Identifying benefits of using an instruction language for virtual simulation of manual assembly and logistics

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Abstract

A digital human modelling (DHM) software is a valuable tool in virtual manufacturing since it supports proactive consideration of ergonomics when designing new workstations by facilitating simulation of manual assembly work and by providing ergonomic assessments of different design proposals. Despite the advantage, there are still a lot of assembly tasks that are not simulated and assessed proactively. One reason is that it is time consuming for the user, even for simple tasks, to create and set up the assembly simulations.

Increasing the automation level of DHM software has the potential to both increase the number of assembly task simulated as well as enabling ergonomics to proactively be included in other manufacturing and product design related decisions.

However, an increased automation level requires a manikin that automatically can compute collision free and ergonomically sound motions based on some sort of instruction language that supports the DHM software user to communicate to the manikin of what tasks the manikin is to perform. The instructions are, during simulation, interpreted by a simulation framework as path planning instances for the manikin, which results in motions that accomplishes the tasks.

In this work, we explore the possibility to use the DHM software IMMA's instruction language to further increase the automation level and to identify gaps between the current functionality and the functional requirements for a more automated simulation framework. More specifically, we investigate the requirements for simulations where: 1) Manikins perform collaborative tasks, such as when two manikins jointly handle an object, and where predicted motions are collision-free and ergonomically sound, and the forces needed to handle the object are distributed between both manikins; 2) Robots and manikins collaborate when performing tasks. The simulation of such interaction needs to consider collisions, weight of carried objects, ergonomics of the manikin, as well as other automation equipment used in the assembly station; and 3) Manikins interact with moving objects, e.g. during assembly of a part on a moving assembly line, or grasping a part that is moved by a collaborative robot.

Keywords: Digital human modelling, Virtual assembly, Simulation, Instruction language