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NEW OPPORTUNITIES TO EXPAND KNOWLEDGE ABOUT COUNTERMEASURE DEVELOPMENT FOR FUTURE LONG DURATION SPACE MISSIONS AND LIFE SCIENCE EXPERIMENTS USING THE NEXT GENERATION SHORT ARM CENTRIFUGE :ENVIFUGE

Abstract

In 2013, the German Aerospace Center (DLR) in Cologne, Germany, commissions their new medical research facility :envihab. The main objective of :envihab is to facilitate highly controlled research into the effects of different environmental conditions (e.g. varying ambient air pressure or oxygen content) on humans in long-term studies and the development of appropriate countermeasures and life support systems. One central element of the facility is a new type of short arm centrifuge called :enviFuge. From past experience with a large number of centrifuge experiments DLR and AMST Systemtechnik GmbH have developed a unique research and training device in the field of artificial gravity. Equipped with the capacity to instantaneously and independently move the four nacelles along the acceleration axis, the centrifuge allows the possibility to perform up to four complex trials simultaneously. The shift of subjects above heart-level on a short arm centrifuge allows unique studies about e.g. the cardiovascular regulation in surroundings with a high gradient of artificial gravity. The maximal acceleration is 6g at the foot level, and each nacelle provides enough space for up to 150kg payload, additionally 2 x 100kg equipment can be mounted on the main arm. Standard features of the centrifuge include a 6-camera motion capturing system and two triaxial force plates to study the kinematics of physical exercise (e.g. squatting, jumping, or vibration training) under increased gravity. Cardiovascular training can be performed with passive spinning, or cycle ergometry and imaging procedures like ultrasound examinations can be done remotely by a compliant robotic arm. Dark environments with full audio and video entertainment and medical monitoring including ECG, blood pressure, SpO2 are available for each nacelle. Future projects involving :enviFuge will allow the development and testing of potential countermeasures and training methods against the negative effects of weightlessness in space on the human physiology. Long term space mission e.g. to Mars will be benefit from the development of new training devices as well as handicapped or bed-ridden patients on earth.