TECHNOLOGY ASSESSMENT FOR EXTERNAL IMPLEMENTATION OF ARTIFICIAL GRAVITY UTILIZING THE DEEP SPACE GATEWAY PLATFORM. R. Raychev[1] and Y. V. Griko[2], Space Challenges Program, EnduroSat Inc. Sofia, Bulgaria, [2]Division of Space Biosciences, NASA Ames Research Center, Moffett Field, CA,USA; Yuri.V.Griko@nasa.gov

Introduction: There is substantial rational to continue research on artificial gravity to prevent spaceflight induced alterations in all physiological systems. Artificial gravity (AG) and AG analogue studies with animals demonstrated some measure of protection against microgravity-induced alteration in model organisms [1]. However, this phenomenon was not tested in real spaceflight studies due to their paucity as well as their short-duration. As beyond LEO-class manned missions are planned and developed, new technology to test AG as a countermeasure in spaceflight is needed. Several approaches exist for research of artificial gravity as a spaceflight countermeasure. Implementation of traditional centrifuge strategy for creation of artificial gravity is associated with challenging issues such as; vibration, significant mass, and power to support a centrifuge. Furthermore, all ground-based studies are extremely expensive given that studies needed for AG should be of very long duration to observed gravity-associated alterations. Although there are several possibilities of introducing a centrifuge to International Space Station (ISS) [2], the ISS-based space studies utilizing centrifusion has a disadvantage of a small radius in addition to the challenges raised above, and therefore unlikely to be feasible for future human accommodation. Therefore, a space centrifuge will have to be designed with little mass and variable radius of rotation which can be possibly accomplished by using a cable connected inflatable habitat. Jet or electrical propulsion engines will provide controlled acceleration as well as tangential velocity in open space relative to the orbital station. The adjustable radius of rotation and tangential velocity will provide an artificial gravity environment (including a head-to-foot gravity gradient) with specific gravity levels including a “comfort zone” suitable for animals and humans with a minimum period of adaptation. The hypothetical AG protocols that may counteract microgravity-associated physiological alterations in all physiological systems have been developed in previous studies [3]. The most suitable for the AG application is electric propulsion and has been used on spacecraft for decades [4]. The electric propulsion with an external power source (transmissible through the solar panels) can provide small thrust of 47.5 m/s for a long time and is enough to provide the artificial gravity centripetal acceleration with around 1 g and angular velocity of 1.97 rpm at the radius of rotation of 230 m which is in the “comfort zone” for humans. The results of the proposed project will justify experimental proof-of-concept, design, implementation, and operation to control artificial gravity parameters. The design could be the starting point in the continued search for comprehensive architectural upgrades and operational protocols suitable for Mars missions which are of long duration.

References: [1] Paloski W. H. (2014) Introduction and background. In Proc. International Workshop on Research and Operational Considerations for Artificial Gravity Countermeasures *(eds Paloski W. H. and Charles J. B.*) 4–8 (NASA, Moffett Field CA). [2] Morita H, et al. (2015) PLoS One. 10:e0133981. doi: 10.1371/journal.pone.0133981. [3] Kaderka J.D. et al., (2010) Acta Astronautica, 67, 10, 1090-1102. [4] de Selding, P.B. SpaceNews. Retrieved 6 February 2015.