# Learning Robot Low Level Control Primitives: A Case Study

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## Abstract

Controlling articulated mobile robots is associated with the manipulation of very complex dynamics, leading to a straightforward lack in the kind of motions these robots can complete, i.e. confined to those computed off-line from the very approximated models of its bodies' physics. Trajectory generation based on safety mathematical conditions, e.g. avoiding singularities or non-equilibrium states, limites its performance. It has been demonstrated that, by means of optimization process inside the low level control laws, robots may outperform its physical capabilities [1]. Inverse dynamics of very approximated and complex models are not helpful to design natural motions.

The system presented in this paper uses a modular control architecture, where joint's actuators share information between each other. The policies that gather and distribute the signals to the actuators are learned based on the task performance.

Here we defend the idea of learning low level control primitives to achieve coordination [2], allowing the system to generate trajectories autonomously by using Policy Gradient Reinforcement learning techniques (PGRL), i.e an optimal control framework is established.

In this poster a time-varying dynamics task is used as a test bed : The simulated version of the AIBO® robot completing a basketball-like task by means of PGRL ( see process video); control actions and output signals are presented while comparing changes during learning; additionally, different kind of PGRL algorithms are proved and compared from a control systems' perspective.

## References

[1] D. Pardo and C. Angulo, *Understanding sensori-motor coordination during a humanoid robot dynamic task*, in Proc. IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2007), London, UK. 2007.

[2] D. Pardo and C. Angulo, *Emerging Behaviors by Learning Joint Coordination in Articulated Mobile Robots* Lecture Notes in Computer Science, vol 4507, pp. 806-813 (IWANN 2007), Donostia, Spain. Springer, 2007.