IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Science Results from Ground Based Research (4)

Author: Dr. Agata Kolodziejczyk
Analog Astronaut Training Center, Poland, fichbio@gmail.com

Mr. José David Villanueva Garcia
European Space Agency (ESA/ESOC), Germany, jdvillanuevagarcia@gmail.com
Mr. Krzysztof Urban
Analog Astronaut Training Center, Poland, krzysztof.urban.93@gmail.com
Mr. Jan Kolodziejczyk
Analog Astronaut Training Center, Poland, jan.m.kolodziejczyk@gmail.com
Mr. Matt Harasymczuk
Analog Astronaut Training Center, Poland, matt@astronaut.center
Ms. Hannah Reilly
ILEWG "EuroMoonMars", Ireland, c18385283@mytudublin.ie
Dr. Manuela Raimbault
France, mr.raimbault@gmail.com
Mr. Mateusz Kraiński
European Space Research and Technology Centre, ESA-ESTEC, The Netherlands,
Mateusz.Krainski@esa.int

EQUATIONS GOVERNING RPM MACHINES AND THEIR APPLICATIONS IN MODELING BIOLOGICAL PROCESSES

Abstract

Gravity is omnipresent on Earth; however, humans in space, such as astronauts at the International Space Station, experience microgravity. Random Positioning Machines (RPMs) are widely used as tools to simulate microgravity on ground. They consist of two gimbals mounted frames, which constantly rotate biological samples around two perpendicular axes and thus distribute the Earth's gravity vector in all directions over time. In recent years, the RPM is increasingly becoming appreciated as a laboratory instrument also in non-space-related research.

In terms of algorithm, the classical mode, which drives only one of the two frames with a constant speed, has been conventionally used. In the subsequent step, two perpendicular axes are rotated at a constant speed to provide RPM motion. However, these algorithms do not guarantee symmetrical coverage of all orientations. By using random angular velocities for two axes, an unpredictable and symmetrical path of gravitational vectors was implemented.

In this paper we describe the equations governing the RPM machines. In the second part of this work we present examples of applications of mathematically described RPM machines for biological experiments, in particular cellular cultures and plants. Based on empirical data we present examples for modeling of biological processes in relation to the RPM machine rotation speeds. Adjusting the speed of RPM machine is crucial to understand its effect on biological processes induced in simulated microgravity experiments.