



Executive Summary - Template



Available on the ACT website
<http://www.esa.int/act>

Theme:

Artificial Intelligence

Code and Title of the study:

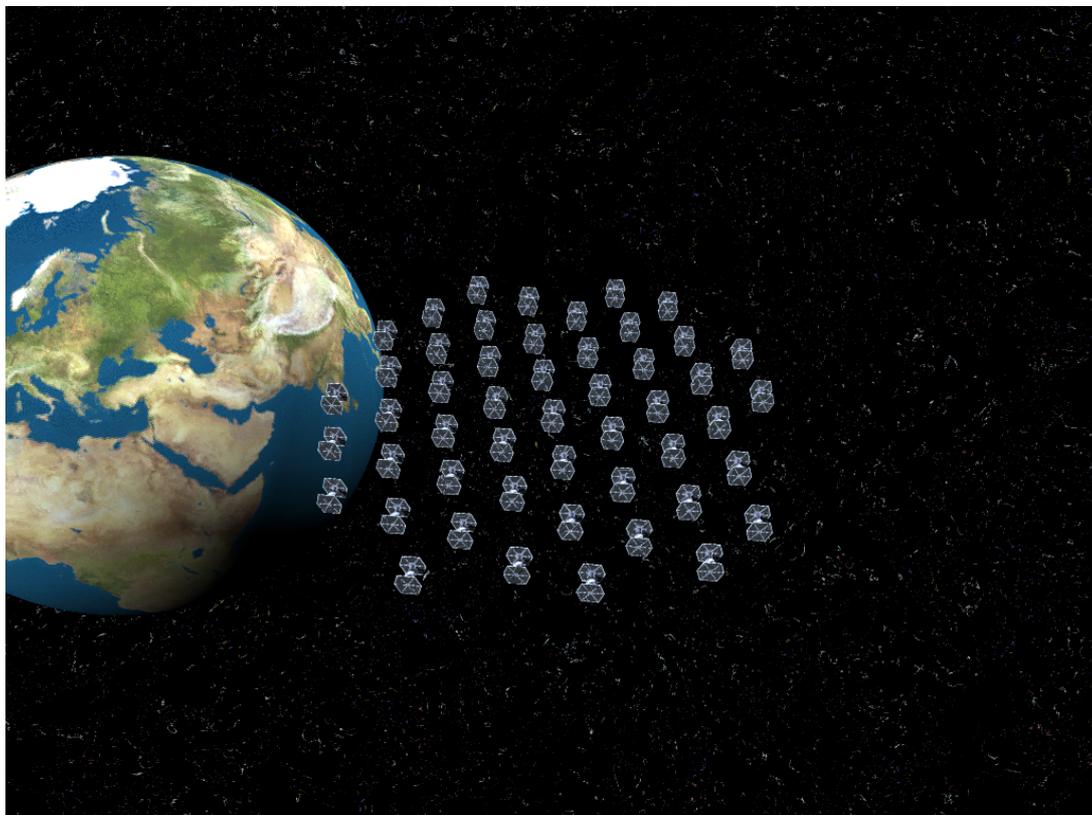
07/8101 Evolving a Collective Consciousness for a Swarm of Pico Satellites

Contract characteristics :

University/Department: Université Libre de Bruxelles/IRIDIA, CoDE

ACT researcher: Dario Izzo

Duration of the study: 4 months

Picture:**Methodology:**

Multi-agent systems whose control structures are designed by using the principles of swarm intelligence seem to be among the most promising technologies for the design of autonomous vehicles to undertake missions in the space. To study the potentialities of this approach, we developed a distributed control strategy for a swarm of satellites to autonomously form a lattice in orbit around a planet. The algorithm is based on the artificial potential field approach and follows the principles of swarm intelligence: interactions among satellites are only local and no explicit

communication is needed. We obtained the control parameters with a genetic algorithm to maximize the precision of the formed lattice.

Results:

1. *Distributed control strategy for a swarm of satellites*
2. *Precision does not depend on the number of satellites used, convergence achieved from all initial distributions of satellites*
3. *Reuse of known results in crystallography*
4. *Optimization of the control parameters*

Publications:

Carlo Pinciroli, Mauro Birattari, Elio Tuci, Marco Dorigo, Marco Del Rey Zapatero, Tamas Vinko, Dario Izzo. *Self-Organizing and Scalable Shape Formation for a Swarm of Pico Satellites*. NASA/ESA Conference on Adaptive Hardware and Systems (AHS-2008). IEEE Computer Society, Washington DC, USA. In press.

Carlo Pinciroli, Mauro Birattari, Elio Tuci, Marco Dorigo, Marco Del Rey Zapatero, Tamas Vinko, Dario Izzo. *Lattice Formation in Space for a Swarm of Pico Satellites*. The Sixth International Conference on Ant Colony Optimization and Swarm Intelligence (ANTS 2008). LNCS, Springer, Berlin, Germany. In press.

Highlights:

1. *We developed a distributed control strategy for a swarm of satellites to autonomously form a bi-dimensional hexagonal lattice in orbit around a planet.*
2. *Experimental evaluation shows that the precision does not depend on the number of satellites used, and that convergence is achieved from all initial distributions of the satellites.*
3. *The method employed to design the strategy exploits known results in crystallography, which may open a new way for conceiving lattice formation.*
4. *The control parameters have been evolved to optimize the precision of the final lattice.*