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A PRAGMATIC APPROACH TO ARTIFICIAL GRAVITY: TESTBED FOR GRAVITY SIMULATION PLATFORM ON-ORBIT.

Abstract

This paper presents research that expands on previous investigations about a testbed for an artificial gravity platform in low Earth orbit. The initial proposal aimed to create a means for better understanding long-term effects of partial gravity on physiological and psychological human capabilities. Because human centrifuges on Earth cannot recreate effects of partial gravity on human physiology and parabolic flights fail to provide long enough exposures to generate feasible data, other research platforms to investigate partial gravity effects on humans and systems are needed. The proposed 3-body testbed comprises of two customized crewed-Dragons docked to a Central Hub, which in turn docks to the Zvezda module of the International Space Station. To execute operations, the testbed will undock, retreat 2000m aft of the ISS and initiate rotation by firing its augmented thrusters. Then, the crewed-Dragons will tether out to the desired radius of rotation to begin test operations. Upon completion, the testbed will de-spin, retract its tethers and re-dock to the ISS. The sequence repeats as needed. The testbed serves two sets of test objectives: technical and physiological. The testbed's first phase will develop the technical systems to ensure the spinning testbed is human rated. The second phase will be dedicated to physiological examinations.

This paper presents the physiological experiments, their varying test parameters and subsequent recommendations for interior design features of crewed-Dragons. Crew adaptation to rotating platforms in short term, in the scale of hours and possibly days, will be the primary area of research. The paper presents three main categories of short-term physiological tests which are to assess the human body's responses to: a. Coriolis and related effects, b. Different levels of gravity, c. Different rates of angular velocity and radius of rotation. The experiments are based upon papers by James R. Lackner, Paul DiZio in 1998; Gilles Clément in 2015; and Al Globus, Theodore Hall in 2017. The parameters of the first experiment have been provisionally identified as following - a 20 min spin duration, 10 m radius of rotation, 9.5 rpm speed of rotation, 1g of gravity level. The paper presents possible subsequent experiments which allow gradual increase in time spent in a rotating environment along with variations of other parameters such as radius of rotation, speed of rotation and the gravity level generated. Finally, the paper presents interior design considerations of the crewed-Dragons. These will be based upon Theodore Hall's suggestions published in 1999.