Nanoparticles programmed to attack cancer

When Sabine Hauert told a recent technology summit in London about **injecting** trillions of man-made smart **devices**, some as small as 10 nanometres (billionths of a metre), into the human body and programming them to work as a pack to hunt down and kill tumour cells, it seemed to be a fantastically futuristic notion. Now Dr Hauert is starting to turn the idea into reality. She lectures at the Bristol Robotics Laboratory in Britain and has worked closely with Sangeeta Bhatia at the Massachusetts Institute of Technology, one of the pioneers of using **miniaturised** biomedical tools to fight cancer. What Dr Hauert is hoping to do with these nanoparticles is to give them the same kind of eerie collective intelligence that is **displayed** by swarms of birds, insects or fish. Some nanoparticles are already used to **deliver** drugs to a specific area of the body or to **gather** at the site of a tumour so that it can be identified more **readily** and destroyed by **heat** or radiation. Studies have suggested that if those nanoparticles could somehow communicate, move and **act** as one they could deliver 40 times as much medication.

One of Dr Hauert's colleagues, Alan Winfield of the University of the West of England, which along with the University of Bristol runs the robotics lab, **compares** the **challenge** to getting robots to swarm, but without the **benefit** of being able to program them to do so. Nanoparticles, after all, do not **contain** electronics and run on software as robots do. To get robots to swarm five software rules are necessary. The first three rules are simple: don't get too **close** to another robot; return if too far away; and keep going forward. The fourth rule, to go only in the same direction as your neighbour, will produce behaviour similar to that of a shoal of fish or a flock of birds. However, it is the fifth rule that would make the **swarm** useful for bioengineers. This would instruct the robots to follow, for instance, a light **source** or magnetic field **applied** from outside the body. The robots would then move like worker ants in the direction of the beacon.

Dr Hauert says it is possible to program nanoparticles by changing their design. This might be their shape, size, coating, electrical charge or the materials they are made from. Ant-like **trail** formations have already been **observed** with some nanoparticles, adds Dr Hauert. Tinkering with the design can lead to **unpredictable** behaviour. But Dr Hauert has a way to **crowdsource** potential designs and simulate the likely **outcome**. This is NanoDoc, which works like an online game. It allows bioengineers, and anyone else who would like to have a go, a chance to model nanoparticles. As in most computer games, players need to earn their spurs and work through the first levels to become a master, or in this case a certified NanoDoc. Their **reward** is a real challenge: for example, designing a nanoparticle that can **detect** a **rare** event such as a sudden **cancerous** mutation. The best **solutions** are tested in the laboratory and, if successful, will be tried in animals and **ultimately** in human trials. Since its **launch** in September 2013, NanoDoc users have **performed** over 80,000 simulations. Successful designs, however, can still **run into** problems: what happens if some of the nanoparticles in the swarm are **damaged**? Would they still be **controllable** or could they turn toxic? The researchers have a lot of work to do, especially in getting some form of communication going between nanoparticles. Yet the research has already come far enough to **persuade** Dr Hauert that she could apply some of the lab's simulation software to programming robots to swarm in the real world. That might be for tasks such as using legions of swarmbots to help **clear up** an oil spill or **put out** a wildfire.

Source: The Economist