

Introducing Quantitative Analysis Methods into Virtual Environments for Real-Time and Continuous Ergonomic Evaluations

ABSTRACT: This paper presents our work on methods to link virtual environments (VE) and quantitative ergonomic analysis tools in real time for occupational ergonomic studies. We pursued two distinct approaches: (a) create methods to integrate the VE with commercially available ergonomic analysis tools for a synergistic use of functionalities and capabilities; (b) create a built-in ergonomic analysis module in the VE. The first approach provides the use of established, off-the shelf tools integrated with the VE to create a hybrid application. This integration is performed through the use of APIs provided by the software vendor and existing Internet and communications technologies. The commercial ergonomics tool and the VE run concurrently and integrate their capabilities. The second approach provides the capability to do ergonomic evaluations in a self-contained VE application. In this method, the required ergonomics calculations are built into the VE. Each approach has its own distinct advantages. The use of a commercially available ergonomics tool integrated with a VE provides significant more capability and should be used where detailed and complex ergonomics evaluations are required. However, the process of integration in this approach is more difficult and time consuming. The self-contained VE application is more suited for simple ergonomic evaluations or in cases where the ergonomics algorithms are readily accessible and easily implemented. The two integration strategies are methodically explained and demonstrated using case studies conducted with industry partners. This integrated capability facilitates integration of ergonomic issues early in the design and planning phases of workplace layouts. It provides functionality beyond the capabilities of current commercial off-the-shelf (COTS) solutions. In addition, it contributes to a new trend in the integration of different technology fields for synergistic use in industry. **KEYWORDS:** Virtual environment; Ergonomics; Upper limb assessment; Virtual assembly; Software integration