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CENTER OF MASS-BASED ADMITTANCE CONTROL FOR MULTI-LEGGED ROBOT WALKING ON THE BOTTOM OF OCEAN

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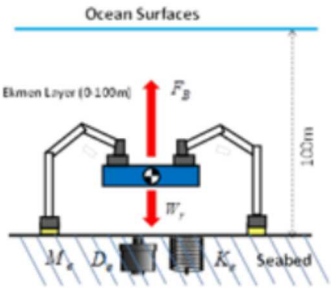
Graphical abstract



Abstract

This paper presents a proposed adaptive admittance control that is derived based on Center of Mass (CoM) of the hexapod robot designed for walking on the bottom of water or seabed. The study has been carried out by modeling the buoyancy force following the restoration force to achieve the drowning level according to the Archimedes' principle. The restoration force needs to be positive in order to ensure robot locomotion is not affected by buoyancy factor. As a solution to regulate this force, admittance control has been derived based on the total force of foot placement to determine CoM of the robot while walking. This admittance control is designed according to a model of a real-time based 4-degree of freedom (DoF) leg configuration of a hexapod robot that able to perform hexapod-to-quadruped transformation. The analysis focuses on the robot walking in both configuration modes; hexapod and quadruped; with both tripod and traverse-trot walking pattern respectively. The verification is done on the vertical foot motion of the leg and the body mass coordination movement for each walking simulation. The results show that the proposed admittance control is able to regulate the force restoration factor by making vertical force on each foot sufficiently large (sufficient foot placement) compared to the buoyancy force of the ocean, thus performing stable locomotion for both hexapod and quadruped mode.

Keywords: Buoyance factor, force restoration, center of mass, admittance control; seabed locomotion

Abstract

Kertas kerja ini membentangkan cadangan kawalan penyesuaian lepasan yang dibuat berdasarkan pusat jisim robot enam kaki yang direka untuk berjalan dibawah air atau dasar laut. Kajian ini telah dijalankan dengan memodelkan daya keapungan mengikut daya pemulihan untuk mencapai tahap lemas berdasarkan kepada prinsip Archimedes. Daya pemulihan perlu positif untuk memastikan perjalanan robot tidak terjejas dengan faktor apungan. Sebagai penyelesaian untuk mengatur daya ini, kawalan lepasan telah dibuat berdasarkan jumlah daya perletakan tapak kaki untuk menentukan pusat jisim robot semasa bergerak. Kawalan ini direka berdasarkan model masa nyata 4 darjah kebebasan (DoF) konfigurasi kaki robot enam kaki yang boleh menjalankan transformasi 6 kaki ke 4 kaki. Analisis ini berfokus kepada perjalanan robot dalam kedua-dua konfigurasi 6 kaki dan 4 kaki, dengan cara berjalan tripod dan traverse-trot. Pengesahan ini dilakukan berdasarkan perjalanan vertikal tapak kaki dan koordinasi pergerakan jisim badan untuk