Learning Model-Free Behaviors

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In this talk we show that a model-free approach to learn behaviors in joint space can be successfully used to learn various kicks in the soccer simulation environment. Keeping the approach model-free makes it applicable to any kind of humanoid robot, or robot in general. The only model assumptions required are the number of motors and the angular range of them. We do not require to know any geometric information as of where these motors etc. As one example, it utilizes the toe to improve kick performance by 30%. The approach does not require any initial seeding or reasonably working behavior to start with. The only help it gets is to place the player near the ball, and to trigger the kick in a suitable state of walk.

Learning is done using plain genetic algorithms to get an initialy working behavior and CMA-ES to improve it. Feedback from the domain is provided by a fitness function that defines the utility of a robot and is the only thing to change for learning different kicks. The resulting initial movement of the robot is shown in Figure 1. The robot learned to improve the kick considerably by stepping on its toes of the support leg, seen especially in sub-images three and four. In the meantime, the robot is able to kick forwards, diagonal, two ways of sidewise, backward and even from full running.

Learning to kick is common in many RoboCup leagues. A good overview can be found in [3]. MacAlpine et al. [4] use a layered learning approach to learn a set of behaviors also learning keyframes for kicking. Abdolmaleki et al.[1] also use a keyframe based approach and CMA-ES. To our knowledge, both require an initial seed of a partly working behavior which is not the case for our approach [2].

References

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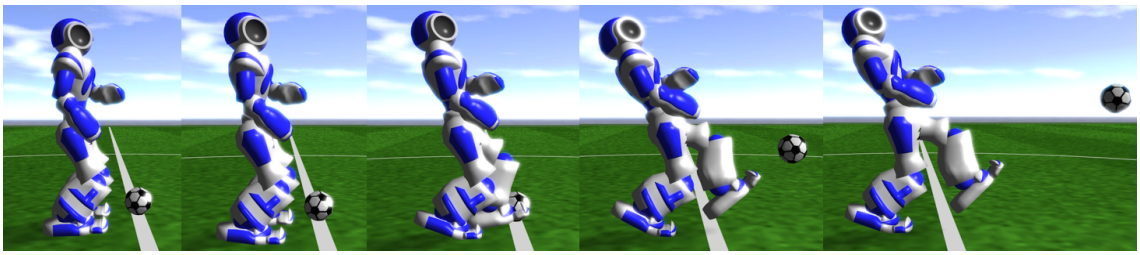

Fig. 1. Sequence of movement when kicking with NaoToe.