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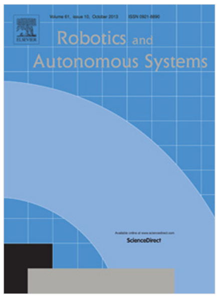

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An Experimental Validation of a Novel Humanoid Torso

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Abstract

In this paper a novel humanoid torso prototype is presented in two design configurations: the torso structure and the humanoid torso with head, arms and hands. An experimental validation has been carried out for each configuration while replicating human-like basic movements. The aim of this paper is to characterize the performance of the prototype by means of angles displacements and linear accelerations measured by an IMU (Inertia Measurement Unit) on the humanoid spine. Furthermore, power consumption has been monitored to check the feasibility for the usage of a Li-Po battery as on-board power supply in order to make the humanoid torso fully portable and to permit its assembly in a full humanoid robot.

Keywords: Humanoid Robots, Humanoid Torso, Mechanism Design, Cable-driven Manipulators, Experimental Validation

1. Introduction

Robotics is undergoing a major transformation in scope and dimension. From a largely dominant industrial focus, robotics is rapidly expanding into human environments and vigorously engaged in its new challenges. Interacting with, assisting, serving, and exploring with humans, the emerging robots will increasingly touch people and their lives, [Kajita et al., 2014].

Nowadays, research activities have been mainly focused on the upper and lower limbs of humanoid robots like for example on dynamic walking control, biped walking pattern generation, and dual-arm dexterous manipulation [Kemp et al., 2008]. Due to the mechanical design difficulties and complex control of multi-body systems, the torso is usually a neglected or simplified design part. The torsos of the existing humanoid robots like ASIMO [Sakagami et al., 2002], HRP [Kaneko et al., 2011], BHR [Yu et al., 2014], HUBO [Oh J.-H. et al., 2006], NAO [Gouaillier, 2009], and iCub [Tsagarakis et al., 2007] have almost a box shaped body with only 2 to 3 d.o.f.s (Degrees of Freedom). Human torso is a complex system and plays an important role during human locomotion such as in walking, turning, and running, [Virginia C., 1999; Huston R.L., 2009]. Therefore, an advanced torso system is needed for humanoid robots so that they can be better accommodated in our daily life environment with suitable motion capability, and anthropomorphic characteristics. Few works have been addressed on design and control issues of torso system for humanoid robots. An example of musculoskeletal replica has been developed in flexible-spine humanoid robot named as "Kotaro" that has an anthropomorphic trunk system with several d.o.f.s and it is actuated by using artificial muscle actuators (Or, 2008). Previous works have been made at LARM to face this problem as in [Nava Rodriguez et al., 2006; Liang and Ceccarelli, 2012].

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