ABSTRACT

"I, robot. Using novel bio-inspired principles to improve adaptability of evolutionary robots in dynamically changing environments"

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One of the important challenges in the field of evolutionary robotics is the development of systems that can adapt to changing environments. However, adaptation to a changing or fluctuating environment, characteristic of a complex adaptive system (CAS), is not straightforward and usually requires a dynamic and preferentially robust solution. In this study, we explore the adaptive potential of simulated robots that contain a genomic encoding of a gene regulatory network (GRN). This hard-wired (static) genomic encoding is combined with an agent-based system, which transduces environmental cues into phenotypic behaviour. Using a simulation framework that mimics a dynamically changing environment, we demonstrate that the combination of a genomic encoding of the GRN and an agent based system has several advantages over more traditional approaches. Indeed, separating the static from the conditionally active part of the network allows changes to affect parts of the static network, generating diversity that might later prove beneficial in a different environment, while not affecting the part of the GRN that is currently active. Furthermore, beneficial network re-wiring in the static genome provides a memory imprint that allows faster re-adaptation to a situation encountered previously. Applying these evolutionary-based principles increases the potential to evolve and adapt in a non-stable environment.