COMPUTATIONAL MODELING USING OPENSIM TO SIMULATE A SQUAT EXERCISE MOTION


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The Digital Astronaut Project (DAP) implements well-vetted computational models to predict and assess spaceflight 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

PROJECT VISION

NASAs Digital Astronaut Project Vision

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MODELING METHODS

OpenSim Biomechanical Model

Deep Parallel Squat

- Base model was scaled to the test subject
- Based on subject’s anthropometrics and motion capture data while in static pose and exercising
- HULK resistance load applied to model as a force at the bar ends
- Ground reaction force from force plates applied to model at the feet
- Deep and parallel squats performed by subject

EXERCISE HARDWARE

Hybrid Ultimate Lifting Kit (HULK)2

- 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

MOTION CAPTURE

OpenSim Descriptive Model Work Flow

OpenSim Model of HULK Squat

- Motion capture data collected using the HULK exercise device with test subject performing multiple exercises
- The data was analyzed extensively using OpenSim
- The analysis resulted in vastly improved knowledge of OpenSim and how the program operates

REFERENCES

3. High Eccentric Resistant Overload Device, Concept of operations, ZIN Technologies, Cleveland, OH.

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