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TECHNOLOGY DEMONSTRATION OF ELECTROMYOSTIMULATION ASSISTED ISS INFLIGHT EXERCISES USING THE EASYMOTION SYSTEM

Abstract

Human locomotion on Earth is based on body stability (body tension) for movement control by both trunk (core body) and the appendicular musculoskeletal system (i.e. limbs, neck and head). In water immersion on the ground as well as in various G conditions (ISS, Moon, Mars), body stability is critically challenged thus impairing performance control during ground-based exercise (e.g. Neutral Buoyancy Laboratory) or in real spaceflight. Currently a set of pre- and inflight countermeasure protocols (ARED, T2 and CEVIS) are prescribed by Space Agencies to prevent astronauts for example from neuro-musculoskeletal deconditioning during long-duration missions, LDM (muscle atrophy, functional impairments). Whole body electromyostimulation (EMS) with a special body skin suit is a relatively new non-invasive exercise protocol to support muscle activity in patients under hypoactive conditions and following rehabilitation by means of supporting muscle contractions during and/or after regular exercise protocols. Moreover EMS is currently in use for normal healthy and middle-aged populations as time saving protocol in commercialized fitness studios in many EU countries, and probably also worldwide, however, with supervision by a personal trainer.

The aim of the EasyMotion technology demonstration on board the ISS is a first pilot test whether EMS can effectively complement the above mentioned countermeasure exercise protocols. Thus, EMS might help saving crew time by a substantial reduction of the duration of training. In particular, EMS assisted training might also help to prevent adverse effects of microgravity during long term missions in space crafts, which do not provide the space for large training devices. A commercially available "off-the shelf system" hardware (COTS-HW) EMS body suit EasyMotionSkin^{TM} has been used for an EMS assisted exercise protocol (whole body EMS) as part of the Matthias Maurer Cosmic Kiss ISS mission in 36 inflight sessions.

The function of the commercial EasyMotionSkin^{TM} developed by the EMS GmbH as well as the modifications of the system for ISS utilization and the space qualification steps performed under the

responsibility of the OHB System AG will be described. Moreover, a description of the in-orbit operations, experiences gained during EMS assisted exercises and derived lesson learned will be provided. Scientific support of EMS assisted protocols in spaceflight is provided by the Charité Center of Space Medicine Berlin, Germany. The EasyMotion project is coordinated by the German Space Agency at the German Aerospace Center (DLR) in Bonn and funded by the Federal Ministry for Economic Affairs and Climate Action (BMWK).