

Arm Motion Planning of Humanoid Robots

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Abstract

The research is conducted to obtain motion planning algorithm of humanoid robots. Our aim is to create the motion of the arm of humanoid robot automatically so that it can avoid obstacles in its surroundings. Our system will use stereo vision to obtain the map of the environment and using mesh modeling, the accumulation of vision input continuously will be done. We will implement PRM (Probabilistic Roadmap) to plan the motion of the robot arm.

Introduction

The arm motion planning of humanoid robots involves the process of determining the appropriate trajectories and configurations for the robot's arm to perform desired tasks. This task requires precise consideration of various factors like robot kinematics, workspace constraints and optimization of motion efficiency. The goal of the arm motion planning is to generate feasible and collision free paths that enable humanoid robot to manipulate objects or perform specific actions. This process typically involves several steps including perception, motion planning and control. In order for the humanoid robot to sense the objects in human environment and automatically perform desired action, the implementation of fundamental components are also required. Here we will also focus on avoiding obstacles and improving human-robot interaction. The system will include several components like fast stereo vision to calculate distances accurately in environment, then storing the outcome in order to create an approximate 3D model probabilistically and ultimately search for a collision free path using PRM search method. The combination of these three components will enable the robot to grasp an indicated target object automatically.

Generating 3D images of surroundings

We will estimate the information of depth or the 3D structure of the surrounding from a 2D image or collection of such images. This process is called Depth map Generation. Such maps are useful in computer vision, augmented reality, virtual reality and 3D reconstruction. By incorporating depth information into planning process, the robot can perceive 3D structure of the environment better and hence can make more informed decisions and perform tasks more efficiently. We will be taking the arm length and hand size of the robot about 60 cm and 15 cm respectively, so we require approximately 1cm accuracy in 1m distance with 10Hz calculation rate in order to grasp target object by humanoid robots. To obtain depth maps for motion planning, the robot arm requires a depth sensing system like stereo camera, depth camera or a combination of multiple sensors.

- A) Stereo Camera: On analyzing the disparity between corresponding points in a pair of stereo images, we can infer the depth information, allowing for the creation of a disparity map. This map will provide valuable data about the 3D structure of the environment which will aid in motion planning. We will assume that no horizontal disparity occurs for two images and our target will be to detect the occlusion region by comparing the two images.
- B) Image Rectification: To make the stereo matching process simpler, the stereo

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