

Evolved Immunity and Artificial Energy Homeostasis

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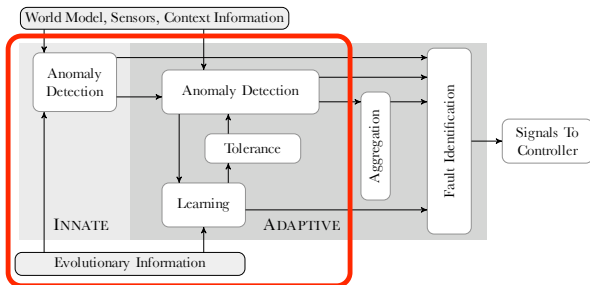
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Evolved Immunity

D4.11 - An Evolved Artificial Immune System (M36)

► Task 4.4

- Evolving the AIS developed in WP3
- Off-line optimisation of the AIS parameters
- On-line 'dynamic optimisation' of the AIS



D4.11 - Progress

- ▶ Initial experiments optimising the parameters of the innate 'mDCA' anomaly detection system
 - ▶ single robot employed in a simple energy foraging task
 - ▶ faults are randomly injected into IR range sensors
 - ▶ if a fault is detected then corrective action is taken
 - ▶ fitness: distance between ideal and actual algorithm output

(Video not included)

D4.11 - Future

- ▶ Continued evolution of the mDCA
 - ▶ optimising the system for other types of fault
 - ▶ alternative fitness functions
 - ▶ make use of the existing genetic framework
 - ▶ on-line evolution
- ▶ Evolution of the combined innate and adaptive AIS
 - ▶ beginning with off-line parameter optimisation
 - ▶ moving towards on-line 'dynamic optimisation'

D3.8 - Integrated Artificial Immune System for Homeostatic Operation (M48)

- ▶ Task 3.3
 - ▶ Investigation of new adaptive immune inspired approaches
 - ▶ Statistical anomaly detection based on the work of D5.4
 - ▶ Predictive immunity - identification of faults *before* they occur
 - ▶ Target application is power management and fault tolerance within the power module - in collaboration with Fraunhofer

D3.8 - Progress

- ▶ Built upon Wenguo's (UWE) Stage simulation to allow robots to transfer energy - with help from Hamza (Fraunhofer)
- ▶ Met with Hamza to discuss *artificial energy homeostasis*
(Video not included) (Video not included) (Video not included)

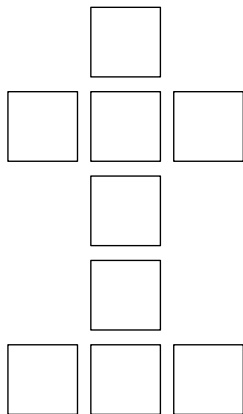


Artificial Energy Homeostasis

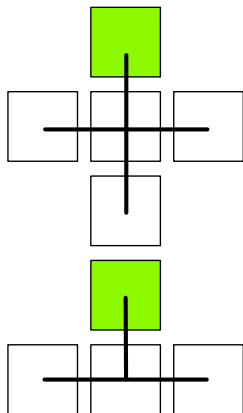
A process that regulates the flow of power within an artificial organism by taking into account: the power distribution amongst the modules, their current state and their role within the organism.

- ▶ Some general requirements:
 - ▶ Efficient usage, delivery and distribution of power
 - ▶ Tolerance to the presence of faults
 - ▶ Low memory footprint and computational requirements
- ▶ Ideally ensured at both the individual and organism levels
- ▶ First application - dynamic re-configuration of the power bus
- ▶ Task 4.6.3 - Fault-tolerant autonomous morphogenesis (UWE)
- ▶ Contribute towards GCI & GCII

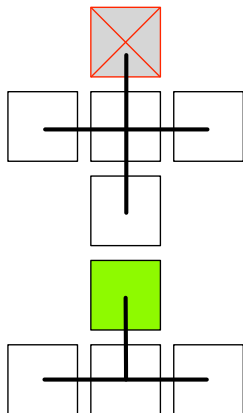
Dynamic Power Bus



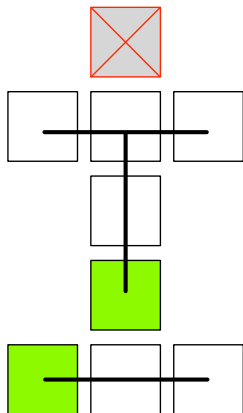
Dynamic Power Bus



Dynamic Power Bus

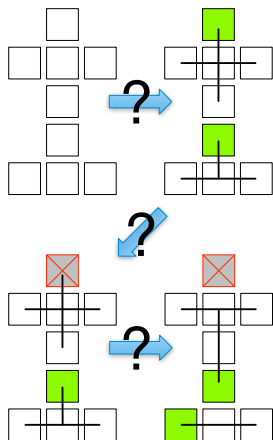


Dynamic Power Bus



Dynamic Power Bus - Challenges

- ▶ What conditions should lead to re-configuration?
 - ▶ Faults
 - ▶ Environmental changes
 - ▶ Energy levels
- ▶ Strategy for re-configuration?
 - ▶ Start from scratch
 - ▶ Adapt existing configuration
- ▶ How to repair faults?
 - ▶ Isolation
 - ▶ Replacement
 - ▶ Morphogenesis



Summary

- ▶ Two main deliverables remaining
 - ▶ Evolved Artificial Immune System
 - ▶ Integrated Artificial Immune System for Homeostatic Operation
- ▶ The next six months:
 - ▶ Continued evolution/optimisation of previous AIS algorithms
 - ▶ Investigation of novel bio-inspired approaches to artificial energy homeostasis
 - ▶ Predictive and statistical immunity
 - ▶ First application - dynamic re-configuration of the power bus

