

MECHANICAL DESIGN AND CONTROL OF HUMANOID ROBOT BHR

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This paper describes the control and mechanical design of humanoid robot BHR. BHR Humanoid is developed at Beijing Institute of Technology. This work is supported by the National High Technology Research and Development Program (863 Program), the Ministry of Science and Technology (MOST) of the People's Republic of China.

BHR Humanoid robot consists of a head, two arms and two legs, and has total 31 DOF (degrees of freedom). The head has 3 DOF, each leg consists of a thigh, shank and foot and has 6 DOF: 3 DOF in the hip joint, 1 in the knee joint, and 2 in the ankle joint. Each arm consists of an upper arm, forearm, and hand, and has 8 DOF: 3 DOF in the shoulder joint, 1 in the elbow joint, 3 in the wrist joint, and 1 in the hand. Each joint is actuated by a DC motor with a harmonic drive reduction gear. The OS is RT-Linux; the servo rate is 0.5[kHz]. The height is 1.6 [m]; the weight is about 65.0 [kg].

To realize the stable biped walking, we propose a walk structure consisting of a dynamic pattern, a sensory reflex control. The dynamic pattern is a rhythmic and periodic motion, and is generated off-line based on the whole dynamics of the humanoid, assuming that the models of the humanoid and the environment are known. The sensory reflex is a quick response requiring no explicit modeling. It has the advantage to quickly deal with unexpected sudden events.

The humanoid robot BHR has sensory devices including 4 6-axes force/torque sensors, 3 accelerometers and 3 gyrosensors. BHR has the ability of the vision and sound recognition, biped locomotion, and can perform some Chinese kungfu such as “Taiji” and “sword” motion.