



WHAT CAN ROBOTS LEARN FROM ANTS?



David Pringle

A robot swarm might sound like something from a sinister science fiction movie. But in the real world, a swarm of robots could do a lot of good. They could clear a beach of garbage, retrieve plastic from the ocean or build a habitable abode on Mars. But the concept depends on getting scores of robots to work together effectively and avoid getting in each other's way.

“Imagine a group of robots that work like social insects, such as ants,” says Mauro Birattari, senior research associate of the Belgian National Scientific Research Fund (FNRS). He is aiming to create a system that can translate complex instructions, such as “collect all the plastic here and put it into that container”, into control software that would instruct scores of robots to work together to complete the designated task. He somewhat grandly calls this system the Demiurge, named after Plato's creator-god.

“My goal is to advance the state of the art in swarm robotics by developing the Demiurge: an intelligent system that is able to design and realise robot swarms in a totally integrated and automatic way,” Birattari explains.

His Demiurge system will select both the optimum hardware and the software modules required to complete each task. It would tap a library of low-level programmes, which it can combine on the fly. “Programming each single robot so that the robots collectively do what we want them to do is a complex problem because they interact with each other in unpredictable ways,” explains Birattari. “Today it is mostly done manually with developers programming the robots in a way that seems reasonable and then using trial and error to improve the overall system.”

Of course, Birattari's robots don't look like the high-tech “Star Wars” models. For example, one of his garbage collection robots might resemble a simple vacuum cleaner. “Programming these robots is not as difficult as programming a humanoid



William Blake, "The Ancient of Days"

Demiurge, Greek *Dēmiourgos* ("public worker"), plural *Dēmiourgoi*, in philosophy, a subordinate god who fashions and arranges the physical world to make it conform to a rational and eternal ideal. Plato used the term in the dialog *Timaeus*, an exposition of cosmology in which the Demiurge is the agent who takes the pre-existing materials of chaos, arranges them according to the models of eternal forms, and produces all the physical things of the world, including human bodies.

From the Encyclopaedia Britannica

robot, but it is still difficult to predict the interactions between two or more machines," Birattari says. For this, he is using so-called "heuristic" methods: basically, rule-of-thumb methods to find good enough, rather than perfect, solutions.

Under a project just begun with ERC funding, Birattari and his team are developing a proof of concept system for automatically conceiving and programming robot swarms that can be demonstrated in a lab. "It will be able to take a description of a mission, generate the control software for that mission, and deploy the software on the robots so that the robots perform the mission," he says. "They will be reasonably simple missions, but non-trivial and with features that map the real world. For example, we could work with 30 to 50 simple research robots, which can push objects into one corner of the environment in which they operate."

The military is at the forefront of the development of robot swarms: there would be clear benefits to

sending drones, rather than soldiers, into conflict zones. Today, military drones are remotely controlled; but in future, autonomous robots could work together to secure an area or clear land mines. Of course, Birattari's ERC research is civilian, rather than military. And the first civilian applications, such as managing the stock in a warehouse, will be more straightforward – but no less important economically. Amazon and Carrefour, take note.