Mathematically Accurate, Double-Axis Microgravity Simulator

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Recently, the desire to travel to other planets and beyond has become more popular as well as more feasible. In order to travel further into space though, scientists must be able to account for every scenario that could possibly occur in a microgravity environment. However, resupply missions to the International Space Station (ISS) are quite costly especially with the limited amount of money and resources. The simulation of microgravity in ground laboratories is therefore becoming increasingly essential from the high cost of space missions to the ISS and the strong desire to explore space. Microgravity has been simulated through free fall, magnetic forces, parabolic flight, and lastly through rotating axes. This experiment's intention was to create a new type of effective double-axis microgravity simulator. Previously made double-axis microgravity simulators used two motors to spin both axes. However, this new simulator design uses only one motor with a 90 degree converter and gear mechanism to spin both axes, increasing efficiency and adjustability while effectively simulating microgravity. The method for simulation is to average out the gravity vectors to achieve a net gravity vector close to 0. With centripetal acceleration, 3D Vector transformations with matrices, and accelerometer measurements, I was able to show that the microgravity simulator is about as accurate as Earth orbiting free-flyers (one-thousandth of the gravity felt on Earth). Also, by reversing these calculations, I've found the RPM speed that one would need to use on my machine to simulate the gravity on other planets. Through this, scientists could study the effects of varying accelerations of gravity in a less costly and a more adjustable manner.

Awards Won:

Fourth Award of $500