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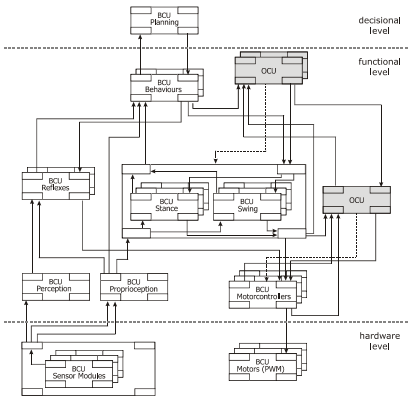
ORCA – Organic Robot Control Architecture



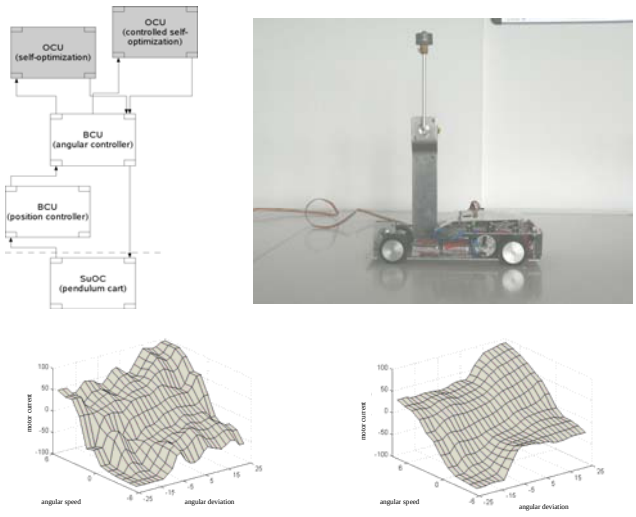
Organic Robot Control Architecture ORCA

- modular, hierarchical architecture to easily manage complex control systems in a fault-tolerant way
- Basic Control Units (BCUs) encapsulate a specific custom functionality
- Organic Control Units (OCU) monitor the BCU-systems and react on anomalies by changes at BCU-level

SILKE-approach

(System to Immunize Learning Knowledge-based Elements)

- meta-level control of self-optimizing BCUs
- can be tuned to the properties of the process by an appropriate adjustment rate
- improves performance and robustness of the self-optimizing process especially in the presence of disturbances

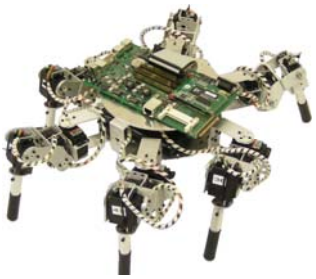


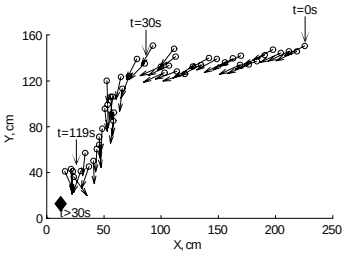
The knowledge base of the angular controller BCU after 30 s. of learning without the SILKE-approach (left) and with the SILKE-approach (right). The knowledge is smoothened because of efficient disturbance rejection.

Testbed OSCAR

- six-legged walking machine with 18 DoF
- force detection for every joint
- self-organizing gait pattern generation
- gait fault-tolerant against leg-amputation, even in complex walking situations

OSCAR III (Organic Self Configuring and Adapting Robot) is the latest test platform for ORCA. Beside the ARM9 Linux controller the robot was improved by current measuring, stronger servos





The Robot's walking path in X/Y positions during a curve walking manoeuvre.
The robot's right middle leg was amputated at X-position 150 while the heat source target (diamond) was detected at time t=30 and reached after 79 s.

ODIL-approach

(Online Diagnostics of Incremental Learning)

Health signal generation for self-optimizing BCUs by locally detecting violations of meta-level characteristics

- online
- instantaneously
- in a gradual way
- for easy integration into the ORCA architecture

Performance of a self-optimizing BCU and the resulting ODIL health signal for a) only initial knowledge, b) unguided learning, and c) learning with the SILKE-approach for the pendulum cart example