HAPTICS AIDED MOTION PLANNING

Description:

Haptics refers to technology that interfaces the virtual environment to the user via the sense of touch by applying forces,vibrations and/or motions to the user. A person, for example, can control a robot and also feel the atmosphere around that robot.

Motion Planning is the process of building a path that would help navigate a robot through complex environments. Traditionally used automatic motion planners sometimes fail due to the difficulty of discovering critical configurations of the robot that are often naturally apparent to a human observer. We plan on finding a viable solution to this problem with the aid of haptic devices.

Purpose:

Haptic aided motion planning could be very useful in maneuvering robots through complex environments. It could save a great deal of time if a human operator and an automatic motion planner worked cooperatively to solve a motion planning query. Moreover, this aspect of motion planning has not been researched much.

Project Goals and Implications:

We would like to test to check if the haptic-aided motion planning methods succeed in finding a collision-free path in complex environments,where traditional motion planners have failed. We would also like to compare these results in terms of time with standard Probablistic Motion Planning methods.

Approaches:

Approximate user guided paths can be collected with aid of haptics and these user guided paths can be transformed to collision free paths using Probablistic Road map methods. The general approach used is as follows-

- Generate a interface through which the user can interact with the environment using the haptics devices.
- Record the configurations of the robot at fixed intervals.
- Use the recorded configurations to generate the approximate user-guided path.
- Using PRM techniques derive a collision-free path from the approximate user-guided path.

Methods and Materials:

- Open-Haptics toolkit(a library from Sensable,the makers of the Haptic Device) was used to help interact with the Haptic Device
- The code required to interact,visualize the haptics environment was written using C++.
- The existing motion planning frame work(PMPL) will be used to find a collision-free path.

Work Schedule:

I work between 40-60 hours a week. I usually average it out to 8 hours a day. Depending on the workload I sometimes also work on week-ends.

Deliverables and Dates:

- Week 1: Set-up the haptic device to run our systems.
  Read a few papers related to motion planning.
- Week 2: Acquired the required software components.
  Familiarized myself with the Open-Haptics toolkit and also sketched out a plan for designing the user interface.
- Week 3 :Began coding the user-interface.
  Familiarized myself with functions and limitations of the haptics device.
- Week 4: Completed the user interface and also was able to record the required configurations in the desired format.
  I had a few issues understanding the math behind the orientations of the robot required to record the configurations.
- Week 5: Spent a large amount of time understanding the math behind the orientations.
  Started exploring the PMPL code and familiarizing myself with it.
- Week 6: Continued to work on understanding the PMPL code.
  Read a few more papers on motion planning methods.
  Worked on the basic algorithm for motion planning.
- Week 7: I plan to finish the motion-planning code required to trace the collision-free paths from the user-guided paths.
- Week 8: I plan to compare the results obtained with the results of the standard Probablistic motion planner.

Personal Goals:

Besides providing me with valuable knowledge in the field of computer science, I would also like this project to serve as invaluable research experience. I would like it give me a feel of working in a research lab and life ahead at Grad school.