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OPTIMAL MULTI-CRITERIA HUMANOID ROBOT GAIT SYNTHESIS – AN EVOLUTIONARY APPROACH

Genci Capi, Masao Yokota

Faculty of Information Engineering
Fukuoka Institute of Technology
3-30-1, Wajiro-Higashi, Higashi-ku, Fukuoka 811-0195, Japan
capi@fit.ac.jp

Kazuhisa Mitobe

Department of Mechanical Systems Engineering
Yamagata University
4-3-16, Jonan, Yonezawa, Yamagata 992-8510, Japan

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Abstract. *Humanoid robots operating in everyday life environments must generate the gait based on the environment conditions. Often the gait has to satisfy different objectives. In this paper, we present a new method for humanoid robot gait generation based on multiobjective evolutionary algorithms. In our method, we consider two different conflicting objectives for the humanoid robot gait generation: minimum energy and minimum torque change. In difference from single objective genetic algorithm, the multiobjective evolutionary algorithm converges in a set of nondominated Pareto solutions. Based on the environment conditions and the user requirements, the appropriate humanoid robot gait can be selected. Simulation and experimental results using the "Bonten-Maru" humanoid robot show a good performance of the proposed method.*
Keywords: Humanoid robot, Multiobjective evolutionary algorithm, Gait synthesis

1. **Introduction.** Humanoid robots are expected to operate in every environment humans operate in. In order to achieve a humanoid robot able to operate in everyday life environments, dynamic stable motion is required. In addition, they have to change their gait based on the environment conditions. Therefore, algorithms for generating humanoid robot gait based on the environment conditions are central for development of humanoid robots. In the early works, the humanoid robot gait is generated based on the data taken from human motion [1]. Most of the recent works [2-4] consider minimum consumed energy as a criterion for humanoid robot gait generation. Roussel [2] considered the minimum consumed energy gait synthesis during walking. The body mass is concentrated on the hip of the biped robot. Silva and Machado [3] considered the body link restricted to the vertical position and the body forward velocity to be constant. The consumed energy, related to the walking velocity and step length, is analyzed by Channon [4]. The distribution functions of input torque are obtained by minimizing the joint torques.

In our previous works, we considered the humanoid robot gait generation during walking and going up-stairs [5] and a real time gait generation [6]. In addition of minimum