H. Kondo, Y. Ogura, H. Aikawa, A. Morishima, J. Shimizu, H. Lim, A. Takanishi. Application of biped humanoid robot to simulate the motion of elderly and disabled people. Gerontechnology 2008; 7(2):143. In recent years, it is required to develop more effective welfare apparatuses for the elderly and disabled. However, it is difficult to evaluate them by anthropometric methods, because of the problems with the safety in experimental subjects and the measurement accuracy. Accordingly, authors have proposed an application of a biped humanoid robot to be a human motion simulator. This application technique will provide us with safe and quantitative evaluation of welfare apparatuses. Until now, the authors have developed a new humanoid robot, WABIAN-2R, and realized human-like walking with the knees stretched, heel-contact and toe-off motion[1,2]. In this paper, the authors report a walking experiment with a walk-assist machine and an emulation of hemiplegic gait to verify the availability of the human motion simulator. **Hardware** The height of WABIAN-2R is about 1.5 [m] and the weight is 65 [kg]. The robot has two 7-DOF (degrees of freedom) legs, two passive 1-DOF toes, a 2-DOF waist, a 2-DOF trunk, two 7-DOF arms, two 3-DOF hands and a 3-DOF neck (total 41 DOF) to mimic human motions[3]. The link length and movable range of each joint are designed in reference to a human. Furthermore, 6-axis force/torque sensors are mounted on both of the ankles and upper arms to measure the reaction forces from the ground and a walk-assist machine. **Experiments and discussion** *Experiment 1*: The authors conducted a walking experiment with a walk-assist machine. The parameters of the experiment were a step cycle of 0.96 [s/step], a step length of 0.20 [m/step] and three different heights of the armrest of the machine (0.85, 0.90, 0.95 [m]). From a clinical point of view, the position of arms is generally set according to the height of the user's elbow. If a user is not handicapped, it should be set higher than the initial position. On the other hand, if he/she is handicapped, it should be placed lower. The result of the experiment made it clear that the lower the arm position is, the less the energy consumption at the knee joints increases (*Figure 1*). *Experiment 2*: An experiment to emulate a hemiplegic gait of a disabled person was conducted. The parameters of the experiment are a step cycle of left leg (affected limb) of 1.56 [s/step], right leg of 1.04 [s/step] and a step length of 0.32 [m/step]. The walking pattern was generated according to one subject's walking data by using an optimization calculation of some of the parameter to minimize the angle errors at all of the joints to strike a balance between the walking stability and reproducibility. The comparison of the joint angle data showed the emulation was realized and the ground reaction force denoted the same tendency of that of the subject, especially the rising edge when the affected limb lands.

References

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Address: Waseda University, Japan; E: kondo_hideki@asagi.waseda.jp

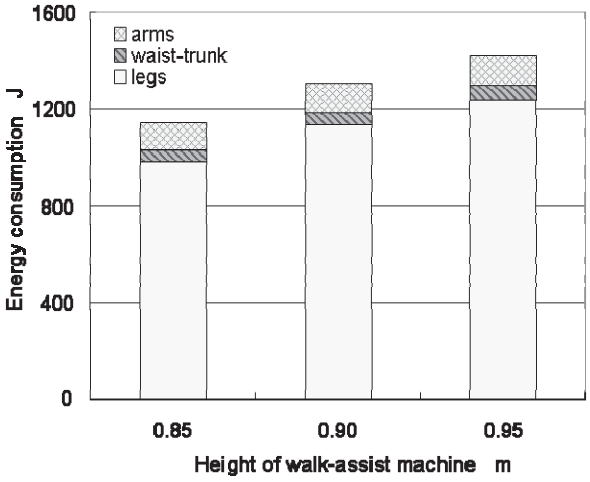

Figure 1 Comparison of energy consumptions