kurzweil's best-seller The Singularity is Near (2005) on Kurzweil's prediction that machines will become smarter than humans, Roy says: "Nobody has ever said anything meaningful about the future, except to drive up the sales of a book."

Fortunately, machines don't have to become smarter than people to be of great practical use. Roy shows a movie of an intelligent wheelchair, which can be controlled by voice. Patients with severe muscle disease can ask the wheelchair to take them to the lift or to order a pizza. The wheelchair also learns from the needs and wishes of the user.

Roy: "This work improves the quality of life of patients. They can lead more independently. At the moment the most successful commercial robots in the world is the Roomba robot vacuum cleaner, quite a simple robot. That will really change. I do not see robots becoming smarter than humans, but more and more artificial intelligence designed to help people will hit the market: in healthcare, in services, traffic and transport, and doubtless in many applications that we cannot yet imagine."

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Weblinks

www.snn.ru.nl/symposium-2010/
Intelligent Machines Symposium, Nijmegen, 17 November 2010

www.youtube.com/watch?v=f7oD3W1kpSI
Intelligent, voice-controlled wheelchair developed by Nicholas Roy's MIT robotics group

www.youtube.com/watch?v=8Thdf_7j4dI How a robot can learn from imitation in unpredictable situations