CLAWAR 2020: 23rd International Conference on
Climbing and Walking Robots and the Support
Technologies for Mobile Machines,
Moscow, Russian Federation, 24-26 August 2020.
https://doi.org/10.13180/clawar.2020.24-26.08.p02

ANIMAL-INSPIRED ROBOTS THAT CRAWL, WALK, RUN, CLIMB AND FLY AND SYNTHETIC NERVOUS SYSTEMS FOR THEIR CONTROL

ROGER D. QUINN
Biologically Inspired Robotics Group
Case Western Reserve University,
Cleveland, Ohio, USA

The goal of our research is to model animal locomotion systems using computational neuoromechanics and then apply their designs and even their materials to robots to improve their mechanical designs, autonomous behaviors, and locomotion. This presentation summarizes our efforts over the last several decades and describes our recent work in more detail. We use bioinspiration or biomimicry depending on our specific goals. Using bioinspiration we have applied the fundamental principles of insect locomotion to develop robots using existing technologies and in a simplified manner. Their motor control is also simplified and the agility of these vehicles makes them suitable for some applications. This approach has been used to develop fast running vehicles and a small fixed-wing vehicle called MALV (micro air and land vehicle) that flies, lands and crawls. Using biomimicry, we are developing other robots and animal models including moth-like compliant, flapping wings that mimic those of the animal. We have developed a number of robots with multi-segmented legs mirroring those of animals. For example, Drosophibot is a dynamically scaled up model of a fruit fly and Puppy is a model of a greyhound with artificial mucles. For these robots, we are developing synthetic nervous systems (SNS) for their control based upon animal neurobiology. We are also developing structurally soft worm-like robots, which crawl via peristaltic waves, for pipe inspection and, when made compact, within the body. Robots with a human in the loop for basic control decisions are limited in their movements in complex terrain because of sparse sensory data and limited communications. Some autonomy is essential for their agility. Insect neurobiology and behavioral experiments are being used to develop SNS navigation systems and decision making strategies. Our autonomous snowplows benefit from a distributed control architecture similar to that found in animals and will eventually implement an animal-inspired SNS brain. In still another approach, teaming with the bio-fabrication groups, we are developing small robots using organic materials.