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Increasing Biped Gait Stability via Phase Resetting Mechanism

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The human biped walking shows phase-dependent transient changes in gait trajectory in response to external brief force perturbations. Such responses, referred to as the stumbling reactions, are usually accompanied with phase reset of the walking rhythm. Our previous studies provided evidence, based on a human gait experiment and analyses of mathematical models of gait in the sagittal plane, that an appropriate amount of phase reset in response to a perturbation depended on the gait phase at the perturbation and could play an important role for preventing the walker from a fall, thus increasing gait stability.

In this paper, we provide a further material that supports this evidence by a gait experiment on a biped humanoid. In the experiment, the impulsive force perturbations were applied using push-impacts by a pendulum-like hammer to the back of the robot during gait. The responses of the external perturbations were managed by resetting the gait phase with different delays or advancements. The results showed that appropriate amounts of phase resetting contributed to the avoidance of falling against the perturbation during the three-dimensional robot gait.
A parallelism with human gait stumbling reactions was discussed.