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COURSE: TECHNICAL BUSINESS WRITING

MEMORENDUM REPORT:

Robot Learning in Simulation for Grasping and Manipulation

To: Board of Directors
From: Executive Director, Association for a Better Community, Inc.
Date: June 15, 2013
Re: Summary of Financial Results as of May 31, 2013
Subject: Learning in Simulation for Grasping
Dear Director,

Teaching a robot to acquire complex motor skills in complicated environments is one of the most ambitious problems facing roboticists today. Grasp planning is a subset of this problem which can be solved through complex geometric and physical analysis or computationally expensive data driven analysis.

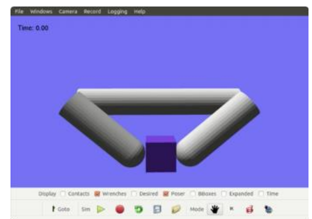
Introduction:

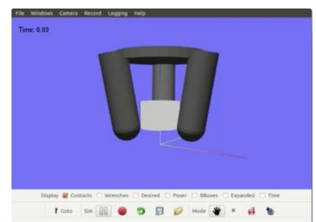
Expanding capabilities and complexity of robots has led to a greater need to explore adaptive control. Creating analytical models of has proven to be difficult; hand tuning policies is not viable due to the intricacy of environments. Simulators can provide efficiency that a physical robot can- not afford. The robot needs to repeatedly perform a task or some variation of the same task to collect data. Before each iteration of task, the researcher has to set or reset the task scene.

Related Work:

Reinforcement Learning has been used successfully in various tasks including navigating through complex environments and manipulating objects.We develop models of the dynamics grasping that that map current state (joint position, joint torque, motor position, joint velocity) and action (motor position command), to subsequent states.

Testing Stimulators:





The most important tool for this project is a robust simulator that can simulate articulated joints, non-dynamic objects, and prescribed base motion for the robotWe evaluated the simulator Klampt which uses Open Dynamics Engine (ODE) as its backend. ODE uses an iterative Linear Complementarity Problem solver to solve contact constraints, to make certain that
interpenetration does not occur.

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Asymmetry:

When we increase complexity by adding a third finger, simulating. we encounter asymmetry in the grasp, despite applying the same magnitude of torque at each of the joints. A system is in stable equilibrium if the second derivative of the potential energy is greater than zero. This means that if the system is disturbed, it will tend to return to its original position. We simplify the problem to a two dimensional problem, focusing on position disturbances.

Comparison with Other Simulators:

Despite the inaccuracies in the clutter simulation, we still believe that Klamp't is an appropriate open source simulator for this project. Other open source physics engines that we explored, Klamp't was able to produce accurate contact dynamics and stably simulated a gripper holding an object for a few minutes. Furthermore, we require several other features which Klamp't is able to suitably provide, such as simulated contact sensors, joint position sensors, prescribed base motion for a gripper to lift objects off a surface. In this project we will use Klamp’t, since it is the most robust simulator we have examined.

Regards

Ibrar

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S. Gu, T. Lillicrap, I. Sutskever, and S. Levine, “Continuous Deep Q-Learning with Model-based Acceleration,” arXiv:1603.00748 [cs], Mar. 2016, arXiv: 1603.00748. [Online]. Available: **http://arxiv.org/abs/1603.00748**

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