Gait Simulator for Various Modes of Walking and its Control by Prediction of Gait Mode Transition

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It is said that a robot will be introduced at home and work near the human or work cooperatively with the human in the near future. Hence it is also said that a robot should have the ability of prediction of the human actions to avoid accidents. In this study I developed a gait simulator as an example of a machine which works in cooperation with a human.

This gait simulator can reproduce various types of walking, that is, straight walking, turn, going up and down stairs and so on. Main part of this gait simulator is two foot plates driven by three arms and actuators. For example each foot plate follows the foot during swing phase and pulls it back during stance phase while the subject is walking straight. However this gait simulator has one weak point, that is, this simulator cannot follow the change of gait mode sufficiently, like the start of walking or the end of walking. To solve this problem it is necessary to predict the change of gait mode to follow the transition perfectly.

In this study I chose the start and the end of straight walking and changing direction, and have tried to predict these transitions of gait mode. To do this I paid attention on the bending of the upper trunk. It is expected that the trunk bends forward before the start of walking and bends back before the stop of walking, and the angle of direction of bending upper trunk changes before the starting point and ending point of the directional change.

In the experiment the distance between the upper trunk and the center of gravity (COG) and direction angle were measured and it was proven that the measurement of the distance and the directional angle showed to be useful to know the transition of straight walking and changing direction.

This prediction algorithm of gait mode transition was examined again on the gait simulator. Results show that the gait simulator could reproduce the start and the end of walking and changing direction by this prediction algorithm.

For widespread application of this technology, I also tried to apply this for the monitoring of walking and jogging monitoring.