Jumping, running, dancing, flying, reaching: moving into the future Design principles for adaptive mobile systems

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Designing for adaptive motion is still largely considered an art. In recent years, we have been developing a set of heuristics or design principles, that on the one hand capture theoretical insights about adaptive systems, and on the other provide guidance in actually designing and building adaptive systems.

We make a distinction between design procedure principles and agent design principles. The former are more about how to go about designing agents whereas the latter concern the actual design and architecture of the agents themselves. Some of the agent design principles are specifically about the relation between embodiment and neural processing.

In this paper we discuss, in particular, the principle of "ecological balance" which is about the task distribution between morphology, materials, and control. As we will argue, artificial evolution together with morphogenesis is not only "nice to have" but turns out to be a necessary design tool. In order to achieve the required diversity in ontogenetic development, the model proposed is based on recent insights on genetic regulatory networks.