Advanced Step in Humanoid Robots Simulation

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Abstract: **In the field of humanoid robots a virtual and reality simulation it is the technique by which we can easily developed and creates the virtual environment for the motion and control dynamics to get the real and human like motions. Now in this paper we design a virtual multibody humanoid robots simulation and controller for mobility in the geometry of kinematics. Several distinct feature or element of a tests in simulator to fetch out the appropriate solutions in the complex motions of manipulator regarding auto balancing for the perfect inherent capacity.**

Keywords—gravitational force, sensor, centripetal force, PD controller

I. INTRODUCTION

The basic problem in virtual reality simulation of humanoid robots will be an auto-balancing development and the simulation may create the virtual motions like human beings. By this simulation technique we can easily generate a realistic or original motions who requires kinematics theory, DLR [2] manipulator depends on DOF's in the work space.

Now many distinct and individual simulator will move into a desired direction of discourse for the appropriate achievement of the desired goal.

In the first model the author will describe the overview of the Humanoid simulator. The flow of information in the simulator may account motions and also specifically included auto balancing through the feet force sensor. In this the kinematics of joints is crucial and relates the simulator with effective technique. ZMP [3] sensor touches the ground and senses the moment at a point.

We control the torque and acceleration so that the CoM [6] (center of mass) is control by hip accelerometer [6] uses the gravity force to stable.

Sensors sense the force provided by the simulator be contingent upon weight, torque, acceleration given etc.

Mainly the virtual motions created in the humanoid robots requires force, torque rendered by actuator and the actuator controller maintains the geometry of virtual motions. If the force between the joints is not balanced i.e. center of mass according to the weight of the complete body and the gravity force vector [5] that provide magnitude and direction to apply force and torque. Sensor weight senses the weight of the body and generates the necessary force.

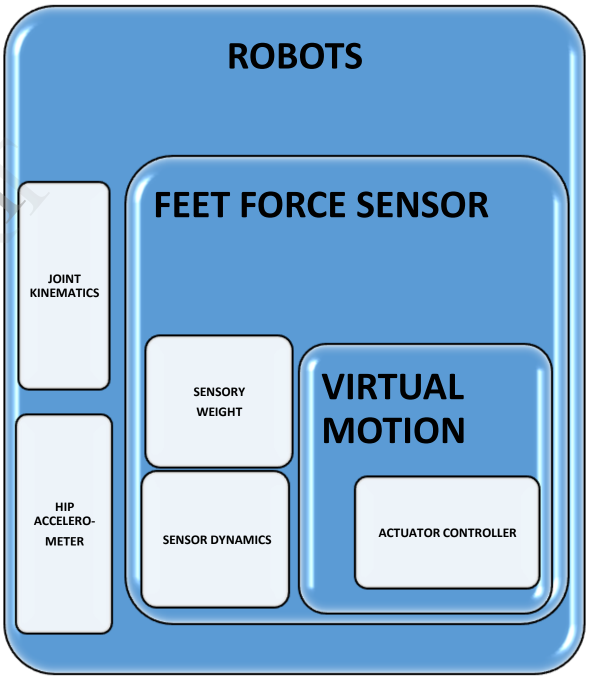

Fig 1:overview of the Humanoid simulator

II. RELATED WORK

A. Robots and Mechanism

In this paper the simulation of a humanoid can be work out by the position of angle of each actuated jointprovided the torque trajectory for every joint and the contact force. For this purpose we follow the algorithm of body motion on the basis of contact force. According to the equation of Featherstone [5]

$$f = R^a i + p^a \quad (1)$$

Where f,R^a, i ,p^a is the applied force, the resulting acceleration, the rigid body inertia and a bias force respectively. When there is no actuated DOF's the equation becomes equal to zero.

$$R^a i_o + p^a_o = 0 \qquad (2)$$

In caseII the forces applied between the ground and feet is the contact force at a point. If the contact force is greater than zero then the feet make an effort to pass through the ground and if the contact force is smaller than zero then the feet will not in the contact with the ground. Each contact point produces a torque.

Torqueτ^con joint may be calculated as it is

$$\tau^c = df^c \qquad (3)$$

Where d is the distance from the contact point location and fis the contact force.

B. Integral balancing Control

Balance in the humanoid has many circumstances and it can be contingent uponCoP [6] on below the feet with the ground. Some of the control options are linear control regulator is crucial for the constraints to limits the torque command. In some of the external disturbance force, these controller will demand for more torque on the robot can give up in the initial state of ZMP all this in constraints that the feet flat on the ground and remains balanced.

In integral balance control in Fig 2 shown derived the equation on activated non constrained planar dynamics with motion

$$M(\theta)\ddot{\theta} = \tau - N(\theta, \dot{\theta}) \qquad (4)$$

Where θ is a joint angle vector, M is the matrix of Inertia, τ is joint torque and N is vector containing coriolis, gravitational and centripetal force.

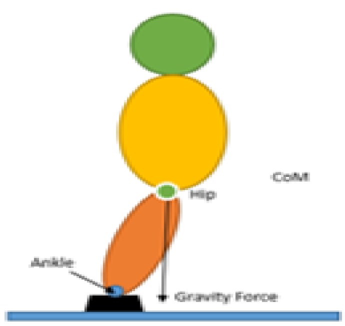

Fig 2:sample model shows gravitational force and center of mass in humanoid robots

At CoP it is very crucial indicator for the humanoid robots to show balancing feature by representing the single force equivalent on the foot of the robots and in order to keep the feet on the ground. The actual needed CoP is achieved by limiting the ankle torque value under the foot and allows the robots to use gravitational force to stable.

III. VIRTUALSIMULATION

Simulation of humanoid robots contains many stages as shown in diagram Fig 3. Some of the important steps like joint kinematics, feet force sensor, hip accelerometer and other methods will be included.

In the integral robots stage the initial circumstances will be determined from data like CoM, CoP and jointtorque. The geometry of joint, balance of body may processed and controlled by joint kinematics, hip accelerometer maintains proper acceleration on the center of mass of the body. Feet force sensoris a very important part of the simulation, it senses according to the weight of the body and body dynamics so that the

feet will remain in contact with the ground. CoP is like pressure which is created below the feet of the robot body.

Actuator controller, is used to control the torque and other mechanical movement, speed of the motions in the robot. The motions in the body a PD controller [5] use to calculate the appropriate torque applied on the feet so that the body remains balanced. Main actuator is a motor connects with joints to create motions in the joints and manipulator.

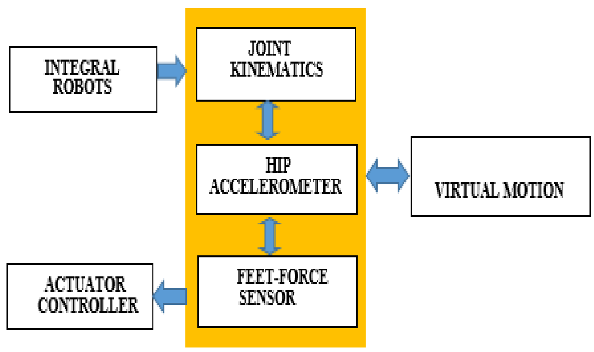

Fig 3: Balancing in virtual humanoid simulation

Virtual motion generated is a very important aspect of the simulation technique, we can compare the responses generated by the virtual simulator to human balance. Each foot is tested to check the ground reaction and control to behave like a balanced body in comparison to human.

IV. CONCLUSION

In this work we proposes a new simulation technique of motions and auto balancing. In this paper we present humanoid balance controller, for applying this balancing technique to complex robot system. The center of pressure and center of mass serves as an important ground reference point and balance point, and is inspired by hip and ankle strategies.

All of the above numerical part and the results on dynamic system analysis will manipulated on MATLAB, and all the result is comparable to human body motions and balancing. Also sensors admired the feet of the body with the ground and regulates the proper torque on them. Gravitational force apply on the feet of the robot so the CoP take place and regulates the balance in the body of robot.

In the future workwe can develop simulation tool with the help of soft computing with fuzzy logic. Also the tool develop may reflects the correct motions of the robots, through soft computing the desired simulating method may perform effectively.

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