Biomimetic Robots for Environmental Inspection Tasks

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In this paper we present a biomimetic design and control approach for autonomous robots, which are highly qualified candidates for environmental inspection tasks. We are working on this topic since the early nineties and created a series of biomimetic systems, like robotic snakes, worms and insect- or spider-like walking robots. [Kir] [Kla] [Spe]

But not only the design of the system's shape is biologically inspired. Also the control approach uses principles from nature: like e.g. the so-called central pattern generator for ambulation control or reflex-like behaviors to enhance the system's reactivity. [Ste] [Esp] [Del] [Cru]

We want to point out that such an approach has several promising features:

- By construction the robots are appropriate to move in a natural environment with minimal risk of disturbance. (A famous example for practical use is a walking robot from Finland for forest work, which has enormous advantages over a conventional caterpillar)
- As in nature, the shape of the body can be optimized according to the task: Inspection of tight hollows or gaps will need a slim, snake-like body, whereas a walking robot shows its advantages in a rough, stony terrain.
- In addition, our robots can cope with failures to some extent: E.g. an eight-legged walking robot has good chances to perform its task even if one leg is out of function (or see [Kub]).
- But also the biomimetic control approach yields several advantages for working in possibly unknown outdoor fields: In contrary to industrial robots, where high precision of motion is essential, here we have more adaptive behaviors to react on unforeseen situations.
- Even in situations that are dangerous for humans (e.g. in poisoned areas) a robot has good chances to serve as device for control and measurement

Another important field for application is the capability of such robots to communicate and cooperate as a team. Robots can be trained to help each other in difficult situations. Or they can control their distances (from each other) to build a mesh of control points over a certain area, without telling each individual robot exactly and a-priori where to go.

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