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Author: Mr. Nicholas Coombe  
Australia, nicholas.coombe@gmail.com

Mr. Morgan Coombe  
Australia, coombe.m@gmail.com

RECREATING THE SPACEBIKE: AN EARTH-BASED ANALOGUE OF AN ARTIFICIALLY  
INDUCED GRAVITATIONAL ENVIRONMENT

**Abstract**

A system of testing space-based exercise equipment has not been properly accomplished with current generation machines. Introducing new systems is often prohibitively expensive to design and test as no Earth-based analogues are readily available or even possible.

This paper details the design and build of an exercise system that includes an Earth-based analogue that has been used for testing and validation. The system features a virtual reality-based simulation connected to a short arm centrifuge bicycle simulator that immerses the user in Google Earth, NASA Worldwind or custom environs through Instant Player. This creates a more psychologically enjoyable and physically beneficial exercise regimen by mimicking a well understood environment.

The analogue test system includes a leaning mechanism that resembles both the space-based system and real life bicycle riding. Force feedback in the form of variable resistance pedals simulates slopes in Google Earth and NASA Worldwind. The system is designed to mimic the physiological effects of the spacebike as close as possible. The effects of the immersive virtual reality simulation on the user can also be qualitatively analysed to determine any short term effects of use.

The analogue test system is shown to very closely resemble the forces that would be experienced by a user of the spacebike. This allows for analyses to be performed determining the potential effects of the space-based system. The forces experienced by users of both systems are comparable, thus the physical effects can be analysed subjectively. The ability to cheaply and effectively test and adapt the simulator and simulation is a major advantage that no other current generation space exercise system can boast.

The results of this research and experimentation point towards a new method of exercising in space that may reduce a vast majority of medical maladies faced by astronauts on extended duration space missions. The similarities between the forces experienced by the rider of the analogue and the theoretical forces experienced using the spacebike indicate that long term Earth-based testing into the effectiveness of the system is possible and would lead to meaningful results.