

Optimising the AIS and Artificial Energy Homeostasis

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AIS Optimisation I

- ▶ Optimising the mDCA algorithm using evolutionary computation techniques
- ▶ WP4 Task 4.4: Evolved immunity
- ▶ Towards D4.11 - An Evolved Artificial Immune System
- ▶ mDCA: an immune inspired anomaly detection algorithm
- ▶ Primarily for the detection of anomalies in IR sensor data
- ▶ Progress since Amsterdam:
 - ▶ Improvements to the base algorithm
 - ▶ More realistic sensor data
 - ▶ More realistic anomalies
 - ▶ Parameter optimisation using NSGA-II
 - ▶ Comparisons with other techniques (SVM) - work in progress

AIS Optimisation II

- ▶ NSGA-II [Deb et al., 2002]
- ▶ Fitness: cumulative distance from perfect output
- ▶ Trade-off between true positives and true negatives
- ▶ Best individual:
 - ▶ PPV: $\sim 97\%$
 - ▶ NPV: $\sim 99\%$

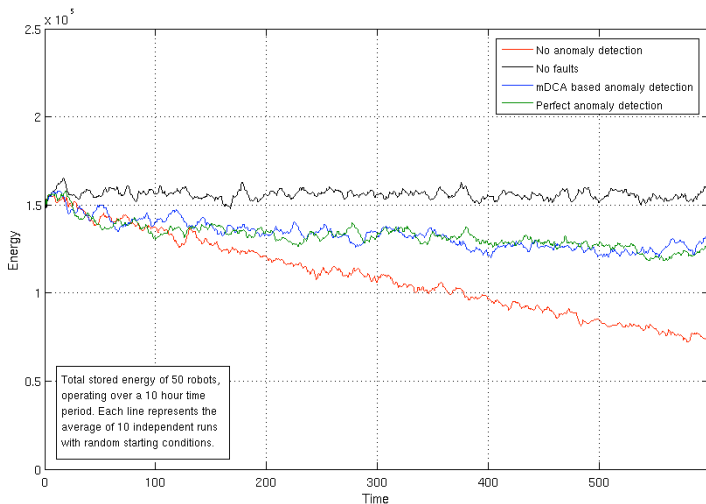
(Video not included)

Best individual

(Video not included)

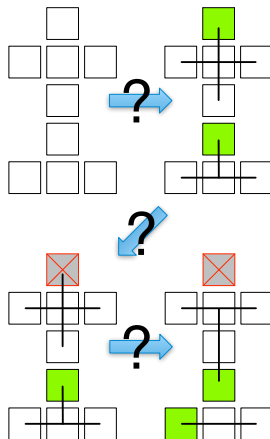
Long-term Survival

► 50 robots, 10 hours...



Artificial Energy Homeostasis

- ▶ Dynamic power management
 - ▶ In collab. with Fraunhofer
 - ▶ Environment/energy aware, fault tolerant, power bus re-configuration
 - ▶ Awaiting energy data from real robots
- ▶ Granuloma- ω -algorithm
 - ▶ In collaboration with UWE



Granuloma- ω -algorithm I

- ▶ Swarm taxis with collective 'self-healing' (recharging)
- ▶ Based upon the ω -algorithm
- ▶ Inspired by granuloma formation
- ▶ To prevent anchoring of the swarm, robots that have ran out of energy are recharged by their neighbours
- ▶ A collective decision process - inspired by granuloma formation - determines which robot(s) perform the repair

Granuloma- ω -algorithm II

- ▶ Self-healing not currently implemented
- ▶ Expected to be completed by the review meeting

(Video not included)

- ▶ Artificial Energy Homeostasis
 - ▶ Dynamic power management (collab. Fraunhofer)
 - ▶ Continue work on Granuloma- ω -algorithm (collab. UWE)
- ▶ Receptor-density algorithm (RDA)
 - ▶ Possible application within PMS



Deb, K., Agrawal, S., Pratap, A., and Meyarivan, T. (2002).
A fast and elitist multi-objective genetic algorithm: NSGA-II.
IEEE Transactions on Evolutionary Computation (IEEE-TEC),
6(2):182–197.