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DESIGN AND PREPARATION OF THE DEXTEROUS MANIPULATION EXPERIMENT 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. Subjects will perform a variety of movements while holding an instrumented manipulandum in a precision grip between the thumb and index finger. Thereby the forces acting between the hand and the manipulandum will be measured. The overall experiment set-up, which has been prototyped during several ESA parabolic flights, will allow to measure grip force and load force between fingers and manipulandum, as well as manipulandum acceleration, rotational velocity and 3D position. Results from experiments conducted in microgravity during parabolic flights since more than ten years 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. The DEX instrument is being developed under ESA contract in view of a launch on ISS in the 2014 timeframe. This paper will present the experiment science background, the experiment set-up, a short design description, and how it will be used on ISS.