Dynamic Walking Control of a Humanoid Robot

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R&D in humanoid robot was originated from the need to build the human-like robots in order to perform human related tasks. Analysis of Bio-mechanics in human structure leads to a design and construction of a two-legged humanoid robot at the Institute of FIeld roBOtics (FIBO). Such robot consists of a trunk and two legs, having 12 joints as shown in figure 1. The motion of robot is governed by two legs and its foot, being kept contact with the environment. This phenomenon leads to high complexity in walking control. In order to design a control system, a stably dynamic walking has been studied in our primary research. Figure 1. shows a dynamic control system, which can be described as follow:

- **Walking Pattern Generator** This module generates reference trajectories of each joint which is planed prior to the walk.
- **Joint Space Controller** This controller controls the motion of the robot joints to follow the reference trajectories. It computes the differences between the desired and the measured values and then computes the torques applied to the robot joints.

- **Body Posture Controller** This controller controls orientation of the robot trunk. It measures the values from an inclinometer, installed in the trunk and then computes torques applied to the hip joints of the robot.
- **Desired Tipping Trajectory** This part generates the reference trajectory of a position of a ground reaction force.
- **Ground Reaction Model** This part computes the position of the ground reaction force, which is measured from the 6-axis force sensors. The computed values are sent to the posture tipping controller, which controls the tipping moments of the robot.

Such dynamic controlling system is currently applied to the robot to control a dynamic walking. The outcome of this research will enable our humanoid to walk dynamically stable with an efficient control algorithm.
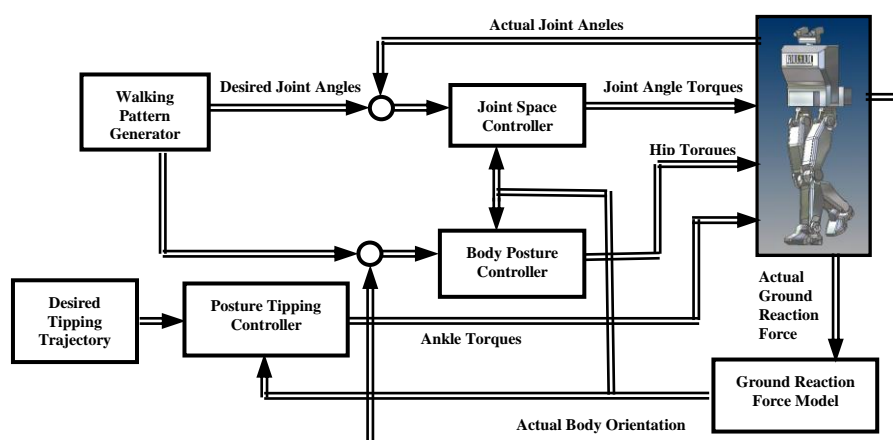

Figure1. A prototyping humanoid robot and its dynamic control system.