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DESIGN OF A BICYCLE SIMULATION FOR EXTENDED DURATION MANNED-SPACEFLIGHT

Abstract

Astronaut muscle atrophy is a serious concern that a strict exercise regimen with current generation exercise machines can lessen.

This paper details the design and build of a system that can operate in an artificial gravitation environment and utilises VR technology with Google Earth and NASA World Wind. This makes the exercise regimen more enjoyable and realistic by allowing real-world routes to be ridden. There is also the potential to decrease negative effects on muscle and bone materials. The artificial gravitation increases the effectiveness of this simulator as a medical tool for astronauts and could potentially be a solution for bone density losses that would debilitate astronauts on extended duration missions.

A software program has been created that allows the functions required to be accessible from one location. It incorporates Google Earth, NASA Worldwind and Instant Player so they can be utilised without having to open multiple programs and without the need for extensive re-calibration.

A testing platform consisting of an exercise bike with the same functionality as the space-faring system was created to allow testing of the program and validity of the space bicycle simulator concepts. Of note is forces exerted on the head due to cross coupling with the Coriolis Effect equal the forces experienced when using the test platform, making the test platform a very useful diagnostic tool for future research.

Theoretical results indicate a module with rotating arm of 2.1 m would produce a hydrostatic pressure gradient in the body similar to that on Earth which would increase the effectiveness of any exercise performed and potential decrease many of the harmful effects of microgravity environments. The motion sickness that short arm centrifuges often induce could be minimised by controlling the visual stimuli through the virtual reality goggles, making the forces acceptable for extended human use.