

**Title:** Toward an IMU-based space suit motion capture system

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**Abstract (300 word max):**

Spacesuits are complex engineering systems that sustain human health and enable performance outside Earth-like environments. These systems must support human mobility and physical workload demands while minimizing injury risk during extravehicular activity (EVA). Future EVA operations on the Lunar surface are expected to be more frequent and require higher physical workloads than previously during the ISS, Shuttle, and Apollo programs. To characterize the workloads and ergonomics needs a suit must support, the kinematics of the space suit must be measured during operationally-relevant tasks in ground analog environments.

Kinematics capture of the suit is challenging for traditional optical motion capture (OMC) approaches due to marker occlusion, harsh lighting or environmental conditions, and tests with suit surrogates in outdoor field environments. To this end, engineers at NASA are developing the *Augmented Suit Inverse Kinematics* (ASIK) system, a complete motion capture method and inverse kinematics solver which relies solely on a network of wireless inertial measurement units (IMUs) attached to the major kinematic segments of the spacesuit. The ASIK modeling language allows for the simple inclusion of probabilistic priors such as suit size and shape or IMU poses.

The ASIK system was tested in a 7-subject pilot study. Each subject donned NASA's new prototype exploration spacesuit in the Active Response Gravity Offload System (ARGOS) facility at Johnson Space Center in Houston, TX. The suits were outfitted with 12 IMUs to estimate lower body and trunk kinematics. The suits were also outfitted with a set of reflective OMC markers, and traditional OMC data was collected and processed. Characterization of the ASIK-derived suit joint angles' accuracy against an optical motion capture datum will be presented. Discussion of these results, as well as discussion of system calibration and nuances of mathematical observability, will be included.