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HUMAN PREDICTIVE SIMULATION FOR EARTH AND SPACE EXPLORATION

Abstract

The computer-aided design (CAD) can be a powerful tool for simulating and testing environments before they are built. Some of these systems are capable of rendering particle physics, with realistic rules for force, mass, acceleration, velocity, and momentum. Simple key-frame animations, with erroneous assumptions about the gravitational environment, cannot be used to visualize or validate a design. At the same time realistic simulation of human articulations is difficult to achieve, because the human body is a complicated mechanism.

A common approach to life-like animation is a motion capture. First the recording body segment poses and rotations of an actor performing various tasks in a studio goes, then these data apply to a geometric model of a human or some other creatures. But the effects of Earth gravity are implicit in the recorded data. This results of a motion-capture data are not valid for predicting mobility in any other gravitational environment.

For better-understanding risks for a human health and performance associated with Earth and Space exploration and developing effective risk mitigation approaches and techniques, we exploited the limits of game engines and developed the predictive simulation based on game engine approach with integration of a mathematical model and/or an artificial intelligence. As well as exploited potential synergies between space and terrestrial application in the field of health and well-being.

Proposed robust, predictive simulation are also suitable for validating a new gravitational environment, which will account for all of these factors by applying the laws of physics to an accurate and detailed biomechanical model. As an additional option, virtual reality tools which could be compatible with this developed simulation were tested "in situation" to help to solve the ergonomic issues.

The expected benefits of our simulation:

- Analysis of human body interaction with machines and equipment
- Calculation of energy consumption/well-being of a human for realization of a mission, partly or mostly
- Calculation of human movements quantity for its action/mission realization
- Testing of different scenarios of interior usage
- Creation of optimal interior design taking into account the human biomechanics, which could be tested virtually
- Prediction of the crew behavior, for example, during emergency situations

Keywords: Human-centered design, Habitat, Simulation, Artificial intelligence, Virtual reality