

## SENSORIMOTOR RESULTS FROM THE JOINT NASA AND RUSSIAN PILOT FIELD TEST

<sup>1</sup>M.F. Reschke, <sup>2</sup>I.B. Kozlovskaya, <sup>3</sup>I.S. Kofman, <sup>2</sup>E.S. Tomilovskaya, <sup>3</sup>J.M. Cerisano, <sup>1</sup>J.J. Bloomberg, <sup>3</sup>M.B. Stenger, <sup>3</sup>S.M.C. Lee, <sup>3</sup>S.S. Laurie, <sup>2</sup>I.V. Rukavishnikov, <sup>2</sup>E.V. Fomina, <sup>4</sup>S.J. Wood, <sup>6</sup>A.P. Mulavara, <sup>5</sup>A.H. Feiveson, <sup>3</sup>E.A. Fisher, <sup>6</sup>M.J.F. Rosenberg, <sup>2</sup>V.V. Kitov and <sup>2</sup>N.Yu. Lysova

<sup>1</sup>Neuroscience Laboratories, NASA Johnson Space Center, 2101 NASA Parkway, Houston, TX 77058, (millard.f.reschke@nasa.gov); <sup>2</sup>Russian Federation State Research Center, Institute of Biomedical Problems, Department of Sensory-Motor Physiology and Countermeasures, Russian Academy of Sciences, Moscow, Russia; <sup>3</sup>Wyle Science, Technology and Engineering Group, Neuroscience and Cardiovascular Laboratories, NASA Johnson Space Center, Houston, TX, <sup>4</sup>Azusa Pacific University, Azusa, CA, <sup>5</sup>Biomedical Research and Environmental Sciences, NASA Johnson Space Center, Houston, TX, <sup>6</sup>National Space Biomedical Research Institute, Baylor College of Medicine, Houston, TX

### INTRODUCTION

Testing of crew responses following long-duration flights has not previously been possible until a minimum of 24 hours after landing. As a result, it has not been possible to estimate the nonlinear trend of the early (<24 hours) recovery process, nor has it been possible to accurately assess the full impact of the decrements associated with long-duration flight. To overcome these limitations, both the Russian and U.S. programs have implemented testing at the Soyuz landing site. This research effort has been identified as the *Field Test* (FT). For operational reasons the FT has been divided into two phases: the full FT and a preliminary pilot version (PFT) of the FT that is reduced in both length and scope. The PFT has now been completed with the landing of the crew of International Space Station Increment 42/43 (Soyuz expedition 41S).

### RESEARCH

The primary goal of this research was to determine functional abilities associated with long-duration space flight crews beginning as soon after landing as possible (< 2 hours) with an additional two follow-up measurement sessions within 24 hours after landing. This study goal has both sensorimotor and cardiovascular elements. The PFT represented a initial evaluation of the feasibility of testing in the field and was comprised of a jointly agreed upon subset of tests drawn from the full FT and relied heavily on Russia's Institute of Biomedical Problems Sensory-Motor and Countermeasures Department for content and implementation. Data from the PFT was collected following several ISS missions. Testing on the U.S. side has included: (1) a sit-to-stand test, (2) recovery from a fall stand test where the crewmember begins in the prone position on the ground and then stands for 3.5 minutes while cardiovascular performance and postural ataxia data are acquired, and (3) a tandem heel-to-toe walk test to determine changes in the central locomotor program. Video, cardiovascular parameters (heart rate and blood pressure), data from body-worn inertial sensors, and severity of postflight motion sickness were collected during each test session. In addition our Russian investigators have made measurements associated with: (a) obstacle avoidance, (b) muscle compliance, (c) postural adjustments to perturbations (pushes) applied to the subject's chest area and (d) center of mass measurements made across most test objectives with insoles inserted into the subjects' shoes. Data from 18 subjects have been obtained for a majority of the PFT objectives.

### SUMMARY

The increased level of functional deficit observed in the crewmembers tested with the PFT objectives has been typically greater than previously observed when measurements were collected after the 2 hr window. Significant improvement in crew performance was observed within 24 hours, but full recovery appears to require 6 to 16 days. Clearly measureable performance parameters such as ability to perform a seat egress, recovery from a fall or the ability to see clearly when walking, and related physiologic data (orthostatic responses) are required to provide an evidence base for characterizing programmatic risks and the variability among crewmembers for exploration missions where the crew will be unassisted after landing. Overall, these early functional and related physiologic measurements will allow the estimation of nonlinear sensorimotor and cardiovascular recovery trends that have not been previously captured.