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DEXTEROUS MANIPULATION IN MICROGRAVITY: EXPERIMENTS DURING AIRCRAFT PARABOLIC FLIGHTS TO PREPARE FOR THE INTERNATIONAL SPACE STATION

Abstract

During exposure to microgravity in parabolic flights, it has been shown that the control of interaction forces when manipulating an object adapts partially to the lack of gravity, yet evidence indicates that anticipation of gravity's effects persists in the short term. The motivation for these experiments to be performed in long-duration space flight is to understand how the central nervous system adapts to an environment without gravity and what will be the consequences of long-term adaptation when an individual returns to a normal (Earth) or partial (Moon or Mars) gravitational field. The experiment "Dexterous Manipulation in Microgravity" (DEX) will target specific questions about the effects of gravity on dexterous manipulation. Some questions have already been studied over the last ten years in experiments conducted in parabolic flights, during which the way how the nervous system copes with repeated transitions between different gravitational environments has been investigated. Results from these experiments provide initial data about short-term adaptation to 0g. The experiments proposed for ISS draws from these short-term precursor experiments, but will emphasize long-term adaptation of sensorimotor processes to 0g and re-adaptation to 1g. A first conceptual definition phase of a DEX instrument has been completed under an ESA contract. The DEX instrument is now in the design and development phase in view of a launch on ISS in the 2013-2014 timeframe. The science background will be recalled and several experiments performed during parabolic flights will be presented, showing how these early breadboards testing in microgravity have helped to refine the DEX conceptual design and how it could be used on ISS.