

Sandfish swim through sand by making waves

Granular solids such as sand are like fluids in many ways and yet are also quite different. For example, you can pour both sand and water, but piles of sand do not flatten out as a result of gravity, as water does; there are no analogous “water piles”. So what about swimming in sand?

Daniel Goldman of the Georgia Institute of Technology and colleagues have studied the motion of the desert-dwelling sandfish *Scincus scincus* – a lizard that “swims” as it burrows through sand. High-speed X-ray photography shows that rather than moving its limbs, the creature generates large-amplitude travelling waves on its body to propel it in a truly novel way, which exploits the unique mechanical properties of sand.

There is no theory of granular drag to date that would do for granular materials what viscous-fluid dynamics does for water. The team therefore developed their own empirical model for the motion of the sandfish based on measurements they made of the granular thrust and drag forces on a small cylinder. In addition to helping understand the behaviour of sandfish and other burrowing creatures, the



The Georgia Tech study shows that sandfish place their limbs against their sides and create a wave motion with their bodies like snakes to swim through sand. (Courtesy Georgia Tech Photo/Gary Meek.)

research may help in the design of robots to travel through rubble and other debris.

Further reading

Ryan D Maladen *et al.* 2009 *Science* **325** 314.

New invisibility cloak alters appearance

There has been much recent excitement surrounding the idea that metamaterials with exotic light-bending properties could be used to create an “invisibility cloak” that would bend light around it, rendering anything inside “invisible” – to the obvious glee of Harry Potter fans around the world. One of the pioneers of the field, John Pendry of Imperial College London, has recently drawn attention to the work of Yun Lai and colleagues of the Hong Kong University of Science and Technology. They are pushing things even closer towards the technological realization of what in Celtic magical tales might be called a “glamour” – disappearing not through invisibility but through the illusion of a changed appearance. Moreover, the illusion is created at a distance.

The idea is that it is possible to bend the light rays from any object and rearrange them into the image of anything else. Basically, in this case the structure of the cloaking device contains an “anti-object” that cancels light from the object beyond it, as well as an image of a completely different object. The result is truly amazing – put a fork into the right sort of metamaterial box, stand next to it, and it looks as though you have disappeared and been replaced by a fork. Amusement aside, this research could lead to a variety of optical applications.

Further reading

Yun Lai *et al.* 2009 *Phys. Rev. Lett.* **102** 253902.

John Pendry 2009 *Nature* **460** 579.

A proper swear can keep the mind off painful business

Many people have an intuitive appreciation for the fact that a proper swearword seems to release more frustration than a more politely muted “fudge” or “fiddlesticks”. To study the phenomenon, Richard Stephens and colleagues at Keele University asked students to put one hand in cold water (about 5°C) and found that repeated swearing (as opposed to the use of softer words, say with a different first letter) allowed most of them to keep their hands in for longer and reduced the apparent perceived pain reported later. The researchers suggest that swearing may induce a fight-or-flight response and reduce the link between fear of pain and pain perception.

Further reading

R Stephens *et al.* 2009 *NeuroReport* **20** 1056.

Rethinking bits: qubits to qudits

Current technology has made the idea that digital data can be stored as “bits” almost beyond question, but as progress is made towards quantum computing using qubits there may be good reasons to revisit some traditional assumptions. Matthew Neeley and colleagues of the University of California at Santa Barbara and the University of Georgia have demonstrated a superconducting phase qudit – a system with d quantum levels – with five states ($d=5$) as opposed to the two states ($d=2$) of the more familiar qubit.

A 5-level system is mathematically equivalent to a spin-3/2 system and can be broken down into conceptual spin-1/2 systems with two states. However, it may be that physical realizations of quantum computation in n -level systems will be easier or more robust than can be achieved by restricting attention to qubits.

Further reading

Matthew Neeley *et al.* 2009 *Science* **325** 722.