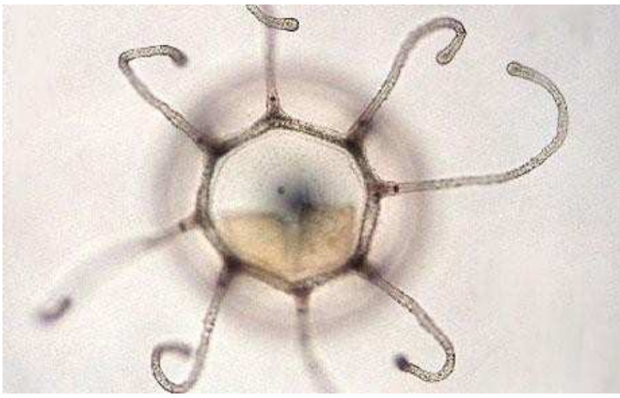
IT Services

Case Study

BlueBEAR provides a substantial computing resource that properly supports the research work of research staff and students at Birmingham. It provides a cost effective facility that optimises the effectiveness of research and ensures the University continues to be a world-class academic learning and research environment.

Co-evolutionary body-brain couplings in models of simple undulatory animals



Overview

I am interested in how evolution has led to an emergence of primitive animals having very specific couplings between their body plan morphologies and nervous systems. I attempt to examine how constraints such as energy consumption and behavioural fitness can affect such couplings on both physical and dynamical levels. Understanding such processes is important from both biological and computer science perspectives. From a biological perspective, we can attempt to shed light on how nature has come to organise information so efficiently; we can try to identify precisely why evolution has honed in on particular structures. From a computer science perspective, we can aim to build more efficient information systems.

Background

It is evident from a diverse range of animal species that the nervous system has been pressured to become architecturally organised in a way that 'fits' with a given animal's body morphology. The coupling between both is conjectured to have been driven by the niche of the animal, together with a need to expend a minimal amount of energy. Energy can be lost because of the metabolic processes of the animal, e.g. neural information processing, and, because of movement. Now, in order to explore these processes, we can take inspiration from the most 'basic' of animals and develop computational models that can be visualised and analysed with relative ease.

Research

In line with the above, my research has examined several computational models of primitive animals. One of them is based on the hydra, a very simple type of jellyfish known to have the most primitive nervous system; a more recent endeavour has explored models of more advanced creatures like the flatworm.

In both, results have demonstrated that the model nervous system will typically emerge with minimal complexity with much of the body plan morphology providing passive actuation. The model nervous system is further observed to become architecturally coupled in such a way that allows for maximum survivability and minimal energy consumption.

Ongoing work is complexifying the simulated environment and exploring how a variety of behaviours can emerge to meet the demands of several situations. This is computationally expensive and via a utilisation of the message passing interface, is continuing to benefit from a parallel distribution over tens of cores.

Client Profile

Dr Ben Jones
School of Computer Science
The University of Birmingham
Birmingham
B15 2TT

Contact Details
E:B.H.Jones@cs.bham.ac.uk

Product Used
C++
MPI
Neuro Simulation Technology (NEST)

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Contributors
Prof. Xin Yao
Prof. Bernhard Sendhoff
Prof. Yaochu Jin.

UNIVERSITY OF BIRMINGHAM

For more information:
BEAR, IT Services
Elms Road Computer Centre (G5)
Edgbaston
Birmingham B15 2TT
Tel: 0121 414 5877
Email: bearinfo@contacts.bham.ac.uk
Website: www.bear.bham.ac.uk