DNU_Explorer Research Proposal

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Abstract. Controlling a biped robot with a high degree of freedom To achieve stable movement patterns is still an open and complex problem. Thus, the development of control mechanisms for biped walking have become an important field of research. With growing calculation power of computer hardware, high resolution realtime simulation of such robot models in effect becomes all the more applicable. This thesis presents a physical simulation of a 20 degrees of freedom real biped robot model used in RoboCup 3D Soccer Simulation League and demonstrates it sapplication for exploring biped motion control techniques.

1 Introduction

This year the 3D Soccer Simulation League has had the obvious change, Most main is the robot has become the present human robot by the spheroid. So this change has caused team's first floor control change, Under new platform. Team's editors need to consider the robot between each joint mutual function, between robot and other object questions and so on collision.

How does our research direction lie in uses the position and each joint coordinates which the known visual information and the robot own each joint information establishment transformation matrix and the corresponding coordinate system judge oneself locate and orientations.

2 Establishes the Robot's active coordinates

In simulation process, Robot each cycle all may receive the news which server transmits, in which including visual news and own each joint condition news. Through analysis vision news, we may obtain the robot on field position and the soccer position; through analyzes robot own each joint the condition news to be possible to know each joint revolved angle. Very obvious, these information cannot obtain the robot each joint concrete coordinates and the posture merely. Therefore, we decided (platform assigns in the overall situation coordinate system coordinate system) in the foundation establishes the robot a series of reference coordinate system. Considered we have already known the robot detail requirements, we the joint which may move for robot 14 establishes one to belong to this joint moving coordinate system separately, and stipulated each moving coordinate system the zero point is located this joint the center of gravity. Then establishes the level by the robot body the active coordinates, establish the second level of active coordinates by arm1_2 and leg1, establish the third level of active coordinates by arm3 and leg2_3, establish the fourth level of active coordinates by arm4 and leg4, establishes the fifth level of coordinates by leg5_6.

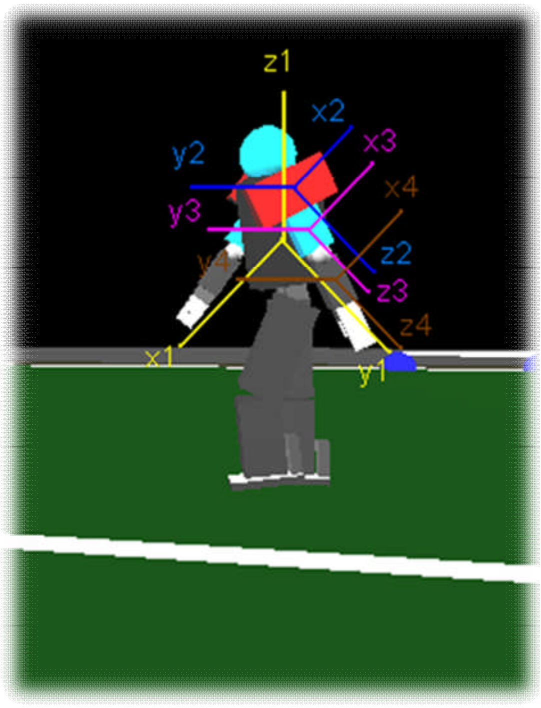

Fig. 1 Robot each joint moving coordinate system establishment.

The bodily center is the level active coordinates, joint Arm1_2 establishment in above level active coordinates, joint Arm3 establishment in second level of active coordinates (joint Arm1_2) above, joint Arm4 establishment in third level of active coordinates (joint Arm3) above.(Fig. 1)

Because the robot joint which uses all only to be able to revolve, therefore only must consider the moving coordinate system in reference coordinate system revolving then. For instance joint Arm1_2 circled the x2 axis to rotate theta the angle, may result in by the transformation matrix knowledge :

$$P_{x1y1z1} = Rot(x,\theta) \times P_{x2y2z2}$$

Revolving matrixes are below:

$$Rot(x, \theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & Cos\theta & -Sin\theta \\ 0 & Sin\theta & Cos\theta \end{bmatrix}$$

$$Rot(y, \theta) = \begin{bmatrix} Cos\theta & 0 & Sin\theta \\ 0 & 1 & 0 \\ -Sin\theta & 0 & Cos\theta \end{bmatrix}$$

$$Rot(y, \theta) = \begin{bmatrix} Cos\theta & -Sin\theta & 0 \\ Sin\theta & Cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Through all levels of active coordinates and world coordinates transformation, then may obtain each joint in the world coordinates concrete position.

3 Agent Action Framework

We separate the action model of the agent to four hierarchy (Fig.2).

1. Physical Actions: Include the physical actions and coordinate actions of the joints.
2. Basic Actions: The basic actions of the agent, for example move forward, turn round, jump and kick.
3. Advanced Actions: Advance actions base on the basic actions, include move to an appoint location, kick the ball to an appoint location and so on.
4. Intelligent Actions: The actions need to make a strategic decision, include run across the opponent with the ball, pass the ball to a teammate, make a goal, keep a close watch on an opponent, keep the goal and so on.

This four hierarchise are all program base on the API that the lower hierarchy supported. Each hierarchy is develops by different person whit different technology. On the premise of standards the API, the development of the four hierarchies is parallel, and the developer of high-hierarchy doesn't need to understand the detail of the low-hierarchy.

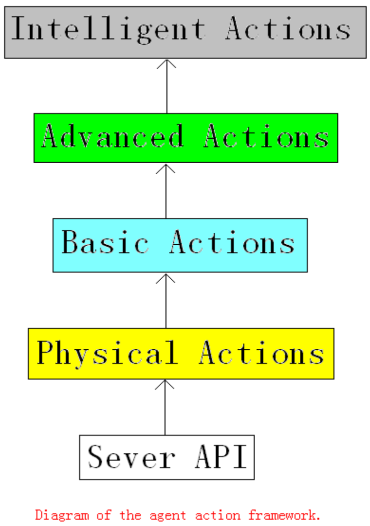

Fig. 2 Agent action framework

4 Debug Tools Develop

We developed a graphics debug tools to raise working efficiency. The running montage is below(Fig 3).

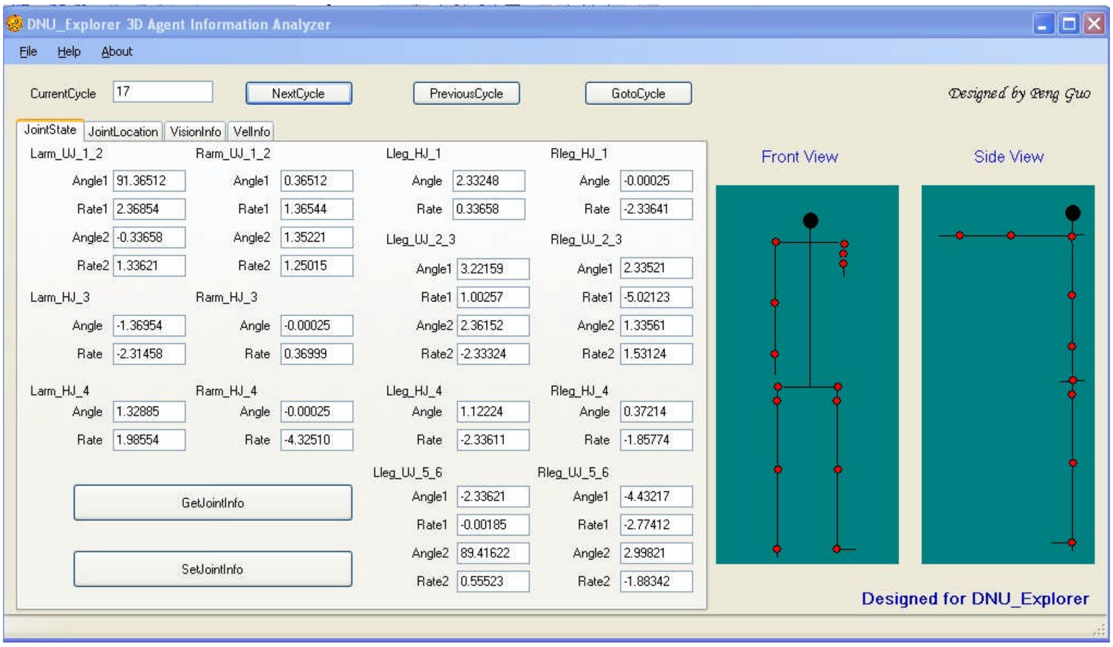

Fig. 3 Agent Information Analyzer

In this tool, the state of an agent can be viewed in two 2D views. Front view and the side view. At the bottom of the window is the state of the eighteen joints.

5 Future Work

How uses the kinematics and the misfortune kinematics solves the robot some joint after to carry out some order condition as well as some joint expected arrives concrete order which some kind of state of motion needs. How analyzes the robot the joint to be opposite in the fixed coordinate system differential movement, Jacobians matrix as well as the robot speed relations. In order to analyze the robot the acceleration and the inertia, we will also study the robot dynamics as well as the robot static relations. In order to let the robot from a displacement in position to another position, We will also study and this correlation way and the path plan, How does this mainly manifest between the movement section lets have the controlled movement sequence, will use each kind in the concrete realization process to approach processing the method.

6 References

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