

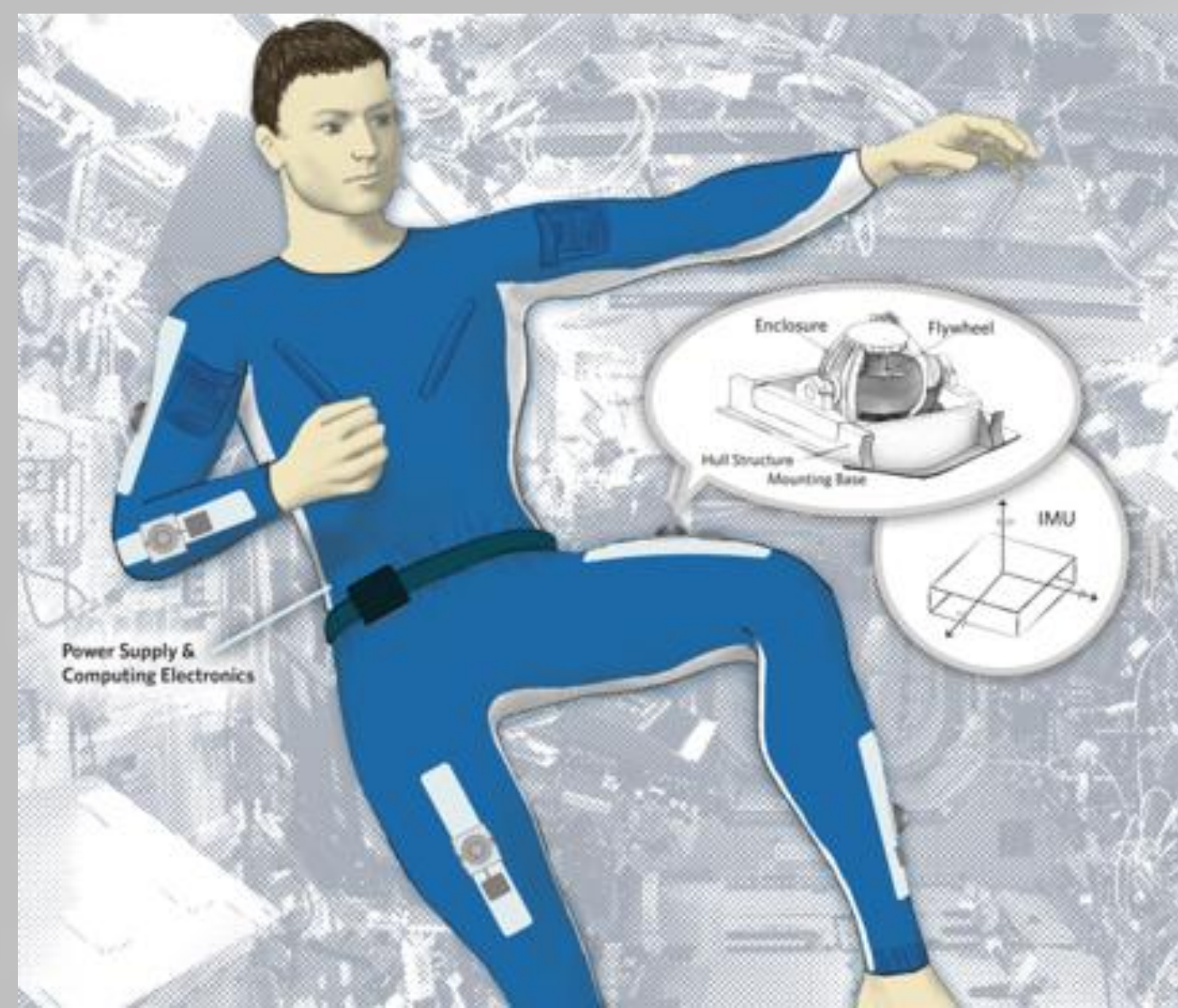


Variable Vector Countermeasure Suit (V2Suit) for Space Habitation and Exploration

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THE V2SUIT SYSTEM

THE V2SUIT IS A COUNTERMEASURE PLATFORM THAT USES GYROSCOPIC MOTION TO PROVIDE A “VISCOUS RESISTANCE” DURING MOVEMENTS TO MITIGATE SPACEFLIGHT PHYSIOLOGICAL ADAPTATION



IMPACT SPACE TECHNOLOGY WITH EARTH APPLICATIONS

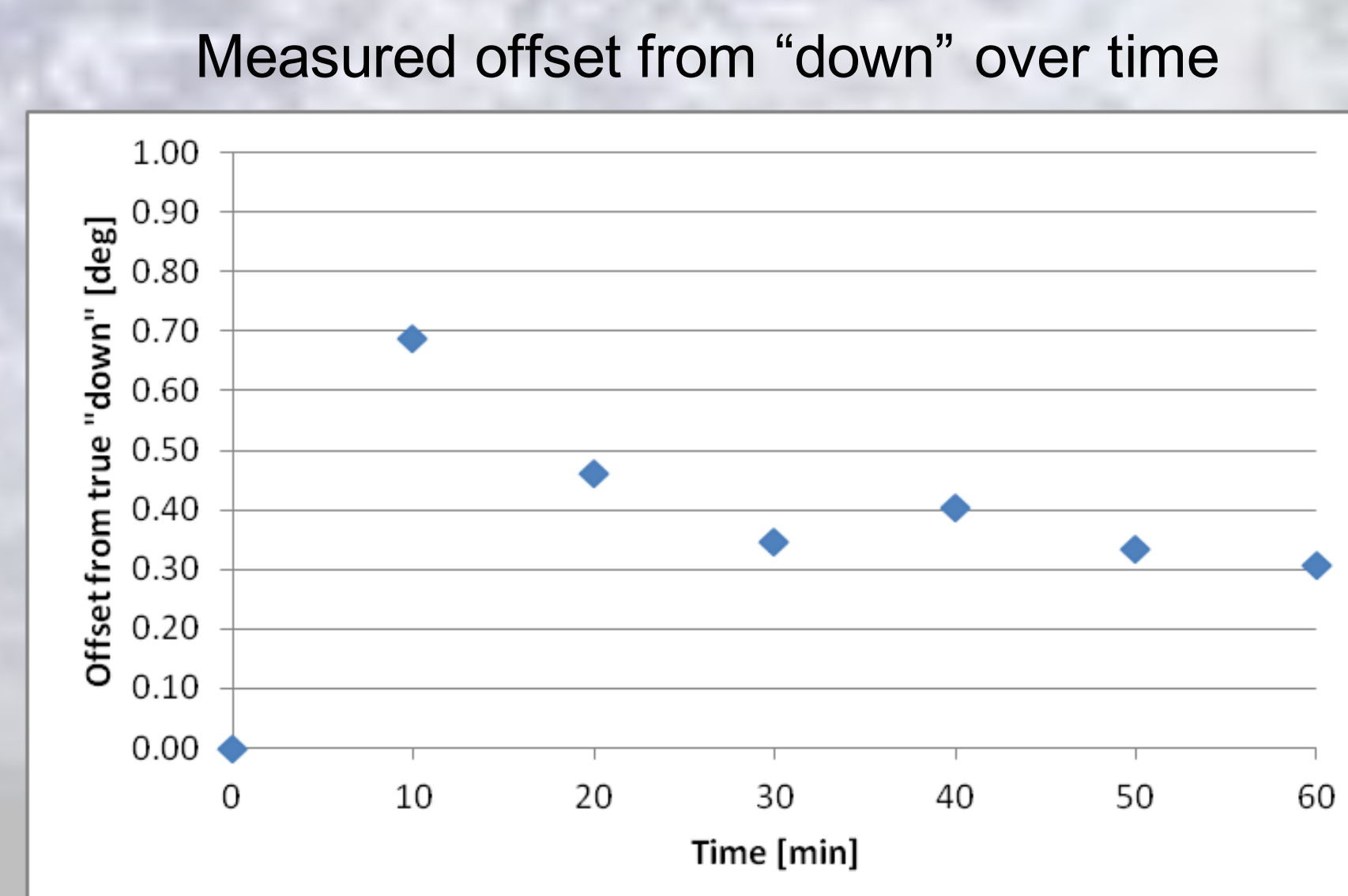
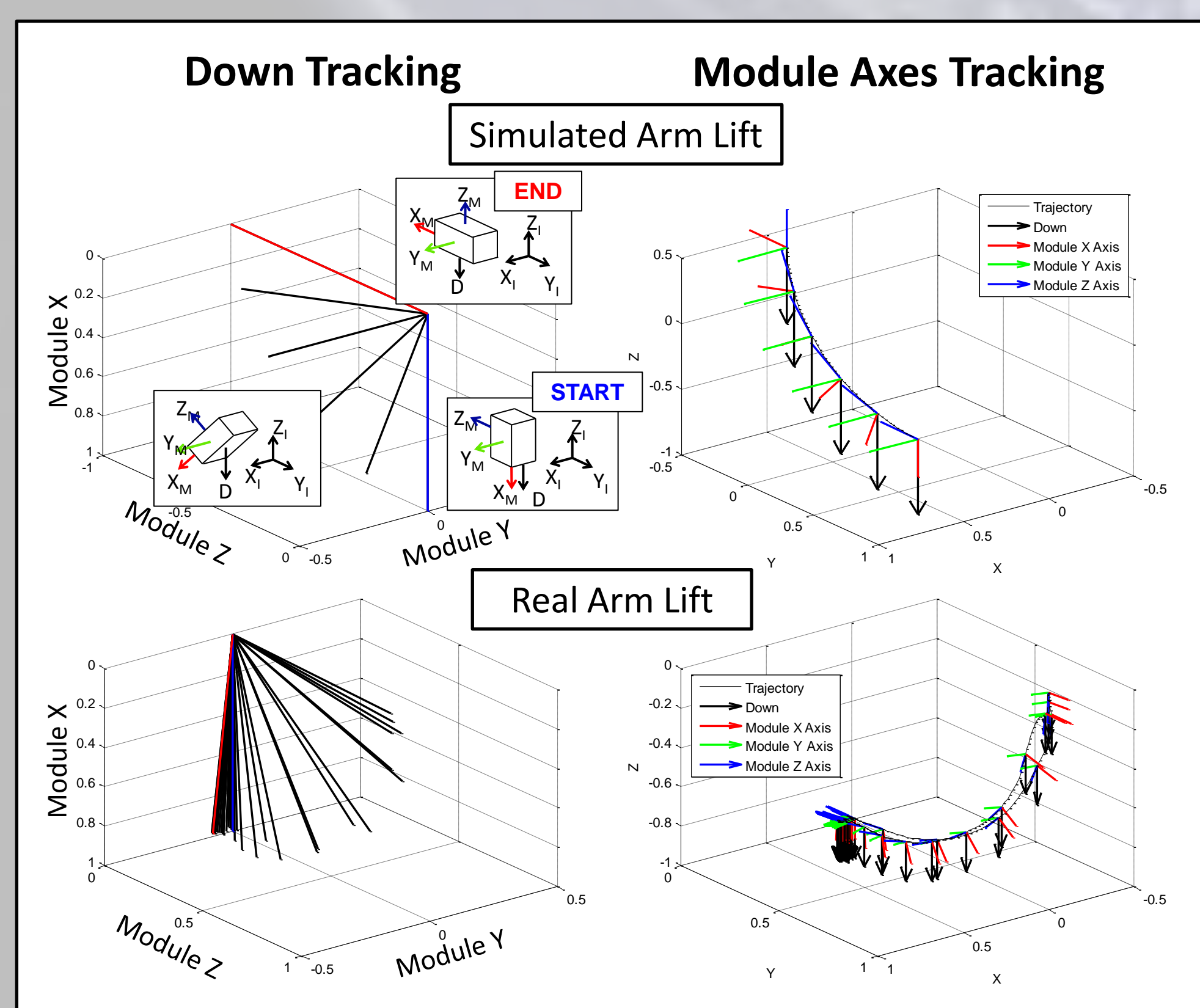
An integrated countermeasure system has a measurable impact :

- Reduce number hours per day allocated to exercise
- Reduce exercise equipment mass and volume
- Enable optimal performance during mission-specific gravitational transitions



“DOWN” INITIALIZATION & TRACKING

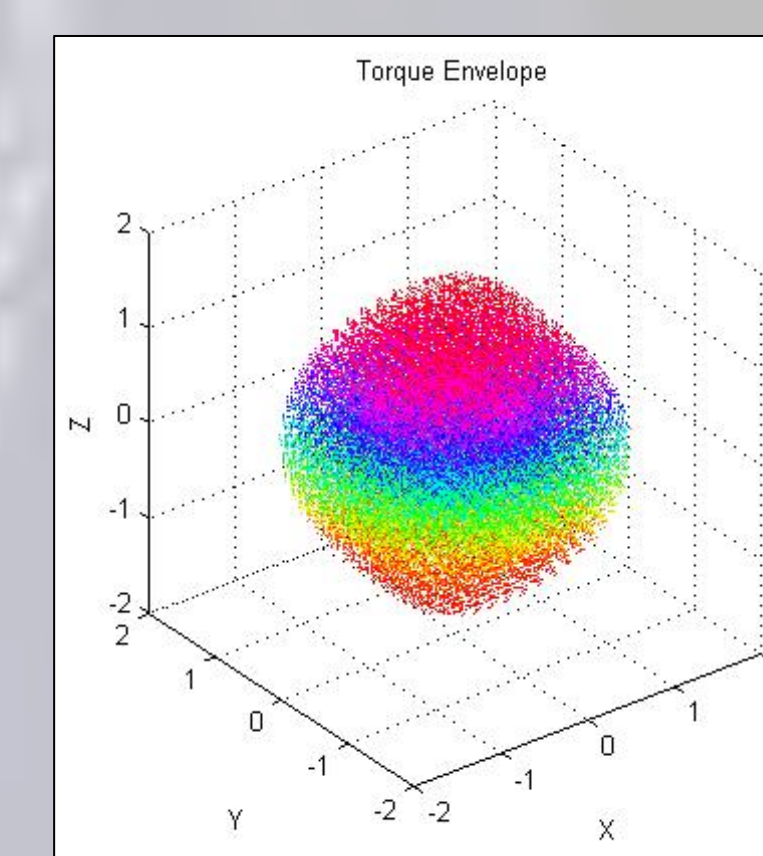
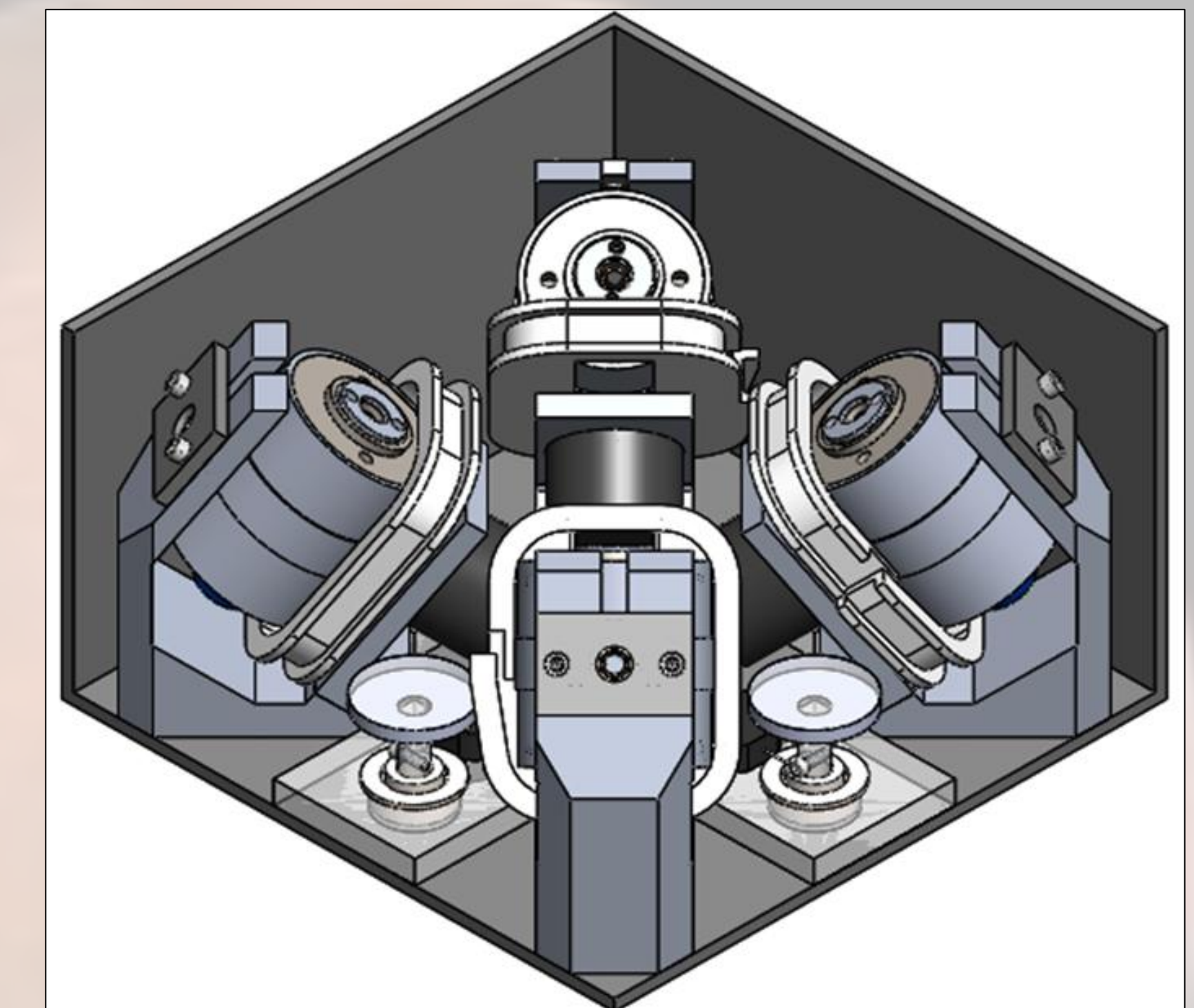
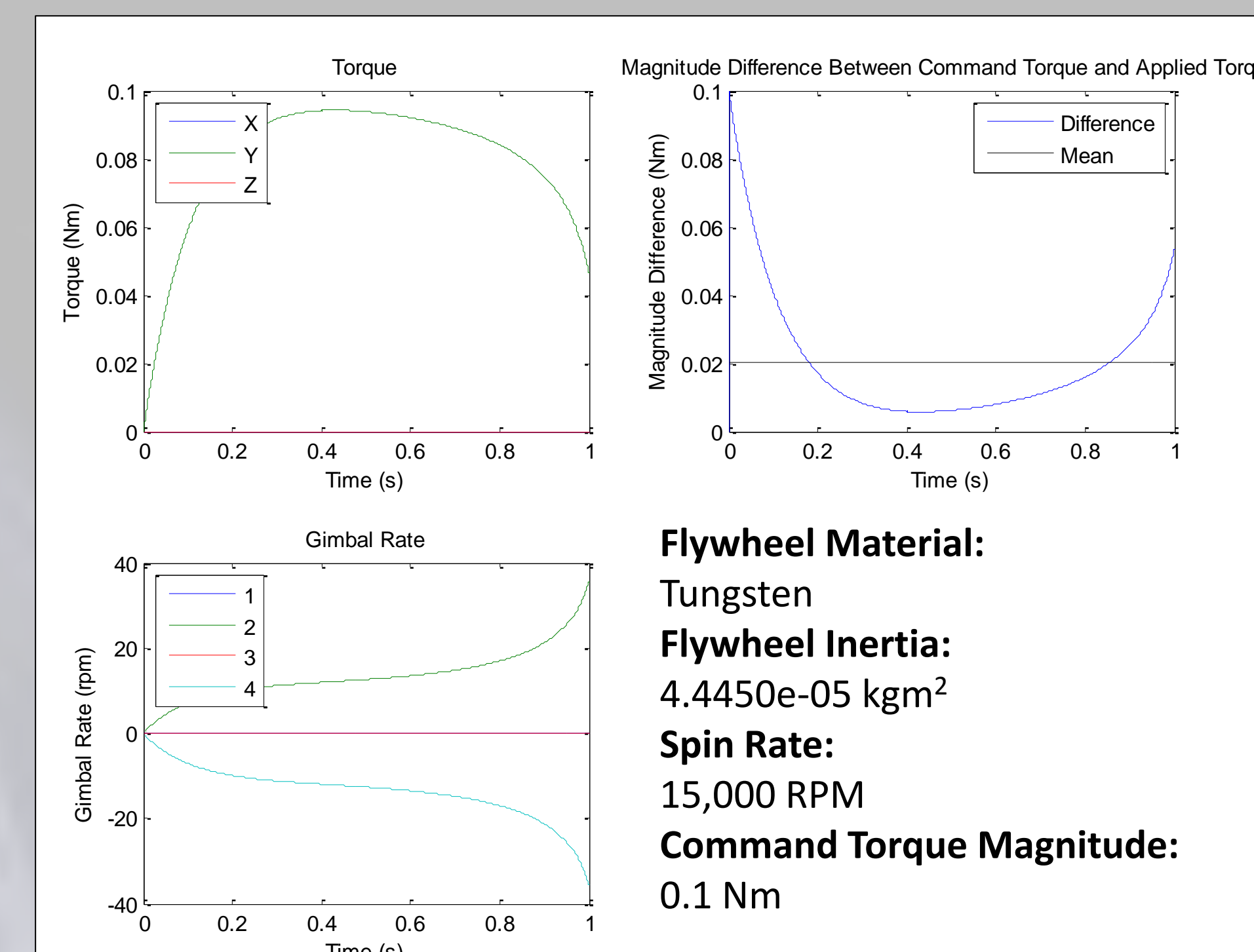
The V2Suit “Down” tracking algorithm enables the wearer to initialize the direction of inertial “down” and uses data from onboard IMUs to track the movement and orientation of the individual modules with respect to that direction of “down.”



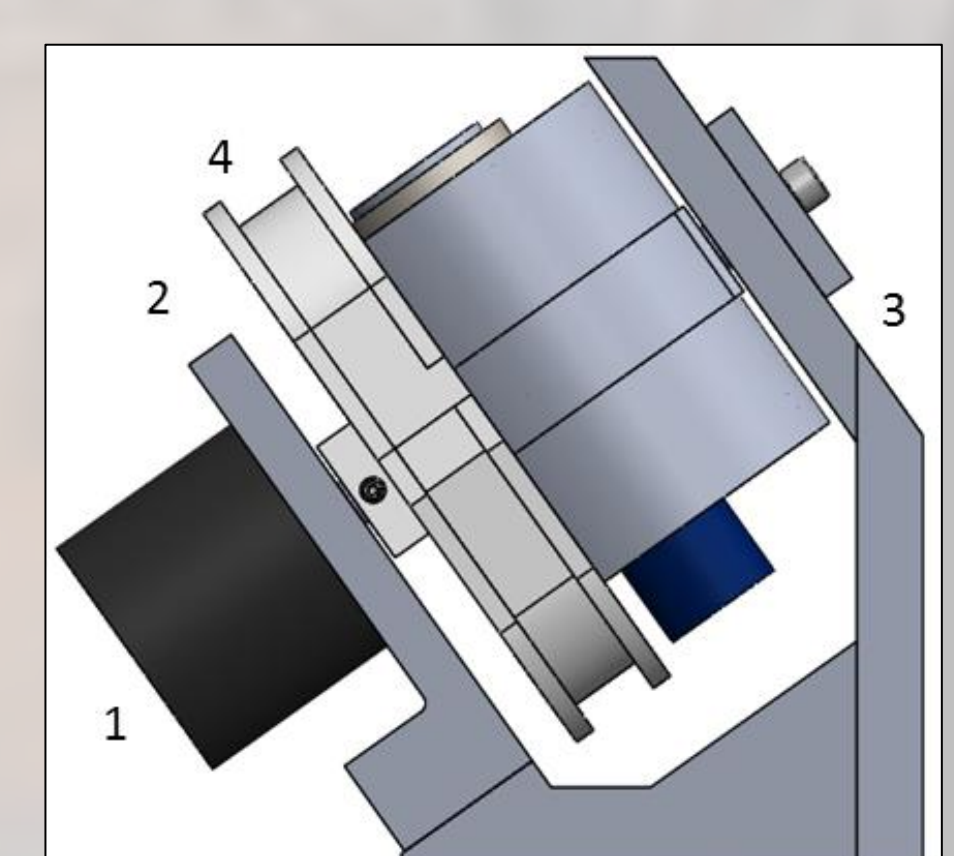
Selected IMU evaluated during operating time of 1 hour with less than a 1 degree offset from true “down.”

CMG ARCHITECTURE & STEERING LAWS

Wearable control moment gyroscopes arranged in a pyramid array will act in a coordinated manner to provide a resistance when movements are parallel to “down”.

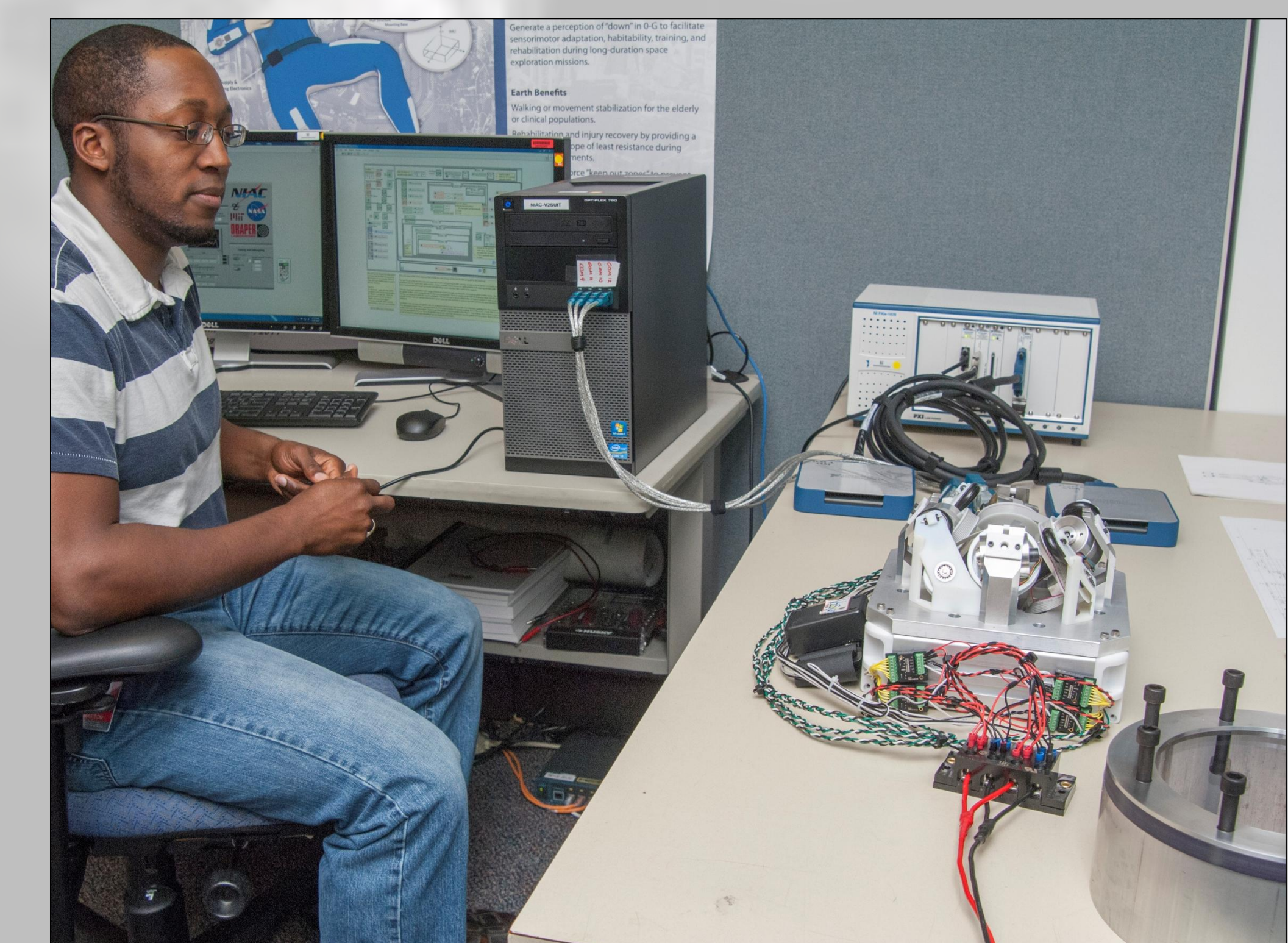
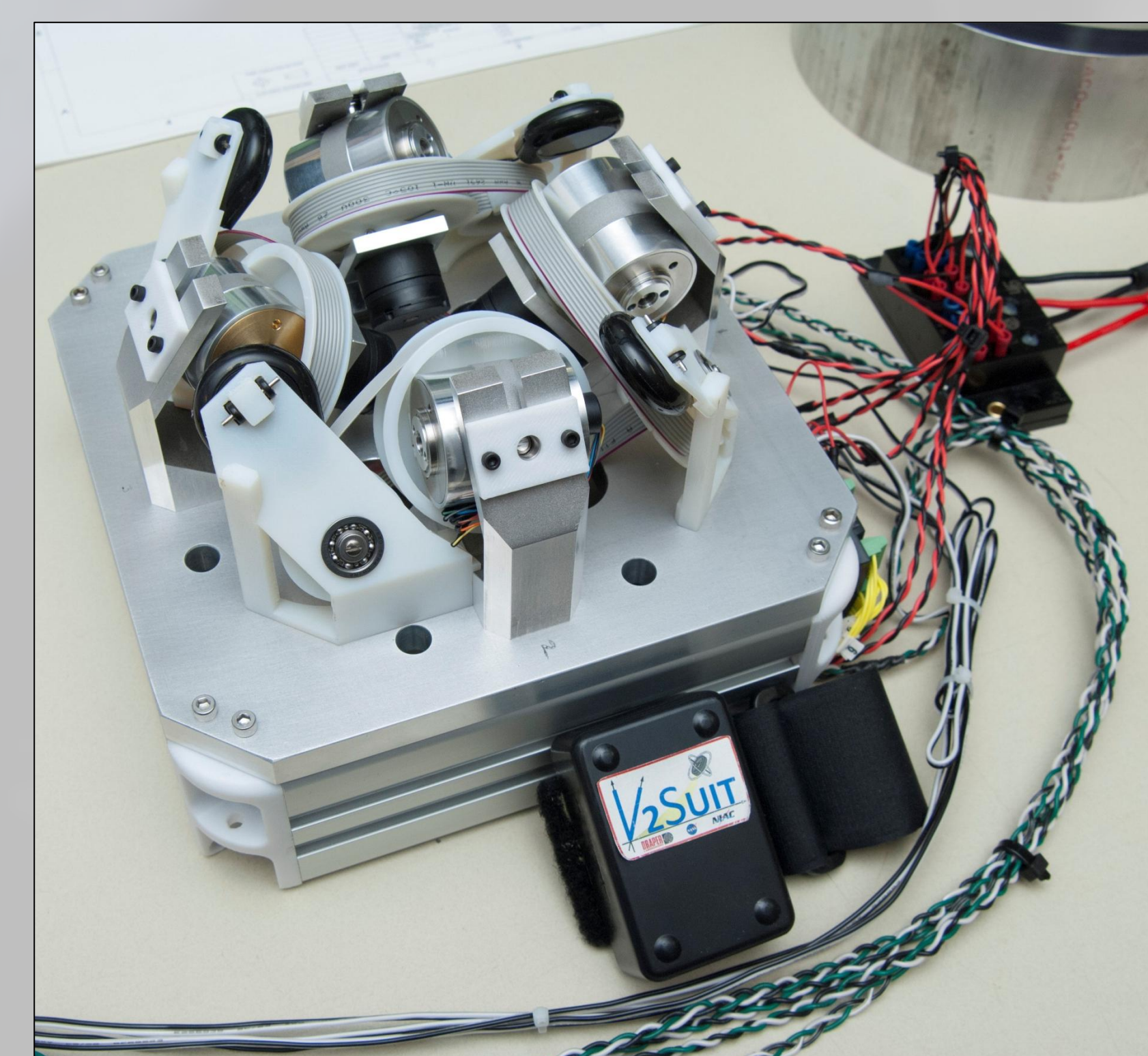


The steering laws for the array incorporate data from the onboard IMU and the “down” tracking algorithm to send gimbal rate commands which point the gyroscopic torque vector in the desired direction.

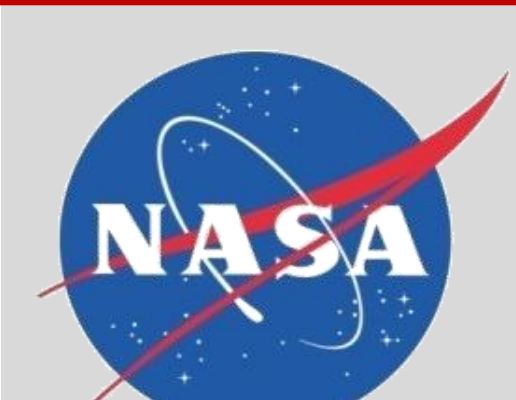


V2SUIT PROTOTYPE MODULE

The prototype demonstrates the V2Suit concept – closed loop control from “down” tracking to CMG actuation. Initial design of a 4-CMG array was conducted and fabricated using commercial off-the-shelf components, and custom machining when necessary. The system is controlled from a desktop computer. Evaluations demonstrated the ability to initialize and track against a specified direction of “down,” simultaneously command 4 CMGs, and that single module power consumption was 8-10 Watts during operation.



THE V2SUIT IS AN ENABLER FOR SPACE EXPLORATION MISSION TECHNOLOGIES, INCLUDING HUMAN ADAPTATION AND COUNTERMEASURES, HEALTH MONITORING, ROBOTIC INTERFACES, AND ADAPTATION AND OPERATIONS DURING ARTIFICIAL GRAVITY.



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