

GENERATING DYNAMIC MOTION USING HIERARCHICALLY CONNECTED JOINTS

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Abstract

“Necessity is mother of invention.” The better solutions to the problems are the ones that examine the problem in its simplest form and take examples from nature. In this paper, it’s planned to propose a solution for a problem in robotics and virtual reality applications. The evolution of this area started with four/six legged robots and then moved to humanoid robots. Many algorithms were proposed to achieve this goal, including inverse kinematics, preprogrammed gaits. There were some real time motion generators, but they require more calculation, and are not efficient. The proposed method generates the motion to reach an object with hierarchical distributed intelligence, simulating humans’ brains working like parallel processors dynamically.

There are different approaches to generate a motion, with their advantages and disadvantages. Before proposing a general motion generation algorithm, it’s best to look at how human motions first. There are two types of joints in human body: spherical and revolute. Spherical joints have three degree of freedom; revolute joints have one degree of freedom. All joints have their limitations.

A number of researchers have hypothesized that humans might simplify the control process by dividing the task into parallel, independent components, as is often done in robotics [1]. Movements of the limb to the proper location, and grasping the object would be controlled independently [2, 3].

In motion generation, inverse and forward kinematics are used for calculations whether in real life or in simulation. Basically forward kinematics is a method for calculating the end point’s position from a given or known point. Inverse kinematics is to calculate joint degrees or positions to reach specific point and orientation. In general 3 joints are enough to reach desired position within robots limitations, and 3 joints to adjust end point’s orientation. If a human arm is modeled as a robot arm, there are 7 joints, so to reach a desired position and an orientation there isn’t a single solution, which robot has to decide one of them. Also more degree of freedom requires more calculation power.

Within this project a multi-layered artificial intelligence architecture will be used. Each unit will be responsible for a joint, and completing its own task. A suitable messaging system will be implemented through units. All units will be able to send and receive messages to/from their neighbor units in a hierarchical manner. A main decision center sends messages, which describe task, to any unit with task priority. And the unit receiving the task will be able to get help from other units with messaging.

The main advantage of this technique is ease of calculation. Each joint will calculate its angle without concerning about other angles. The decision system sees other joints as fixed from its perspective, and uses the change of distance to invoke help from other joints. These steps will repeat at every time quanta for each joints.

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