SUBJECT OF THESIS 2021 2022

Thesis title : Evaluation of changes in motor skills in an immersive computer environment for the simulation of gestures and movements. Integration into an Augmented Reality Environment

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Brief Description:

Scientific challenges: Current simulation platforms do not offer sufficient information for the complete simulation of gestures and movements, including the management of operator / human data based on physiological data (signal-ElectroMyoGraphie EMG among others). In order to improve the quality of a real-time gesture and movement simulation environment, the proposed research subject focuses on two elements: i). better integration of tracking devices / infrared motion capture system: ChingMu camera (high speed of 10,000 images/sec), OpenSim process (gait and posture analysis), Skeleton Markersets, Kistler force platform, wireless electromyography Delsys) and associated software (Gait Anlysis) and ii). mobility assessment, including physiological data on the musculoskeletal state of the subject (operator, athlete or actor). The latter must be able to generate the mobility of its members in relation to its evolving environment, and the capacities of its muscles. As a result, more transparent access to different places in the simulation environment is obtained. Nowadays, Augmented Reality (AR) environments have evolved considerably towards the simulation of gestures and movements, highlighting new requirements for the phases of preparation, their integration and their optimization. Many of these platforms use tracking devices with immersive visual feedback and reveal difficulties when simulating gestures and movements made by a human, in particular by changes in the realization of the gesture associated with computer immersion. While the cognitive integration of computer immersion has been described for a long time, knowledge of its impact on motor skills remains very incomplete. However, our recent results show that motor skills can be modified by computer immersion (theses by CHEN Jingtao and WANG Jun).

Objectives: In this context, the main objective of the proposed research subject is to integrate various physiological data into tracking devices in order to improve the simulation of gestures and movements in an AR environment. To this end, tests with an infrared motion capture system, the Kistler force platform and the Delsys wireless electromyography acquisition system will be performed in order to collect the subjects' kinematic, dynamic and EMG data (plate-form GIPSA-Lab, AIP Grenoble and Shanghai Key Laboratory of Mechanical Automation and Robotics, University of Shanghai) while integrating the necessary EMG data. Thus, the objective is: i). to provide a robust acquisition technology associated with an appropriate processing of the EMG signal (electromyography), based on the use of networks of EMG sensors (location and optimal number of electrodes) or new technologies such as matrix EMG in order to improve the characterization of human movement, ii). to offer a mobility module capable of modeling the relationships between the biomechanics of the motor gesture (operator movement) and the modification of the external constraints of the environment by computer immersion (VR/AR). A model including the physiological state of the operator, including the quantification of muscle fatigue for example, for planning, simulation and optimization of gestures and movements will also be proposed. It will be validated by its integration into an enhanced scalable environment allowing the simulation of gestures and movements within the framework of existing IT environments in Grenoble and Shanghai. The main issues addressed in this proposal are: i). introduce muCI as additional data in

a gesture and movement simulation, ii). evaluate the possibility of implementing a gesture and movement simulation module in a real-time AR environment; iii). interact naturally with the augmented world by modeling and simulating human movement.

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