EvoRBC: Evolutionary Repertoire-based Control for Robots with Arbitrary Locomotion Complexity

Miguel Duarte[1], **Jorge Gomes**[2], **Sancho M. Oliveira**[3], **Anders L. Christensen**[4]

[1] IT-IUL and Instituto Universitário de Lisboa (ISCTE-IUL), Lisbon, Portugal

[2] IT-IUL and BioISI, BioISI, Faculdade de Ciências, Universidade de Lisboa, Lisbon, Portugal

[3] IT-IUL and Instituto Universitário de Lisboa (ISCTE-IUL), Lisbon, Portugal

[4] IT-IUL and Instituto Universitário de Lisboa (ISCTE-IUL), Lisbon, Portugal

Sancho.Oliveira@iscte.pt

The use of evolutionary robotics (ER) in robots with complex means of locomotion has, so far, mainly been limited to gait evolution. Increasing the number of degrees of freedom (DOF) available to a controller significantly enlarges the search space, which in turn makes the evolution of solutions for a given task more challenging. In this paper, we present Evolutionary Repertoire-based Control (EvoRBC), an approach that enables the evolution of control for robots with arbitrary locomotion complexity. EvoRBC separates the synthesis of control into two levels: the generation of a repertoire of behavior primitives through the application of Quality Diversity techniques; and the evolution of a behavior arbitrator that uses the repertoire's primitives to solve a particular task. We evaluate EvoRBC in simulated robots with different numbers of DOF in two tasks, navigation and foraging. Our results show that while standard evolutionary approaches are highly affected by the locomotion complexity of the robot, EvoRBC is consistently able to evolve high-performing solutions. We also show that EvoRBC allows for the evolution of general controllers, that can be successfully used in robots different than those with which they were evolved.