An Infrastructure for Recording User Demonstrations of Complex Tasks
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**Introduction**

We developed a software framework for capturing user demonstrations of complex mobile manipulation tasks in a simulated environment using the PR2 robot. For example, picking up a bottle and placing it elsewhere.

**Scene & Task Builder**

*Scenes* are composed of objects, either statically placed in the environment or manipulable. *Tasks* consist of a sequence of goals (e.g. pick up or place an object). Researchers can easily build new scenes and tasks using a drag and drop interface. Suitable meshes are readily available from websites such as Google 3D Warehouse.

**User Demonstrations**

User demonstrations are composed of 7 DOF arm motions and 3 DOF base motions ($x$, $y$, $\theta$). We created two sets of controls: one mouse-based for novice users, and one that makes use of the mouse and keyboard in concert for advanced users.

Users provide waypoints for the base and end-effector to a simple workspace controller (carrot controller).

As controllers move toward their “carrots,” movements are checked for validity against collision, kinematic, and other constraints.

We record user chosen grasps, as well as the motion used to accomplish them. Full or partial demonstrations can be replayed from recorded files.

**Research Applications**

This tool will facilitate the collection of large amounts of data about complicated mobile manipulation tasks. Some applications include:

- Motion planning that makes use of previous plans, such as E-Graphs [1, 2].
- Studying context-specific object grasps.
- Learning motion primitives for graph-based planning.

**Future Work**

- Incorporate usability improvements from a preliminary, 10 person user study.
- Embed this tool in a web browser to facilitate data collection.
- Publish our collected data for use in other research.

**References**