Exploratory Study of Internal vs. External Motion Capture of Space Suits

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BACKGROUND

- Scientists and astronauts are making amazing discoveries and our technologies to do that keep getting better
- Space suits used to make these discoveries have improved a lot
- A safe, efficient space suit is essential to space travel and study
- There are many factors that must be considered in making sure a space suit is safe and works well for the astronauts
- There are also some problems we must consider when testing and preparing a suit

Problem

- Movement of a spacesuit, is different from the movement inside of the suit.
- Currently, it is difficult to measure movement inside of the spacesuit
- External movement can be captured by traditional motion capture systems
- The issue with this is that the long-term effects of operation of a space suit need to be assessed in order to determine possible injury effects of operating a suit.

Exploratory study

The current study has two goals

1. Test an inertial motion capture system to assess movement on the inside of a spacesuit.
2. Explore possible variables of interest for suit and operator performing standard work envelope and range of motion testing.

   Comparisons between:

   I. Unsuited operator
   II. Suited Operator kinematics
   III. Suit Kinematics

Test Suit

NDX 2 Analogue Suit

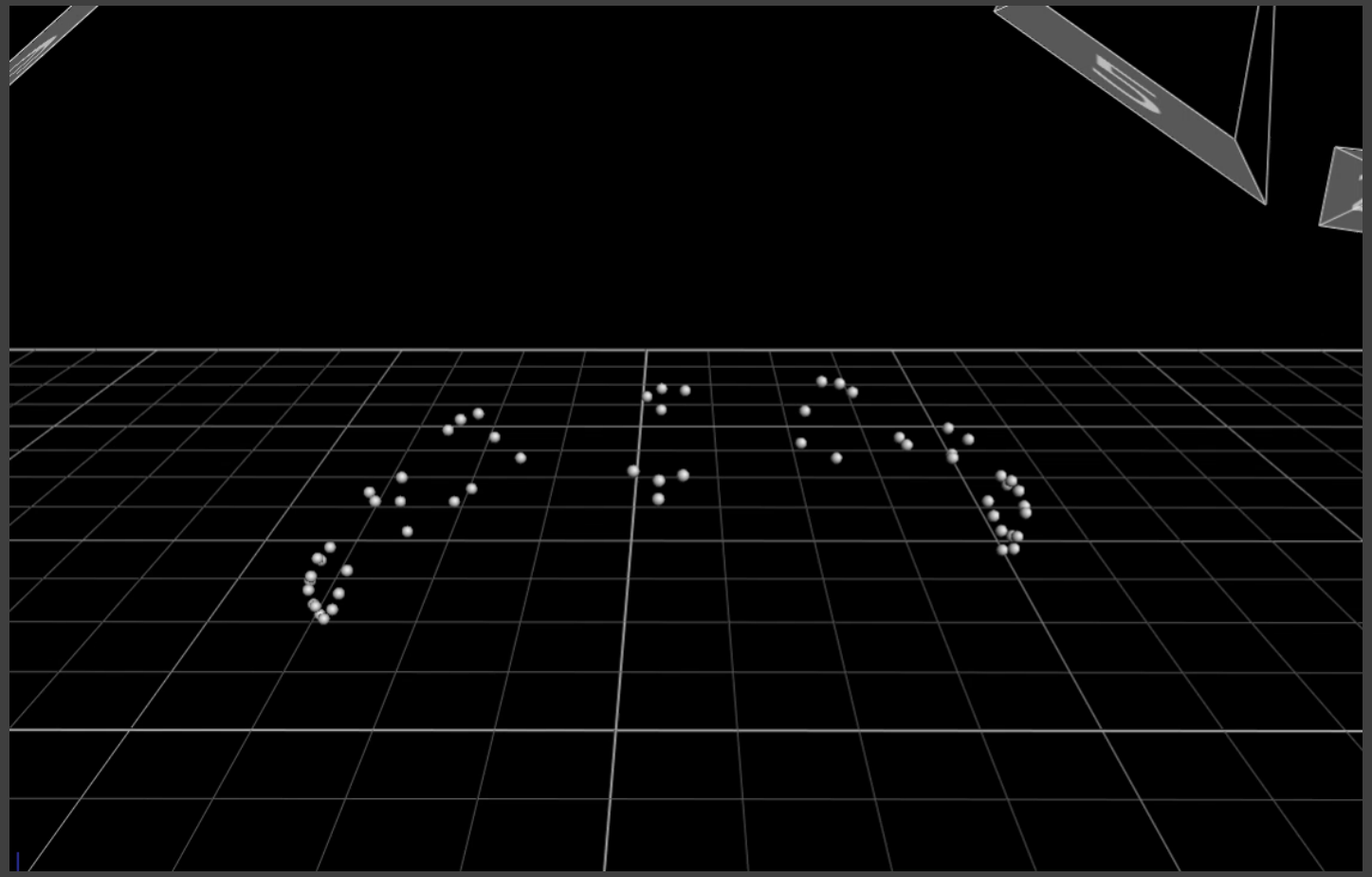
Vicon Motion Capture

- Traditional Reflective markers

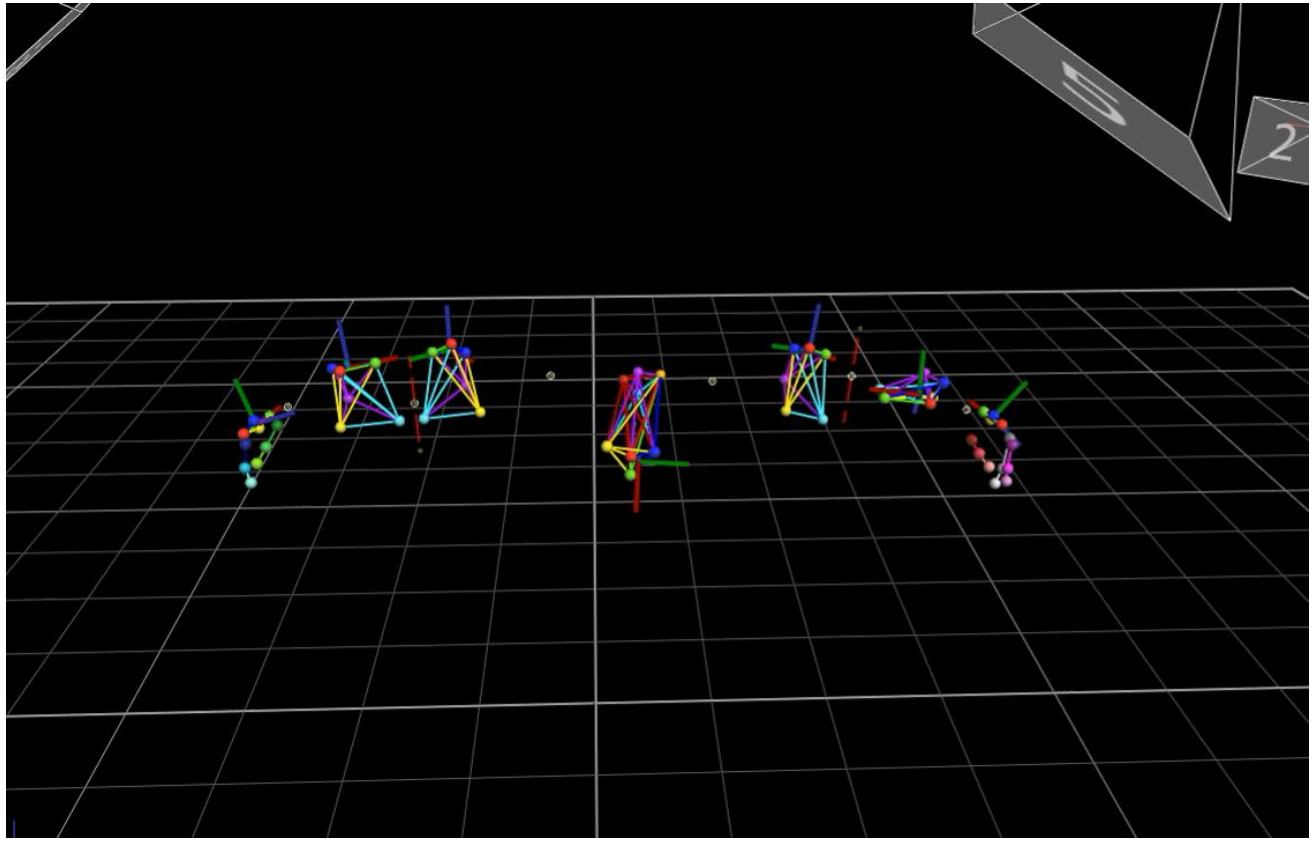
Xsens (Inertial Motion Capture System)

- Relatively new technology allowing for the collection of motion capture data without cameras or extensive laboratory equipment.
- More importantly for this study it will fit within a spacesuit.

Instruments

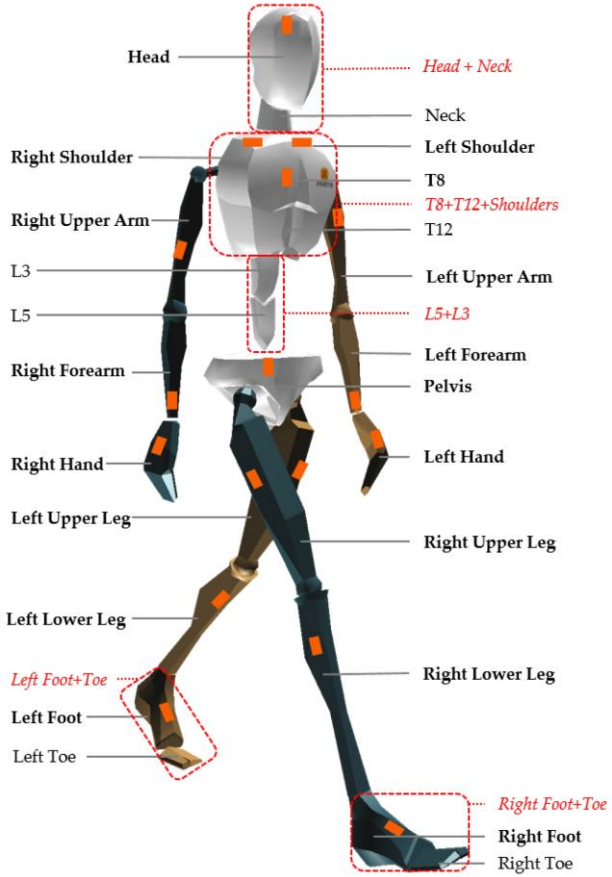


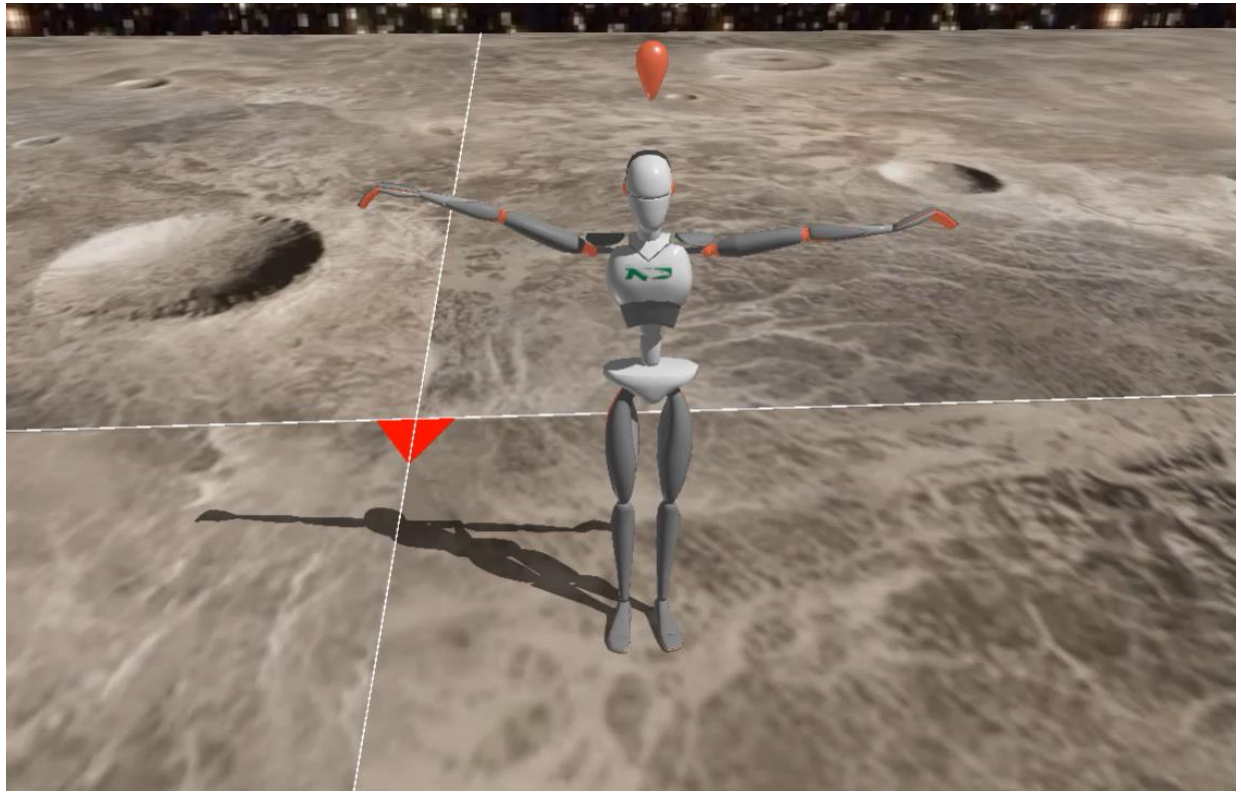
Vicon Motion Capture



Vicon Motion Capture

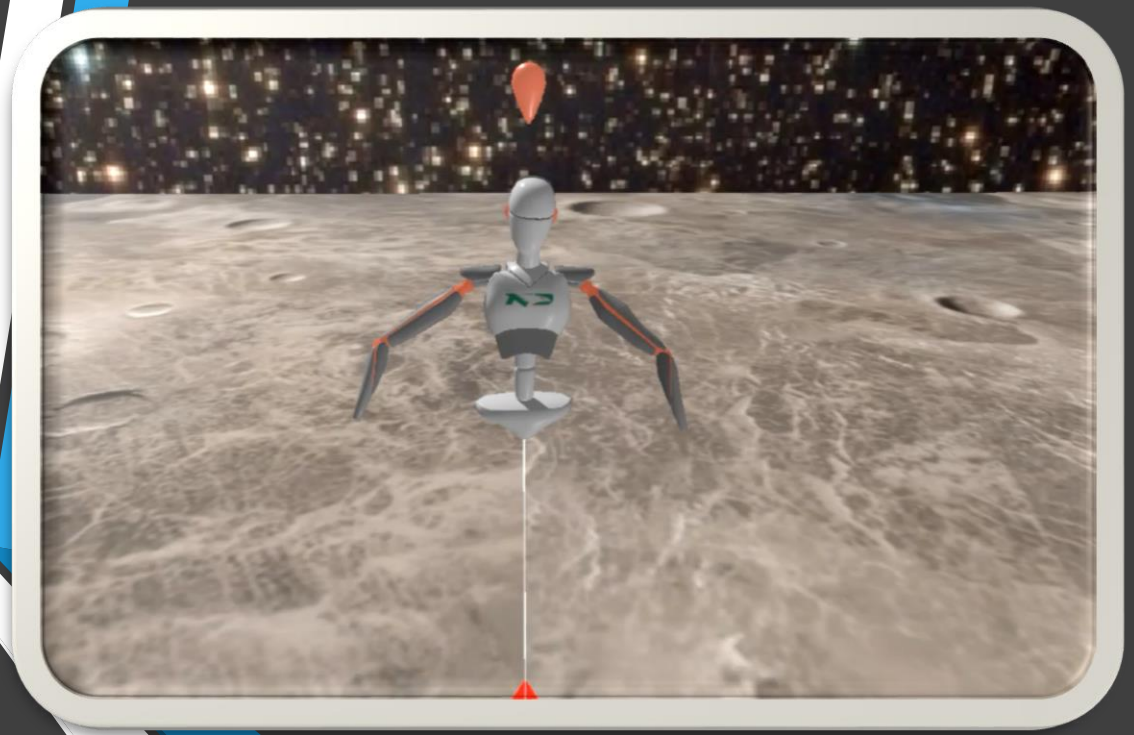
Joint Centers Calculation





Xsens Motion Capture

Capture of full-body motion with no cameras allowing for kinematics within the spacesuit to be accurately measured



NDX space suit

Collection

- Series of movements with xsens motion capture system
- Series of movements with Vicon motion capture system
- Series of movements with space suit and xsens motion capture system
- Series of movements with space suit and Vicon motion capture system

Progress

- Tested 5 volunteers over the course of two weeks
- Came across a few problems with the IMU system
- Processing the data
- Tests worked as a protocol for the Final Frontier Design Space Suit

Things I'm Learning Because of This Project

Gaining Knowledge About:

- The Research Process
- Institutional Review Boards
- Research Problems
- Motion Capture Systems
- Data Processing
- Cameras

Life Skills:

- Instructing Volunteers
- Communication
- Thinking Deeply/Thinking Outside the Box
- Working With Others