Simulation Study of self-excited walking of a biped mechanism with bent knee

K. Ono and X. Yao
Tokyo Institute of Technology

Abstract

This paper presents simulation study of a new self-excited walking mode with bent knee angle. The four-link biped model with and without feet, which is self-excited by the hip joint torque proportional to the absolute angle of the swing shank, succeeded in walking on the level plane in computer simulation. It distinguishes from our earlier one in that the supporting leg has a bent knee angle. By holding a bending angle at the knee of the supporting leg, the new model can walk faster than the straight support leg model. The numerical results have shown that the stable walking locomotion is possible with a bent knee angle of no more than 17 degrees and the velocity of the mechanism increases with a relatively large angle while the period is shortened and the step length is increased. But the specific cost become a little higher because of the increase in energy input. The reason of walking faster is that the center of mass of the swing leg moves toward the hip joint, therefore a shorter swing period can be realized, and at the same time the center of mass is moved forward in contrast to the straight leg one. Therefore, the support leg rotates forward faster because the offset of mass yields the gravity torque to make the support leg rotate in the forward direction. In addition, the influences of the parameters, such as feedback gain, foot radius, mass ratio and the length of the thigh and the shank etc, on the walking speed, period specific cost and stability are discussed.