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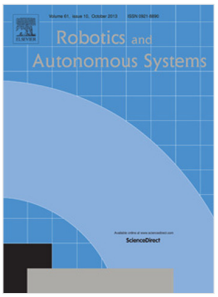

A study of arbitrary gait pattern generation for turning of a bio-inspired hexapod robot

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A Study of Arbitrary Gait Pattern Generation for Turning of a Bio-inspired Hexapod Robot

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Abstract: Constant radius turning pattern can be extended into an omnidirectional movement, while it is inefficient to build different control algorithm when the robot chooses different gaits. So in order to simplify the process of gait generation and extend several typical gaits into arbitrary gaits during turning of bio-inspired hexapod robot, take insect gait as inspiration, an arbitrary gait patterns generation algorithm is proposed. These gait patterns are planned through adjusting the swing phase and support phase of each leg according to the features of different gaits, which is only controlled by gait coefficient. This algorithm can not only greatly expand the gait patterns of turning, but also reduce the difficulty of planning. In addition, the maximal turning angle under different turning radium is calculated by the geometric constraint and stability margin condition. A series of tests are carried out to validate the algorithm. The results show that the proposed method is effective and have good performance on stability of the robot, which provides the basis for subsequent research of avoiding obstacles and autonomous locomotion.

Key words: bio-inspired hexapod robot; turning; arbitrary gait patterns; attitude

1. Introduction

In nature, all kinds of creatures have formed strong adaptability to environment after a long-term evolution, which is reflected in high rationality of their structure, movement form and energy consumption. Advantages of these creatures have been concerned by many scholars and adopted by advanced technology and equipment. The multi-legged inspired robot is a product with perfect combination of robot and bionics. Since an inspired robot [1,2] has some special performances that other robots do not have, such as crossing obstacles, environment adaptability, load capacity and movement flexibility. These advantages have broad application prospects in the fields of disaster rescue, military reconnaissance, transportation in mountain, exploration of the outer planets and so on. In recent years, many scholars have been dedicated to the research of multi-legged inspired robots.

Gait planning plays an important role in this field [3]. So far, some gaits such as walking, running, spanning obstacles have been studied by some researchers [4,5]. As early as 1899, Muybridge used 24 cameras to photograph a running horse to study the movements of its legs, which is considered as the earliest study of the creatural gaits. Tomovic and Karplus [6] firstly adopted GA-fuzzy control algorithm to study gait in a mechanical leg simulation platform. The movement process of robotics was divided into support phase on ground and swing phase in the air for the first time. Hildebrand [7], took horses as inspiration, proposed a calculation formula of symmetrical gait. On the basis of this study, further research on gait was carried out by McGhee and his team on a simulation platform [8], and they proved that there was always an optimal gait for the robot to achieve the maximum stability margin [9]. After in-depth study of the crab, a gait generation algorithm on an eight-legged robot imitating crab based on environmental self-adaptive was proposed by Xi Chen [10]. After the experiment, compared with quadruped gait, the algorithm mentioned above can maintain the stability of body, and eliminates the phenomenon of pause and backward occurred in original gait during walking. Pal and Kar [11] planned gaits by judging states of each leg according to the images

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