Open Internship in the ESA Advanced Concepts Team in 2014

on

Simultaneous evolution of morphology and locomotion of soft robots by novelty search

Topic Description

Soft robotics is a vivid research field on the science and engineering aspects of soft materials in mobile machines. Recent development in soft robotics and evolutionary optimisation have shown the possibility to simultaneously evolve the morphology and locomotion of soft robots. Generative encoding coupled with neural evolution of augmented topologies (NEAT) shows promising results [1,2]. It is of interest to study the development of different types of locomotion in low gravity environments while rewarding diversity at the behavioural level (novelty search [3]). Unlike most evolutionary algorithms, novelty search seeks novel behaviours and has no defined objective (e.g. distance travelled or speed). This research could result in a taxonomy of possible locomotion strategies at a given (low) gravity level that inspire new concepts for future robotic missions.

Candidate's tasks

The successful candidate will implement the generative encoding method [1] to generate soft robot morphologies. The pattern generating network of the encoding method will be evolved with novelty search on top of NEAT and locomotion patterns will be evaluated in VoxCAD (see [4]).

The ideal candidate

- Excellent programming skills (C++ required, QT/Python is a plus)
- Interest in robotic locomotion

Desirable:

- Experience with NEAT or Hyper-NEAT

References

[1] Cheney, Nick, et al. "Unshackling Evolution: Evolving Soft Robots with Multiple Materials and a Powerful Generative Encoding." Proceedings of the Genetic and Evolutionary Computation Conference. 2013.

[2] http://tinyurl.com/EvolvingSoftRobots

[3] Lehman, Joel, and Kenneth O. Stanley. "Abandoning objectives: Evolution through the search for novelty alone." Evolutionary computation 19.2 (2011): 189-223.

[4] VoxCAD: http://www.voxcad.com/