Using Biological Inspiration to Develop Adaptive Walking Robots: Towards Neuro-Autonomous Systems

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Abstract:

Nature apparently has succeeded in evolving biomechanics and creating neural mechanisms that allow living systems like walking animals to perform various sophisticated behaviors, e.g., different gaits, climbing, turning, orienting, obstacle avoidance, attraction, anticipation. This shows that general principles of nature can provide biological inspiration for robotic designs or give useful hints of what is possible and design ideas that may have escaped our consideration. Instead of starting from scratch, in this talk I will present how the biological principles can be used for mechanical design and control of walking robots (see Fig. 1), in order to approach living creatures in their level of performance. Employing this strategy allows us to successfully develop versatile, adaptive, and autonomous walking robots [1-3]. Versatility in this sense means a variety of reactive behaviors including memory guidance, while adaptivity implies online learning capabilities. Autonomy is an ability to function without continuous human guidance. These three key elements are achieved under modular neural control and learning. In addition, the presented neural control technique is shown to be a powerful method of solving sensor- motor coordination problems of high complexity systems.

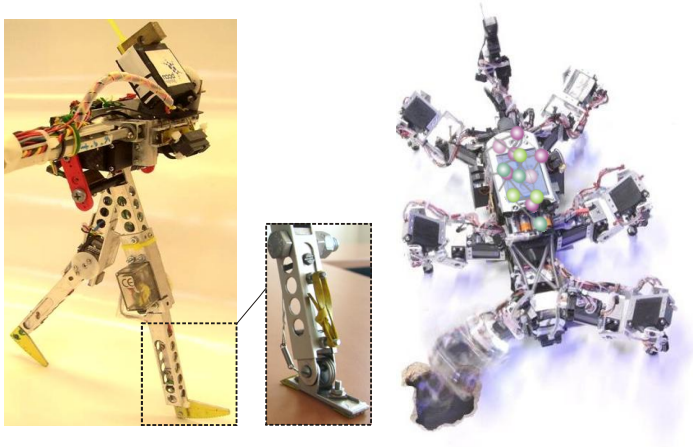

Fig.1 : Biologically-inspired walking robots. Left: The planar dynamic robot RunBot with new compliant ankle joints connected to flat feet [4] (shown in a small frame). Its new feet have been developed in collaboration with the Lauflabor Locomotion Laboratory Jena. Right : The animal-like walking robot AMOS.

References:

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