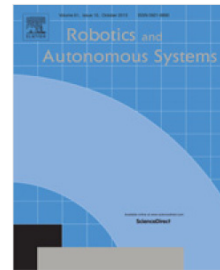


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Whole-body multi-contact motion in Humans and Humanoids: Advances of the CoDyCo European project

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Abstract

Traditional industrial applications involve robots with limited mobility. Consequently, interaction (*e.g.* manipulation) was treated separately from whole-body posture (*e.g.* balancing), assuming the robot firmly connected to the ground. Foreseen applications involve robots with augmented autonomy and physical mobility. Within this novel context, physical interaction influences stability and balance. To allow robots to surpass barriers between interaction and posture control, forthcoming robotic research needs to investigate the principles governing whole-body motion and coordination with contact dynamics. There is a need to investigate the principles of motion and coordination of physical interaction, including the aspects related to unpredictability. Recent developments in compliant actuation and touch sensing allow safe and robust physical interaction from unexpected contact including humans. The next advancement for cognitive robots, however, is the ability not only to cope with unpredictable contact, but also to exploit predictable contact in ways that will assist in goal achievement. Last but not least, theoretical results need to be validated in real-world scenarios with humanoid robots engaged in whole-body goal-directed tasks. Robots should be capable of exploiting rigid supportive contacts, learning to compensate for compliant contacts, and utilising assistive physical interaction from humans. The work presented in this paper presents state-of-the-art in these domains as well as some recent advances made within the framework of the CoDyCo European project.

Keywords: whole-body, control, free-floating, interaction, contacts, compliance.

1. Introduction

For cognitive agents, such as humanoid robots, to persist and act in natural human environments, contact and physical interaction become necessary and unavoidable. Everyday tasks involve making and breaking contact, among all areas of the body, whether the contacts are accidental disturbances or intentional support for dynamic movement. Critically, robots should be robust enough to cope

with unpredictable contact, via safe control mechanisms and compliance. Moreover, cognitive goal directed robots need the ability to exploit predictable contact, to aid in goal achievement, as well as learn dynamics of contact in order to generalise to novel tasks and domains.

Physical interaction has been studied in robotics, extensively under the umbrella of manipulation. For historical reasons, these studies have assumed a fixed-base as cur-

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