Grasp Planning Toolbox in Choreonoid

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1. Introduction

For aged society, service robots are demanded which can bring daily life objects to the old who require life care. The robots have to be able to grasp any daily life objects under complex environment. For grasping objects, the robots need many software functions, solving kinematics, checking grasp stability, and collision detection. We aim to develop grasp planning toolbox which has these functions.

The toolbox is structured as plugins in Choreonoid which has an efficient framework for integrating various functions. We design the toolbox that each function can be extended and be replaced with other functions depending on works and robot specification. Planning and actual robot operations can be performed using this toolbox .

2. Software environment

The grasp planning toolbox uses softwares in the NEDO project of “Intelligent RT Software Project”.

OpenRTM-aist[1] a software platform of ”RT components” to develop the robotic system in component-oriented

RT components software modules such as image processing, voice recognition, and robot controller which can connect each other easily

OpenHRP3[2] an integrated software platform for robot simulations and software developments

Choreonoid an integrated software that allows us to choreograph humanoid robot motions

Choreonoid has functions for designing robotics motion. The functions, such as inputing motion, previewing motion animation, and simulating motion dynamics are used for the grasp planning toolbox for autonomous motion planning.

3. Grasp planning

3·1 Outline of grasp planning

Our grasp planning method was presented in [3][4]. The planner calculates grasp posture with checking kinematics, force closure, and collision. Approximated force closure is quickly checked by using the proposed method[5] of ellipsoidal approximation of friction cone. The planner calculates grasping posture in 1 sec, after it is given a polygonal model of grasped object and its position. The planner can be used for on-line calculation.

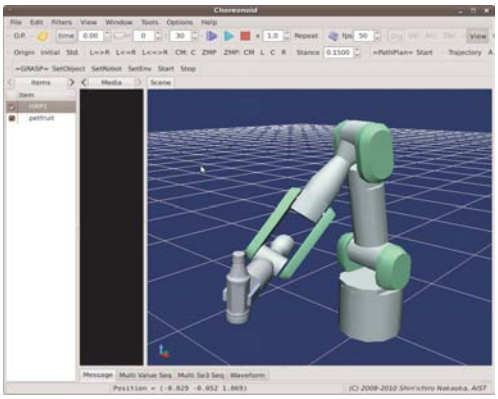

Fig. 1 PA-10

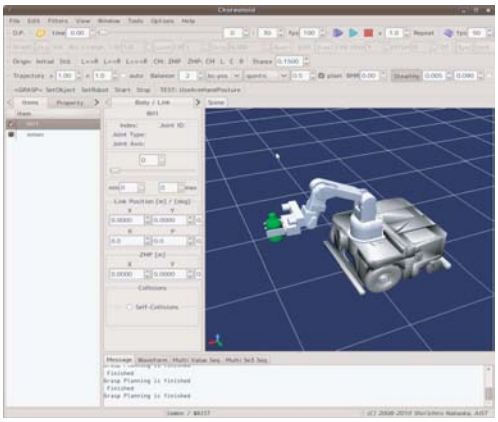

Fig. 2 RH1

3·2 User interface for grasp planning

The simple interface for grasp planning is explained. The main buttons for operating the planner are as below.

SetRobot Assign the selected item on ItemTreeView to a working robot.

SetObject Assign the selected item on ItemTreeView to a grasped object.

SetEnv Assign the selected items on ItemTreeView to obstructions.

Start Start grasp planning.

Stop Abort grasp planning.

The motion pattern of planning result is displayed using Choreonoid animation function.

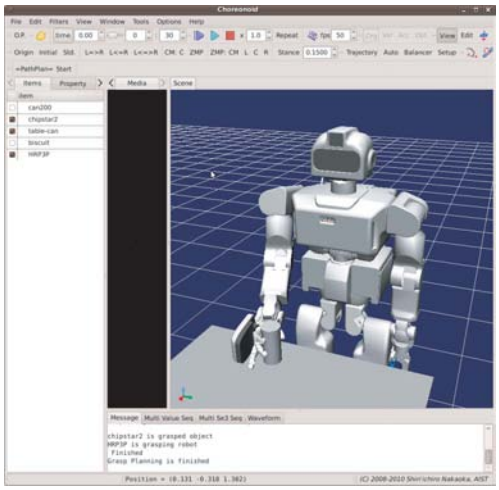

Fig. 3 HRP-3P

3·3 Simulation

We verify the grasp planning using PA-10 (Fig .1), RH1 (Fig. 2), HRP-3P (Fig. 3), HIRO, and Smart-Pal. The planner is confirmed to be able to use different types of robots, such as gripper, multi-fingered hand, humanoid arm, and industrial arm.

4. Tools

The grasp planning toolbox has tools for planning motion and operating robots as below.

Trajectory planning Generate motion trajectory with avoiding collision using probabilistic roadmap

Inputting sensing data Access vision sensor via OpenRT-middleware for recognizing object position and environment.

Outputting robot motions Output robot motions via OpenRT-middleware for operating actuators.

Geometry analysis Analyze shape of a grasped object for exploring grasping posture.

5. Conclusion

We develop grasp planning toolbox for service robots which grasp the daily life object. Since the toolbox can easily be extended, and customized, it has high reusability.

We will publish the toolbox as open source software and extend the functions: stability analysis of soft-finger contact, dynamic simulation, geometry analysis of curved surface.

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