# Reinforcement Learning for Robots Locomotion Learning

***Project Proposal***

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## 1. Motivation and Problem Definition:

One of the first important tasks in Robotics is the motion. If the motion of some robot's type like wheeled-robots and crawler-robots is not really a big issue, since they are naturally well balanced on the floor and need only a force to let them move, there are other types for whom the locomotion is not evident and it's a very difficult task that they must learn. The multi-legged robots are one of the later types.
Traditionally, a designer had to implement a large amount of manual tuning to ensure a stable locomotion for a multi-legged robot. Currently, with reinforcement learning, we can achieve the learning of a suitable gait for the robot by setting the appropriate reward functions

In this project, we will try to apply RL algorithms such as DDPG, TD3 to achieve the locomotion learning for the Ghost Minitaur, a dog robot proposed by GHOST ROBOTICS.

For the simulation of our experiments, we will use Pybullet Minitaur environment.

## 1. Methodology:

To handle this learning problem, we will take inspiration from the work of *Tan et al.* [1] that introduce the use of deep RL to learn agile locomotion automatically for robots, especially for a quadruped robot. We expect to use one of two algorithms (maybe both): DDPG (Deep Deterministic Policy Gradient) and/or TD3 (twin-delayed deep deterministic policy gradient).

The first one is an algorithm which concurrently learns a Q-function and a policy. It uses off-policy data and the Bellman equation to learn the Q-function and uses the Q-function to learn the policy. This approach is closely connected to Q-learning.

The second one looks like an evolution from the first one, it is a model-free, online, off-policy reinforcement learning method. TD3 makes some improvements on DDPG and achieves a better performance

## References:

[1] Jie Tan, Tingnan Zhang, Erwin Coumans,etc.Sim-to-Real: Learning Agile Locomotion For Quadruped Robots arXiv:1804.10332v2 [cs.RO]