Development of Evolutionary Design System for Dynamically Stable Legged Locomotion

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Evolutionary robotics aims at designing autonomous robots with technological applications of biological evolution. These design approaches have characteristics to exclude designer's bias so that unexpected superior functions tend to emerge. In this research, we mainly focus on "interdependence between controller and morphology," which is represented by passive dynamics walkers, and apply evolutionary robotics to achieve dynamically stable legged locomotion such as running and jumping.

(i) We investigated the morphology and controller of biped robots because we viewed them as design components that together can induce dynamically stable locomotion. We conducted coupled evolution of the morphology and controller in three-dimensional simulation. As results, both pseudo-passive dynamic walkers (PPDWs) and active-control walkers (ACWs) emerged, but the PPDWs showed more dynamic stability than ACWs. Finally, we have concluded that appropriate compliance is a key to achieving dynamical stability and a computational trade-off between controller and morphology occurs in these devices.

(ii) An important issue in evolutionary robotics is to solve "reality gap" problem, which indicates functions of virtual robots do not necessarily realize in real world. We propose interdependent use of evolutionary and heuristic designs for crossing reality gaps and develop graphical interfaces, which integrate heuristics into evolutionary design (fig.2).

Keywords: Evolutionary Robotics, Legged Locomotion, Passive Dynamics, Morph functionality.

References

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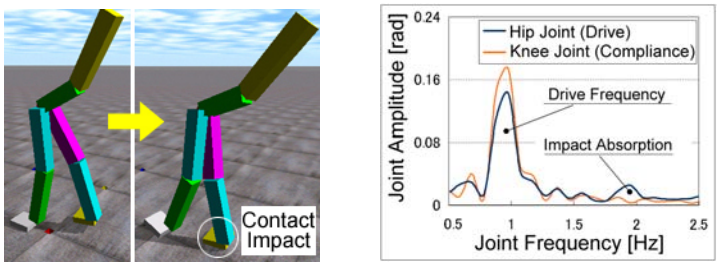

Fig.1 Investigation of the interdependence (left: walking scene, right: FFT Analysis of joints)

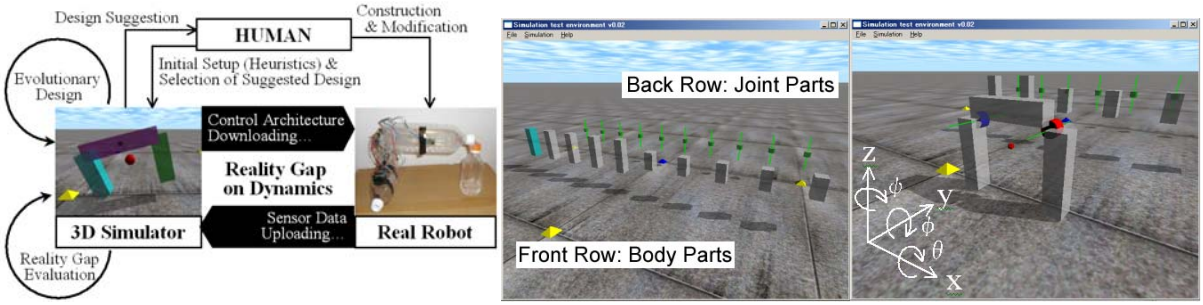

Fig. 2 Evolutionary Design System(left: concept, right: graphical interfaces for heuristics)