

Grains of gold shine at computing

Bas den Hond

MOVE over, microchip. A random assembly of gold nanoparticles can perform calculations normally reserved for neatly arranged patterns of silicon.

Traditional computers rely on ordered circuits that follow preprogrammed rules, but this limits their efficiency. “The best microprocessors you can buy in a store now can do 10^{11} operations per second, and use a few hundred watts,” says Wilfred van der Wiel of the University of Twente in the Netherlands. “The human brain can do orders of magnitude more and uses only 10 to 20 watts. That’s a huge gap.”

To close that gap, researchers have tried building “brain-like” computers that can do calculations even though their circuitry was not specifically designed to do so. But no one had made one that could reliably perform calculations.

Van der Wiel and his colleagues have hit the jackpot, using gold particles about 20 nanometres across. They laid a few tens of these grains in a rough heap, with each one about 1 nanometre from its

nearest neighbours, and placed eight electrodes around them.

When they applied just the right voltages to the cluster at six specific locations, the gold behaved like a network of transistors – but without the strict sequence of connections in a regular microchip. The system not only performed calculations, but also used less energy than conventional circuitry.

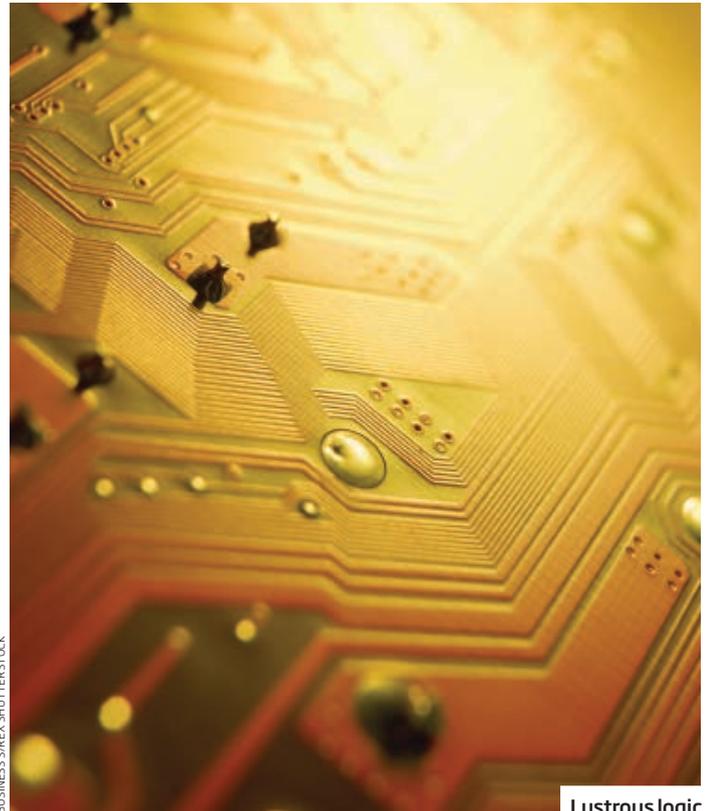
Nothing about the particles told the researchers what voltages to try, however. They started with random values and learned which were the most useful using a genetic algorithm, a procedure that borrows ideas from Darwinian evolution to home in on the “fittest” ones.

The team was able to find voltages to transform the system into any one of the six “logic gates” that are the building blocks of computer chips. The algorithm even arrived at the combination for a higher-order logic unit, which can add two bits of information. “This shows that you can get to calculating ability by a completely different route,” van der Wiel says (*Nature Nanotechnology*, doi.org/7s5).

of the University of Oregon in Eugene.

Our bodies are home to an estimated 100 trillion bacteria, viruses and fungi. People leave traces of their microbial communities on surfaces like their phones, and Meadow’s team wondered if the air around us also carries such signatures.

The group asked people to sit still in a small sterile room, and took samples from the air 1 metre away, and from the floor to catch falling bacteria. Analysing the bacterial DNA, the team found many species that usually live on the skin and in the mouth, nose and gut, and in the case of women,



Lustrous logic

The gold clump has to be cooled to just 0.3°C above absolute zero, but making the grains even smaller would allow the working temperature to rise. Van der Wiel says there is no reason the approach couldn’t work at room temperature.

“The physics is there, but of course you still have to demonstrate it,” says Jie Han

of the University of Alberta in Edmonton, Canada.

Van der Wiel hopes the work will lead to specialised processors that can solve problems that are difficult for computers, such as pattern recognition. That’s because the gold grains work in parallel – much like neurons in the human brain, which is especially good at these tasks. n

We walk around in a cloud of our own microbes

HYGIENE obsessives – your worst fears have been confirmed. Everyone walks around enveloped in an airborne cloud of bacteria, a bit like the *Peanuts* character Pig-Pen, and some of the bugs come from our most intimate nooks and crannies.

“You are standing in another person’s microbial cloud the moment you shake hands,” says James Meadow

of the University of Oregon in Eugene. The results could have a forensic use, helping to place a suspect at a crime scene through their bacterial signature. “I don’t think it’s crazy to think that, in the future, we could be recognising people by their bacterial mist,” says Tim Spector of King’s College London.

But Meadow says the findings are just a first step. Volunteers in the study sat in the room for up to 4 hours, but in reality someone may spend only moments at a crime scene, and it would probably already be contaminated with the bugs of many other people. Clare Wilson n

“In the future we could be recognising crime suspects by the bacterial mist they leave behind”