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Indoor robots learn to use lobster's magnetic map trick

SPINY lobsters have become the unlikely inspiration for a robot with a unique sense of direction. Like the lobster, it uses a map of local variations in the Earth's magnetic field to find its way around – a method that could give domestic robots low-cost navigational capabilities.

In 2003, computer scientist Janne Haverinen read in *Nature* (vol 421, p 60) about the amazing direction-finding ability of the Caribbean spiny lobster *Panulirus argus*. A team from the University of North Carolina, Chapel Hill, had moved the critters up to 37 kilometres from where they were caught and deprived them of orientational cues, but found they always set off in the right direction home. They concluded *P. argus* must navigate with an inbuilt map of local anomalies in the Earth's magnetic field.

"My first inspiration came from birds, ants and bees," says Haverinen. "But the spiny lobster clinched it for me."

The findings set Haverinen, who works in the intelligent systems lab at the University of Oulu, Finland, wondering if he could draw magnetic maps of buildings for domestic and factory robots. It is well known that compasses are sent haywire by the metal in buildings – plumbing, electrical wiring and the steel rods in reinforced concrete, for instance – and cannot find magnetic north. Haverinen's idea was that these distortions of the Earth's magnetic field might create a distinctive magnetic topography.

"So we decided to try to use this 'magnetic landscape' – the array of disturbances – that was upsetting the compass as a map for a robot," says Haverinen.

The team used a magnetometer to scan the magnetic field strength close to the floor in their lab (see picture) and in a 180-metre corridor in a local hospital. They then stored the field variations in the memory of a small wheeled robot and mounted a magnetometer on a rod projecting in front of it to prevent interference from its motors.


If you had magneto-vision

JANNE HAVERINEN/UNIVERSITY OF OULU

The robot was able to work out where it was and to drive along the corridor without a vision system. What's more, the magnetic map stayed true a year after the first mapping was done, Haverinen reports in *Robotics and Autonomous Systems* (DOI: 10.1016/j.robot.2009.07.018).

"So there just might be enough stable information for robots to work out where they are in the ambient magnetic field," he says. That would obviate the need for expensive "indoor GPS" systems in which triangulation between fixed radio beacons in a building tells robots their position.

"Reliance on any one guidance method is not a great idea in case it fails," warns Chris Melhuish, director of the Bristol Robotics Laboratory in the UK. "But you could use a system like this, if it's proven to work, to boost your confidence in a robot by using it in conjunction with, say, vision-based navigation." **Paul Marks** ■

Patterned nanocubes could open door to nano-circuits

DO YOU remember as a child producing paper cubes by folding up a flat cross shape? Now two researchers have applied the same technique to the nanoscale, in the process creating the first nanoparticles with precisely patterned surfaces. These patterns could form the basis of electronic nano-circuits or provide docking stations on targeted drug-delivery particles.

"At the macroscale, everything can easily be patterned in three dimensions," lead researcher David Gracias at Johns Hopkins University (JHU) in Baltimore, Maryland, told *New Scientist*. "However, nanoparticles with precisely patterned 3D surfaces simply do not exist."

The problem is that existing methods for patterning at the nanoscale only etch onto flat, two-dimensional surfaces. However, Gracias and his colleague Jeong-Hyun Cho realised that they could make a patterned 3D structure provided they could find a way to assemble it from a 2D one.

Using a narrow beam of electrons, Gracias and Cho carved into a silicon wafer the outline of six square panels, each 500 nanometres wide, to form a cross-shaped mould. Into this they deposited a film of nickel to form the sides of the cube, adding grains of tin between the panels to form hinges.

The researchers found two methods to create a pattern on the panels. They could either incorporate the pattern directly into the mould or deposit a quantity of another metal, such as gold, onto the wafer before coating it with nickel.

Getting the panels to then "self-assemble" into a box required the application of gases to etch away the silicon, while also heating the panels to melt the tin hinges. This caused the hinges to contract as the grains of molten tin merged together, pulling up the panels to form a nanoscale box.

"The researchers produced nanoscale boxes with letters carved in each side or printed in gold"

Using this technique, Gracias and Cho produced boxes with the letters JHU carved in each side, as well as boxes with the letters J and U printed in gold (*Nano Letters*, DOI: 10.1021/nl9022176).

"Since we can build these particles with dissimilar materials [such as nickel and gold], we can construct electronic circuits on the faces to create 'smart' nanoparticles," predicts Gracias.

Chad Mirkin, director of the International Institute for Nanotechnology at Northwestern University in Evanston, Illinois, says such "tour de force" techniques could be the nanoparticle equivalent of understanding and controlling protein folding. Jon Evans ■