M2S Laboratory

SafranVR

Summary

This doctoral project, in partnership with the company Safran Landing Systems, aims to develop a methodology based on virtual design environments to anticipate the risk of musculoskeletal disorders (MSDs) in industrial settings for operators. To this end, a virtual environment will be developed based on an existing industrial workstation, and operator behaviors will be compared between the real-world situation and the virtual environment. A comprehensive ergonomic analysis will be conducted for both environments. This framework will allow the investigation of critical interaction variables such as immersion and presence parameters in virtual environments. The influence of operators' familiarization with the virtual environment by varying the time and frequency of exposure to the virtual situation—will also be studied.

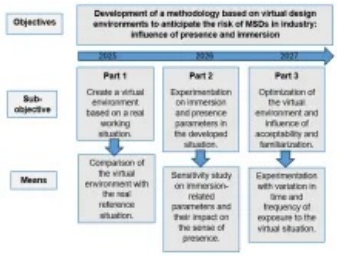
Objective

The main objective of this PhD work is to develop a virtual working situation in order to identify key parameters of interaction within the simulation. Factors related to immersion (hardware aspects of interaction) and presence (sensorimotor aspects) will be particularly explored. Other factors such as acceptability and familiarization with the virtual environment will also be analyzed. Once identified, these parameters will be optimized to reduce the risk of MSD occurrence in the simulated situation. This project will be carried out by comparing the results obtained with those from a real working environment. All of these steps will help define a functional framework for interaction in virtual environments, addressing the challenges of proactive ergonomics.

The first step of the work consists in transposing a real situation from the Safran Landing Systems factory into a virtual environment. Several work situations have been identified: final assembly of several wheel components, replacement of a mechanical part (chuck, tailstock) on a machining tool (during a program change), and installation of specific tooling (assembly, tightening, cleaning). Recordings with real operators (videos, questionnaires, inertial systems...) will be carried out to gather as much information as possible for digital reproduction. Then, a continuous comparison between the virtual and real situations will be performed to assess the simulation's validity.

Next, a sensitivity study will be conducted to determine the most impactful immersion parameters in the virtual reality simulation. The goal will be to vary technological tools (haptic interfaces, movement tracking, graphic resolution...) to study their influence on the user's sense of presence.

Based on the results from the previous two steps, the objective will be to enhance the most important immersion parameters that contribute to the feeling of actually being present in the virtual environment. An experiment on the frequency and timing of virtual reality use will also be conducted to study acceptability and familiarization with this emerging technology.



PhD Project Plan

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