

Virtual ergonomics for the design of collaborative robots

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Résumé

The growing number of musculoskeletal disorders in industry [1] could be addressed by the use of collaborative robots, which allow the joint manipulation of objects by both a robot and a person [2]. However the efficiency of a collaborative robot regarding the reduction of musculoskeletal disorders risks is highly task-dependent. Yet, even when designing dedicated systems, the ergonomic benefit provided by the robot is hardly ever quantitatively evaluated, because of the lack of relevant assessment tools [3].

This work presents a generic tool for performing accurate ergonomic assessments of co-manipulation activities (*i.e.* activities executed with the assistance of a collaborative robot), with very little input data. This tool relies on an evaluation carried out within a digital world, using a virtual manikin to simulate the worker. Indeed, the simulation with a virtual manikin enables easy access to many detailed biomechanical quantities, for different kinds of human morphologies. Besides in the case of collaborative robotics, a virtual - instead of a physical - mock-up of the robot is used, which can be more easily modified.

A framework is developed to enable the estimation of the different biomechanical solicitations which occur during manual activities. Multiple ergonomic indicators are defined and measured through a dynamic simulation of the considered co-manipulation activity (Fig. 1). The virtual manikin is animated through a LQP optimization technique [4], and the robot is controlled according to the manikin-robot interaction force. However, the high number of indicators that are measured makes any kind of conclusion difficult for the user. Hence, a methodology for analyzing the sensitivity of the various indicators to the robot and task parameters is proposed [5]. The goal of such an analysis is to reduce the number of ergonomic indicators which are considered in an evaluation, while sufficiently accounting for the global ergonomic level of the considered activity.

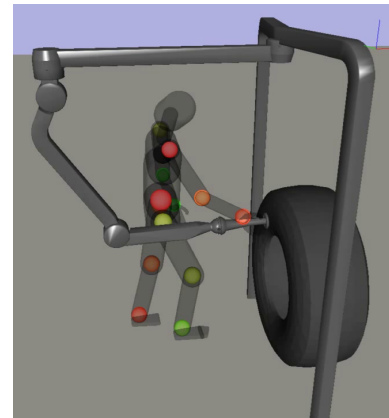


FIGURE 1 – Dynamic simulation of co-manipulation activities

Références

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