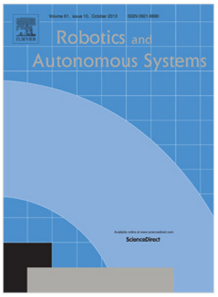
Accepted Manuscript



Bifurcation gait suppression of a bipedal walking robot with a torso based on model predictive control

Ka Deng, Mingguo Zhao, Wenli Xu

PII: S0921-8890(16)30421-3
DOI: http://dx.doi.org/10.1016/j.robot.2016.11.023
Reference: ROBOT 2759

To appear in: *Robotics and Autonomous Systems*

Received date : 28 July 2016
Revised date : 25 November 2016
Accepted date : 27 November 2016

Please cite this article as: K. Deng, et al., Bifurcation gait suppression of a bipedal walking robot with a torso based on model predictive control, *Robotics and Autonomous Systems* (2016), http://dx.doi.org/10.1016/j.robot.2016.11.023

Bifurcation gait suppression of a bipedal walking robot with a torso based on model predictive control

Ka Deng, Mingguo Zhao*, Wenli Xu

Department of Automation and Tsinghua National Laboratory for Information Science and Technology, Tsinghua University, 100084 Beijing, China.

Abstract

In our previous work, we have studied a bipedal walking model with a torso, in which the gait evolves from the stable period-1 pattern directly into the Neimark-Sacker bifurcation pattern. Using the Ott-Grebogi-Yorke method, the bifurcation gait could be suppressed into the period-1 gait with higher energy efficiency and walking speed. However, the disturbance rejection ability of the obtained period-1 gait was insufficient, i.e., the basin of attraction was small. In this paper, a new suppression method based on the idea of model predictive control is proposed. Because of the design of the new walking model, which has a time window for computation, and the ability to calculate the walking map quickly, the optimal parameter perturbation can be generated in real time during walking. As a result, the suppression of the bifurcation gait for our bipedal robot can be achieved on-line. This new method not only makes the gait of the controlled model converge to the target period-1 gait with desired high performance, but also guarantees that the obtained gait is better able to reject disturbances.

Keywords: Bipedal walking robot; bifurcation gait suppression; model predictive control; parameter perturbation; Poincaré map

*Corresponding author
Email address: mgzhao@mail.tsinghua.edu.cn (Mingguo Zhao)