

## Using IT to help synthesise artificial living cells

By embracing the challenge of producing artificial living cells from inanimate matter, and with the support of innovative IT systems, the PACE project aims to explore the creation of complex, self-organising processing systems.

If next-generation robotics and nanoscale technologies are to become a reality, they are likely to need the resources of distributed processing systems with self-organising, life-like properties. Yet the gap between present-day processing systems and living organisms remains a formidable one.



And it is reducing this gap between the binary and the living world that is the focus for the [PACE](#) project. The participants in this IST initiative, which ends in March 2008, hope to create the foundation for a new generation of embedded information-technology systems using programmable, self-assembling artificial cells.

The PACE team consists of a consortium of some 13 partners and two cooperating groups from eight European countries, including Switzerland and Lithuania. Several US organisations are also involved in this pioneering new approach.

### Vast scientific agenda

"PACE has this vast scientific agenda of trying to uncover the roots of complexity in the transition between living and non-living matter," says project coordinator John McCaskill. He and his collaborators are trying to take the step from current, relatively simple chemical manipulations to actually building systems that have the core functionality of a living cell.

The team has already developed a computer-programmable closed-loop controller, based on microfluidic technology, which enables the local physical environment of cell-sized chemical subsystems to be observed and controlled in ever more sophisticated ways.

Significant progress has also been achieved on making the chemical subsystems compatible. One of the PACE partners, the University of Copenhagen, has demonstrated that Peptide Nucleic Acid (PNA) – an artificial molecule with similar properties to both proteins and nucleic acids – can actually synthesise or direct the information in the synthesis of another copy of itself.

This breakthrough in effect represents a step halfway towards the ultimate test for living cells – that of self-replication. The PNA molecule is also more directly compatible with artificial containment and metabolism subsystems than DNA.

On the theoretical front, simulation models have been developed that can describe the artificial cell on an intermediate physical level using the three basic chemical subsystems. These models enable investigation of the control, stability and breakdown of the subsystems.

The simulations are still a fair way removed from the true physical chemical entities, but nevertheless provide invaluable insights. The project is also evaluating the use of artificial cells as a novel platform for self-assembling microscopic robots, both in simulation and experiments.

### Tackling ethical issues

Another task for the PACE team has been to tackle some of the ethical issues raised by the concept of developing artificial cells. "What we are talking about is not chemically making a copy of an existing artificial cell," McCaskill explains, "but chemically synthesising something which we could call an artificial cell."

Ironically, such artificial cells are useful to the project's research precisely because of their distinctness from, rather than similarity to, current biology. Says McCaskill, "They are certainly very different from existing modified organisms, and they are very different from us."

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