

Discontinuous gait for statically stable stair climbing and descending of quadruped robot with horizontal body posture

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ABSTRACT

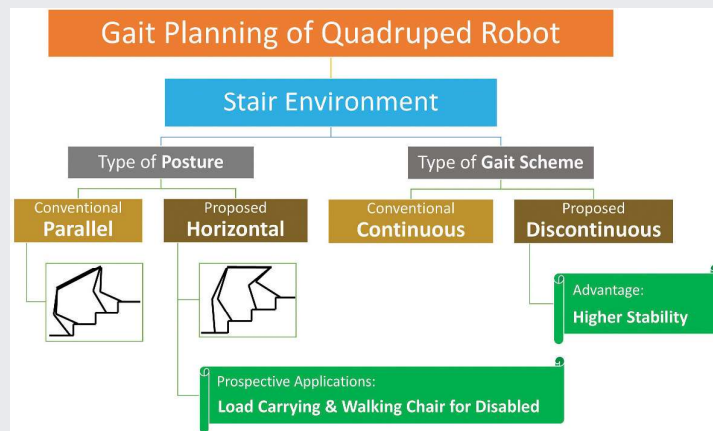
For improving the functionality, a quadruped robot must have the capabilities to manoeuvre over different terrain conditions like slope & stair climbing, obstacle avoidance, uneven & rough terrain, etc. In all such conditions, the primary requirement for a robot is to be stable while walking. In the present work, an attempt is made to develop a gait scheme of quadruped robots for statically stable straightforward stair climbing and descending, with horizontal posture. The use of a discontinuous type of gait in the proposed scheme makes it more stable and easier to implement. The proposed scheme has been simulated and its stability is validated.

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KEYWORDS

Quadruped robot; static gait; stair climbing; stair descending



1. Introduction

Legged robots are widely utilised in verities of applications like load carriers, surveillance, exploration, medical helper, and other tasks. Among legged robots, quadruped robots have advantages in terms of stability and load-carrying capability than biped robots and control simplicity than hexapod and octopod robots (Li et al. 2011). Because of these advantages, it can be used in complex conditions, which are hazardous for humans. With a view to its prospective applications, extensive research on quadruped robots has been carried out in the last 7 decades. The majority of the research is focused on either design and development or the walking algorithm.

The walking pattern i.e., gait of quadruped robots can majorly be classified into statically stable and dynamically stable gaits (De Santos et al., 2006). The statically stable gait is more suitable for complex terrain. In a statically stable

gait, the system is made stable by always keeping the projection of CG inside the support polygon. Support polygon is formed by foot tips, which are in contact with the ground. Statically stable gait is further classified into periodic and aperiodic gait. In periodic gait, the robot follows the same event sequence in each of the cycles (McGhee and Frank 1968) of the walk, and in aperiodic or free gait (Estremera and De Santos 2002), it changes the parameters in each cycle as per the terrain condition. The majority of the work in statically stable periodic gait has been carried out on continuous gaits in which the robot moves continuously, similar to the animals. There is another gait, named discontinuous gait, which is not highlighted by many researchers but has some inherent advantages in terms of higher stability and easier control (De Santos and Jimenez 1995a, 1995b).