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A NOVEL DESIGN OF A RANDOM POSITIONING MACHINE. A COMPARATIVE STUDY WITH A CLASSICAL, FRAME-BASED APPROACH.

Abstract

The current state of space exploration, its rapid development in recent years and plans for the coming decades - especially those related to long term human spaceflight - demand and at the same time allows for extensive microgravity research. Most popular microgravity research platforms are International Space Station and satellites, however, they require relatively long and expensive experiment development processes and have some limitations related to environmental conditions and operations. Therefore, there is a need for more accessible, preferably ground, research facilities.

One of these platforms is a random positioning machine (RPM), which is capable to simulate microgravity conditions for biological samples by averaging the gravity force vector. The most common RPM simulator consists of independently rotating frames with the samples placed in the center of the machine, where they experience low gravity conditions as gravity vector is zeroing over time.

This paper presents alternative, novel design inspired by ball balancing robots. It consists of the sphere rotating on a platform made of three omnidirectional wheels. Principle of obtaining low gravity force is similarly based on the averaging of the gravity force vector. Paper presents details of mechanical and electrical design. Control algorithms for the developed platform are also proposed.

Comparative study of a classical, frame-based random positioning machine with developed sphere-based RPM is presented.