RISKS AND GAPS

NASA’s Digital Astronaut Project Vision

The Digital Astronaut Project (DAP) implements well-vetted computational models to predict and assess space-flight health and performance risks and to enhance countermeasure development by

- Partnering with subject matter experts to inform Human Research Program (HRP) knowledge gaps and countermeasure development decisions
- Modeling and simulating the adverse physiologic responses to exposure to reduced gravity and analog environments
- Ultimately providing timely input to mission architecture and operations decisions in areas where clinical data are lacking

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OBJECTIVES

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- Determine specific and anatomically localized outcomes: joint torques and forces, muscle forces for a known set of kinematics and loading
- Compare the effect exercising with a bar load applied to a single point at the back of the neck vs. a harness load distributed about four points on the back for the variables associated with exercising

EXERCISE HARDWARE

Hybrid Ultimate Lifting Kit (HULK®)

- Compressed air and piston assembly provides direct resistance
- Servo motor provides an eccentric overload
- Load cells in cables for load history
- Provides a wide variety of resistance exercises

Harness Simulated Load

- Harness load is distributed over four points on the back
- Same load used as for bar
- 30% load at the shoulders
- 70% load at the lower back
- Motion capture data not taken using harness
- Same kinematics as bar load were used

MOTION CAPTURE

OpenSim Descriptive Model Work Flow

Human Research Program Risks/Gaps Addressed

Risk of Muscle Atrophy: Impaired performance due to reduced muscle mass, strength and endurance
- Gap M7: Can the current in-flight performance be maintained with reduced muscle mass?
- Gap M8: What is the minimum exercise regimen needed to maintain muscle strength?
- Gap M9: What is the minimum set of exercise hardware needed to maintain those fitness levels?

Risk of Loss of Bone Mineral Density: Early onset of osteoporosis
- Gap M10: Identify options for mitigating early onset osteoporosis before, during, and after spaceflight (formerly Gap B15)
- Gap M11: How do skeletal changes due to spaceflight modify the terrestrial risk of osteoporotic fractures? (formerly Gap B7)

SUMMARY

This work is funded by the NASA Human Research Program, managed by the NASA Johnson Space Center. Specifically, this work is part of the Digital Astronaut Project (DAP), which directly supports the Human Health and Countermeasures (HHC) Element. The DAP project is managed out of NASA/Glenn Research Center (GRC) by Dr/En W. Griffin, Ph.D., and Lealem Mulugeta of USRA-Houston serves as the DAP Project Scientist.

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