Towards Incorporation of Hierarchical Bayesian Models into Evolution Strategies for Quadruped Gait Generation

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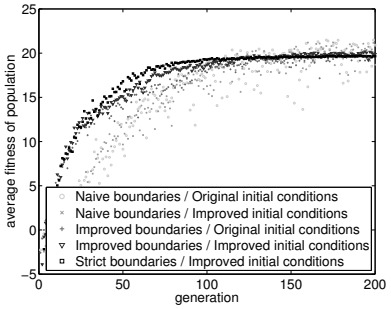

Figure 1. Fitness in function of generation

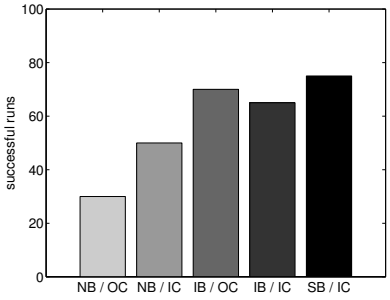

Figure 2. Number of successful gaits

Learning how to control a compliant quadruped robot is a challenging task. Hand tuning and evolutionary strategies are the two most often used approaches for developing quadruped gaits. These approaches are time consuming and the end result is only usable in a specific environment. Furthermore the stability of the gait is often very sensitive to minute parameter changes. This limits the usability of such a robot. We want to circumvent these problems by using transfer learning. The goal in transfer learning is to improve learning by using knowledge from a relating task. This can speed up the learning process and improve the end result. Hierarchical Bayesian Modeling (**?**) is a method which can be used for transfer learning which is able to learn from just a few examples.

We investigated the similarity between gaits on flat terrain and slopes. We simulated the robot using an in-house built simulator, based on Open Dynamics Engine (ODE). The gaits were optimized using CMA-ES(**?**). In the first experiment we optimized gaits for specific slopes. Inspection of the final population has shown that distributions over gait parameters are very similar for the different slopes. Thus indicating that transfer learning is applicable to this task. As a proof of concept we ran a second experiment where we have changed the starting conditions and/or the search boundaries based on the data obtained by optimization on a single slope. The results in Figure 1 show that the optimization process converges faster and that there is less variance on resulting fitness. In Figure 2 we see that the number of gaits which are stable has increased with the adapted search.

Future work will focus on combining ideas from Hierarchical Bayesian Models with Evolution Strategies.

Acknowledgments

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