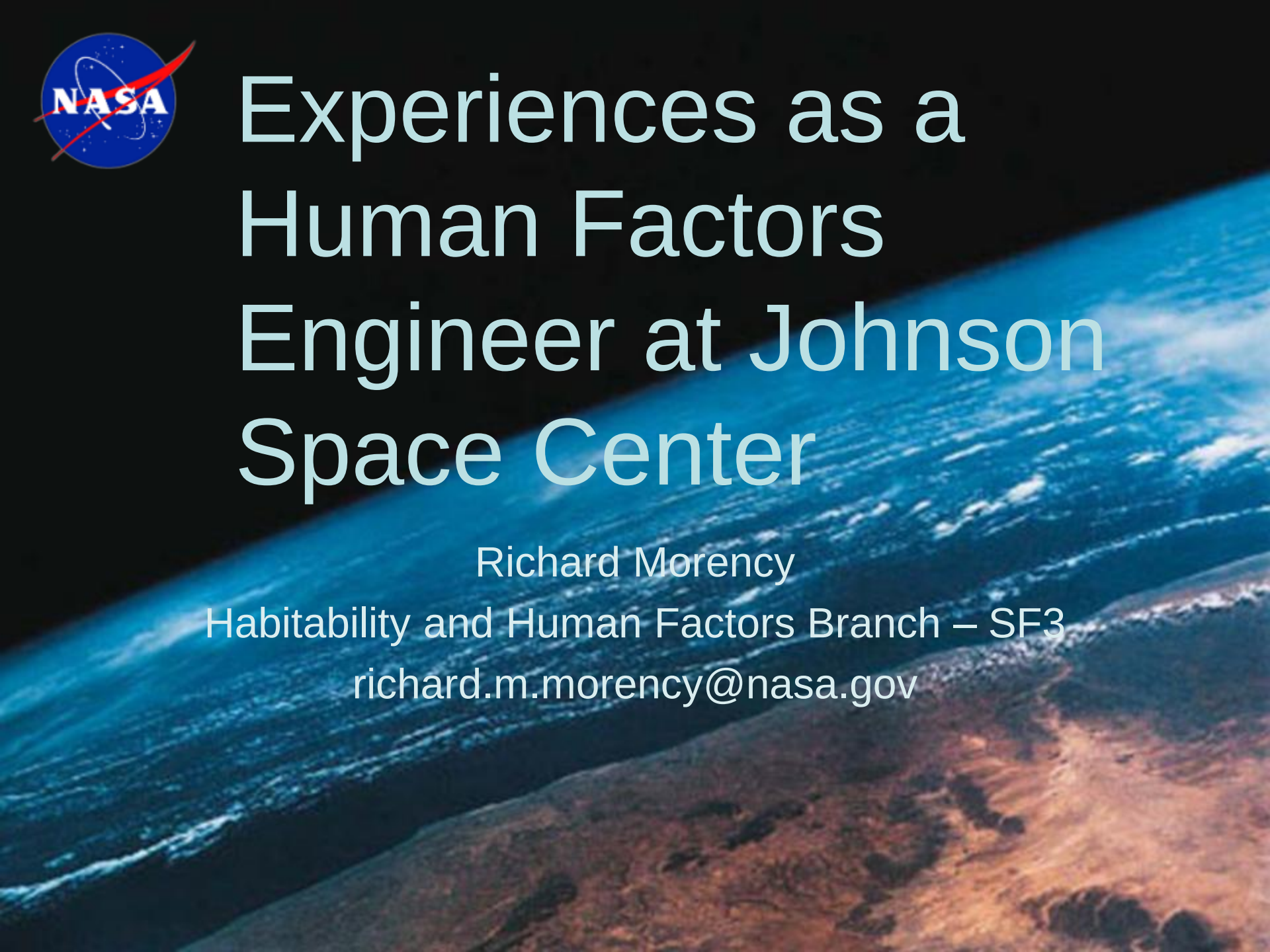


Experiences as a Human Factors Engineer at Johnson Space Center

Richard Morency
Habitability and Human Factors Branch – SF3
richard.m.morency@nasa.gov

A little about me

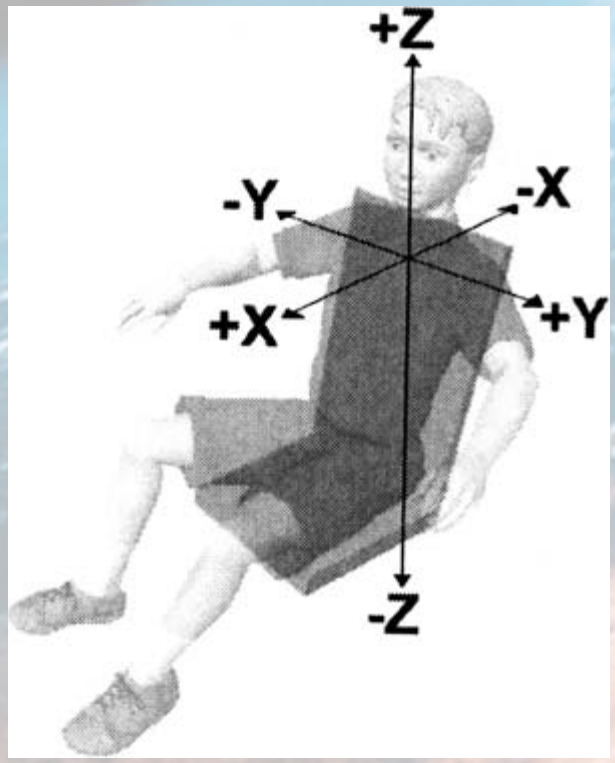
- Roller Coaster Enthusiast
  - (ridden over 250 worldwide)
- Musician
  - Saxophone, Bass Guitar, Drums
- Distance Runner
  - 5 marathons completed, including 1 Abbott World Marathon Major
  - In training for Berlin 2019, Houston 2020
  - In lottery for London 2020
- Private Pilot
  - Own a 1974 Cessna 182P Skylane
  - Working on instrument rating

How did I get into Space Human Factors?

- Researched roller coasters in undergrad, grad school

How did I get into Space Human Factors?

- So how did I end up at NASA?
- Forces!



So what work have I done at NASA?

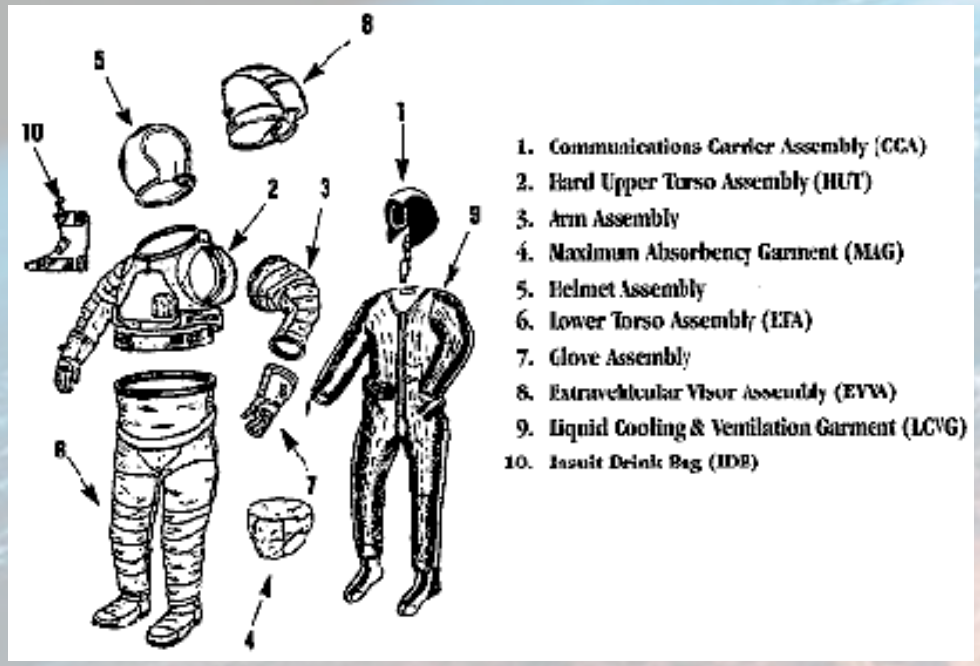
- Space Suit Fit
- Motion Analysis
- 3D Volumetric Worksite Analysis
- Orion Displays & Controls

Space Suits

- Current US Space Suit
  - EVA (Spacewalking): EMU (Extravehicular Mobility Unit)

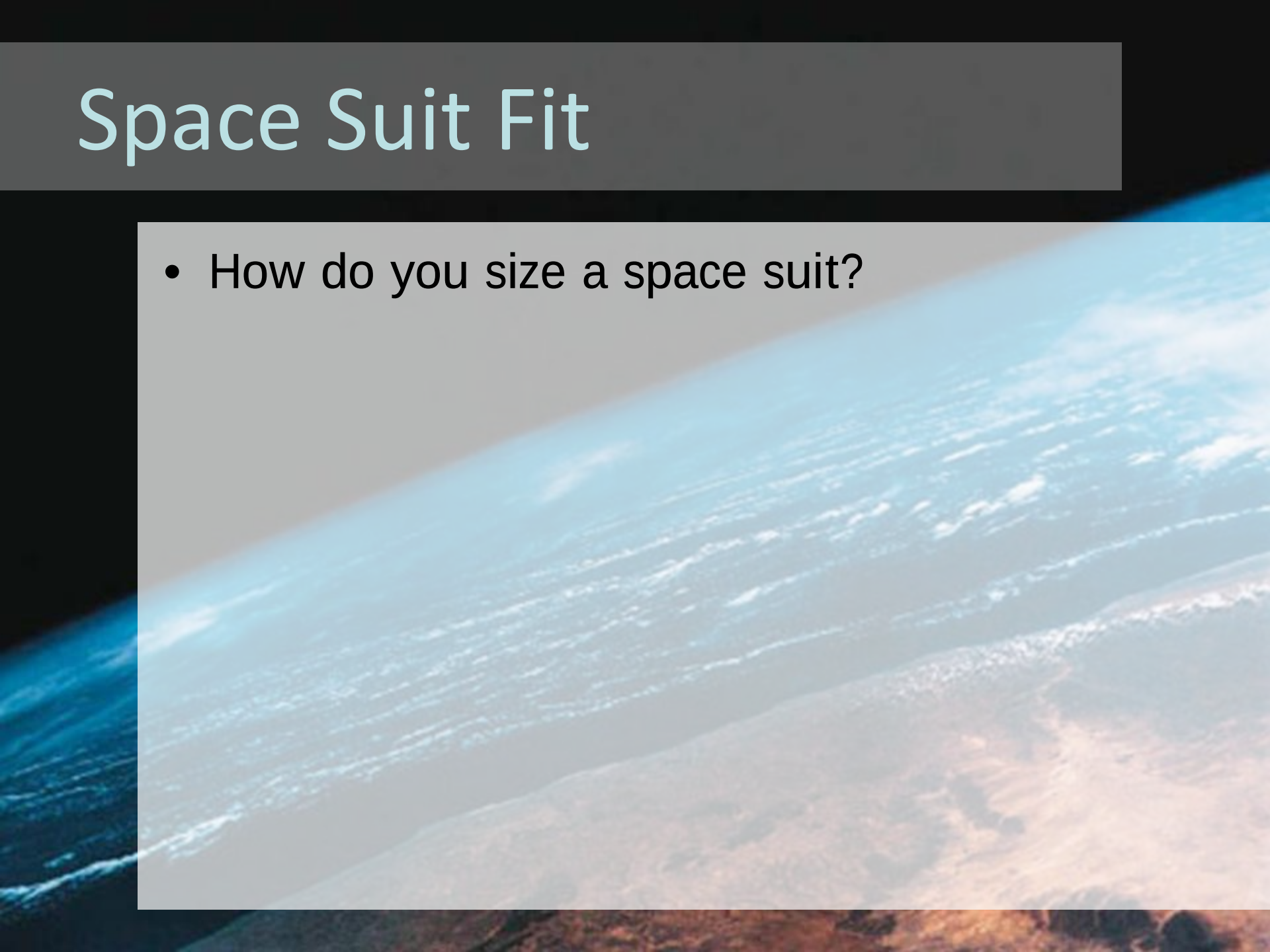
Space Suits

- Parts of a (spacewalking) space suit
  - Suit Components: Arms, Legs, Chest, Helmet



Space Suit Fit

- How do you size a space suit?

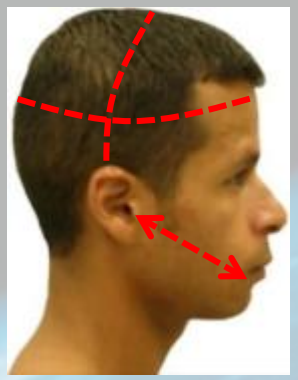


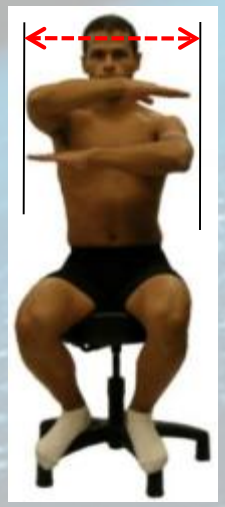
Space Suit Fit

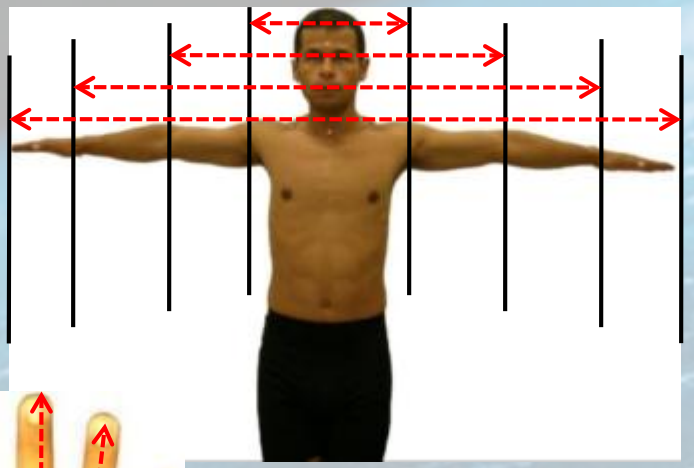
- Going to a tailor – common measurements
  - Men – generally about 8 - 20 measurements
  - Women – generally about 8 - 24 measurements

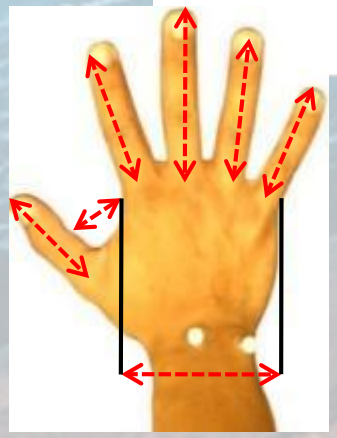
Space Suit Fit

- But what about a space suit?
  - 118 measurements









Space Suit Fit

- Custom-made suits?
  - Yes…for everything before the shuttle

Space Suit Fit

- Mix-and-Match
  - Cost
  - Storage Space
  - Repair

Motion Analysis

- Who uses this technology?
  - Movie Studios (Polar Express, Iron Man, Avatar)

Motion Analysis

- Who uses this stuff?
  - Movie Studios (Polar Express, Iron Man)
  - Video Games (Madden, MLB 2kX, Uncharted)

Motion Analysis

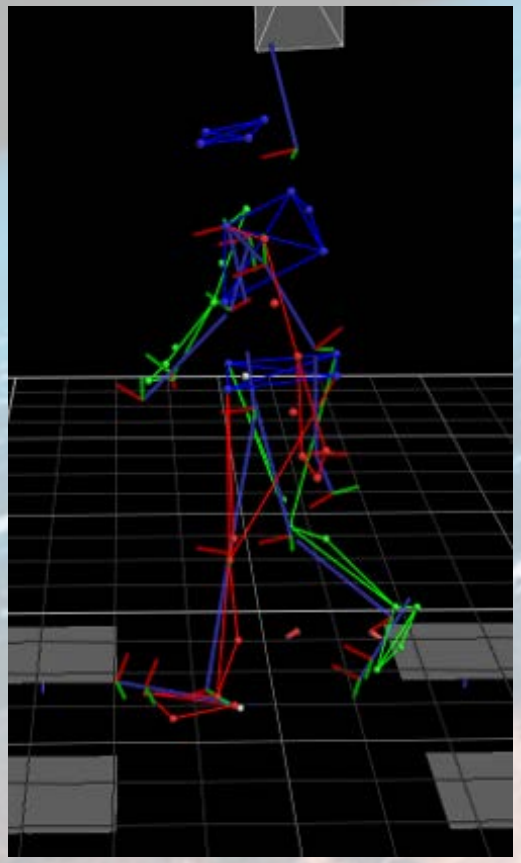
- Who uses this stuff?
  - Movie Studios (Polar Express, Iron Man)
  - Video Games (Madden, most other sports games)
  - Medical Research

Motion Analysis

- How does it work?
  - Retroreflective markers
  - Specialized Cameras

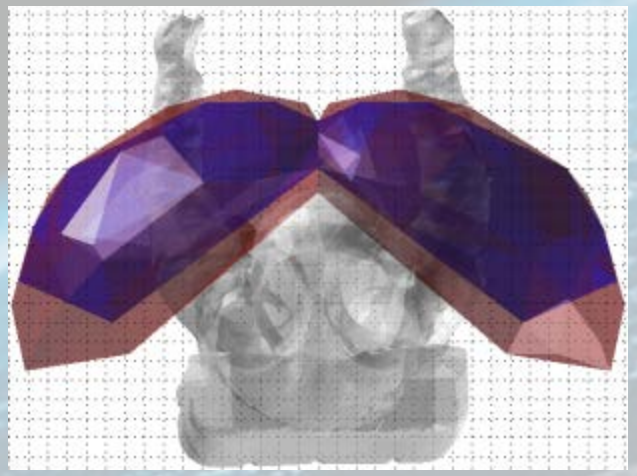
Motion Analysis

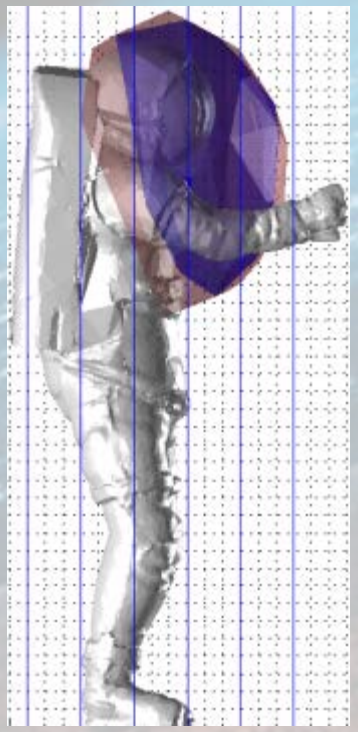
- Points stored on computer – tells us 3D location of each marker

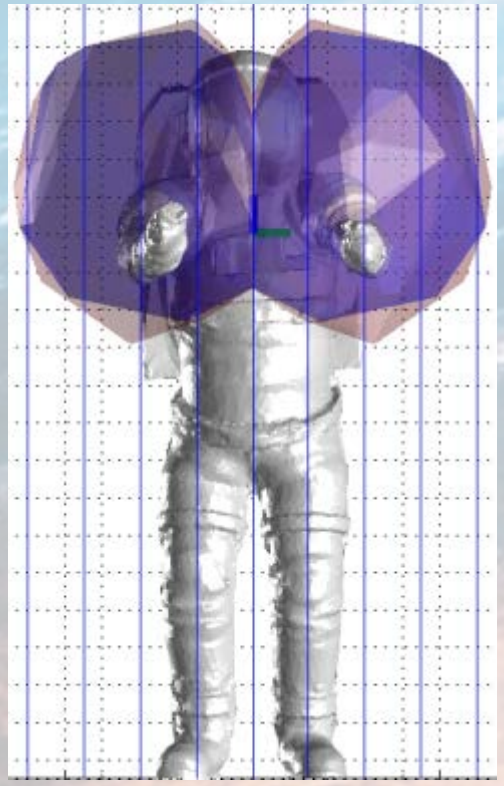


Motion Analysis

- This can tell us many things!
  - Where a person has to reach to do a task

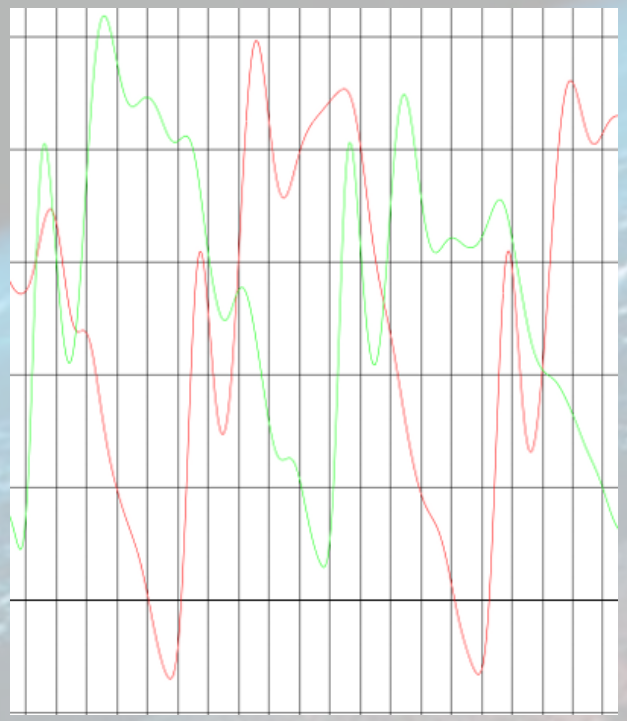


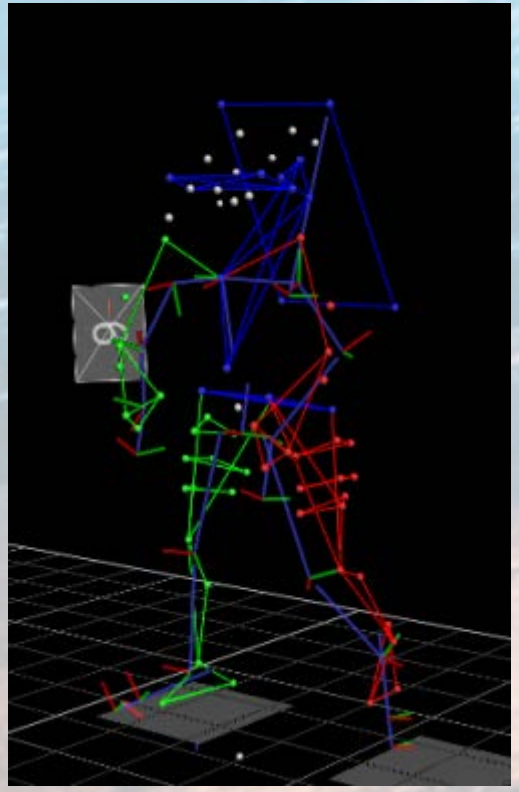




Motion Analysis

- This can tell us many things!
  - How much a joint moves in the space suit





Motion Analysis

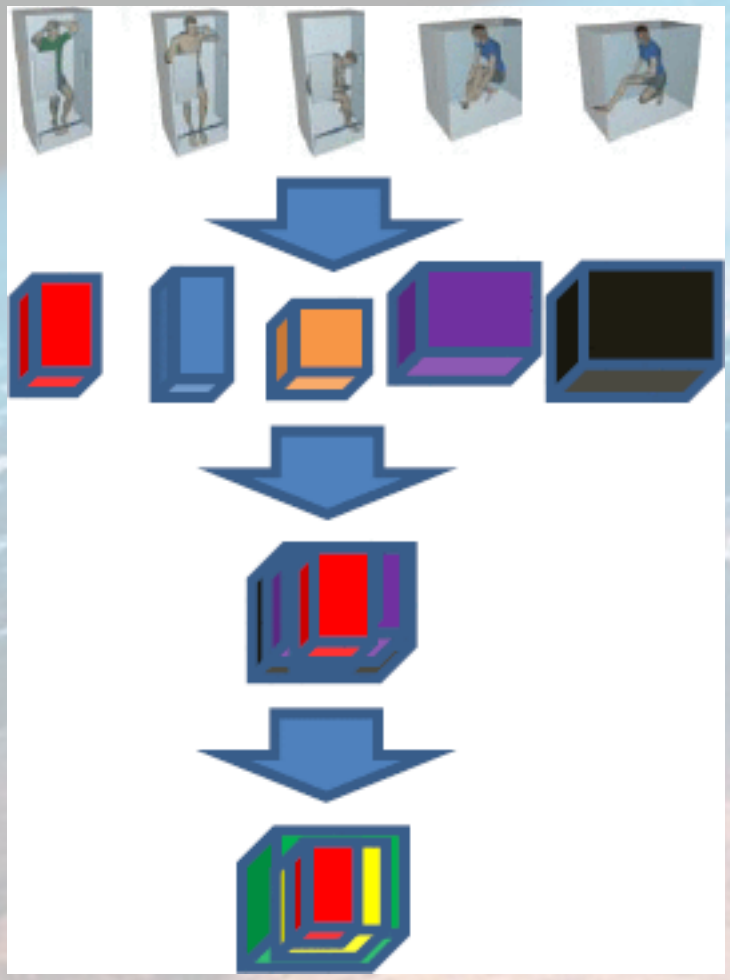
- Information is used to help engineers design a new suit

3D Volume Optimization

- SOLV – Spacecraft Optimization Layout and Volume
  - Attempts to model an optimum layout of a conceptual spacecraft habitat
  - Can contain multiple ‘zones’: sleep, exercise, medical, hygiene, multipurpose
  - Minimizes total volume while maximizing volume for each zone

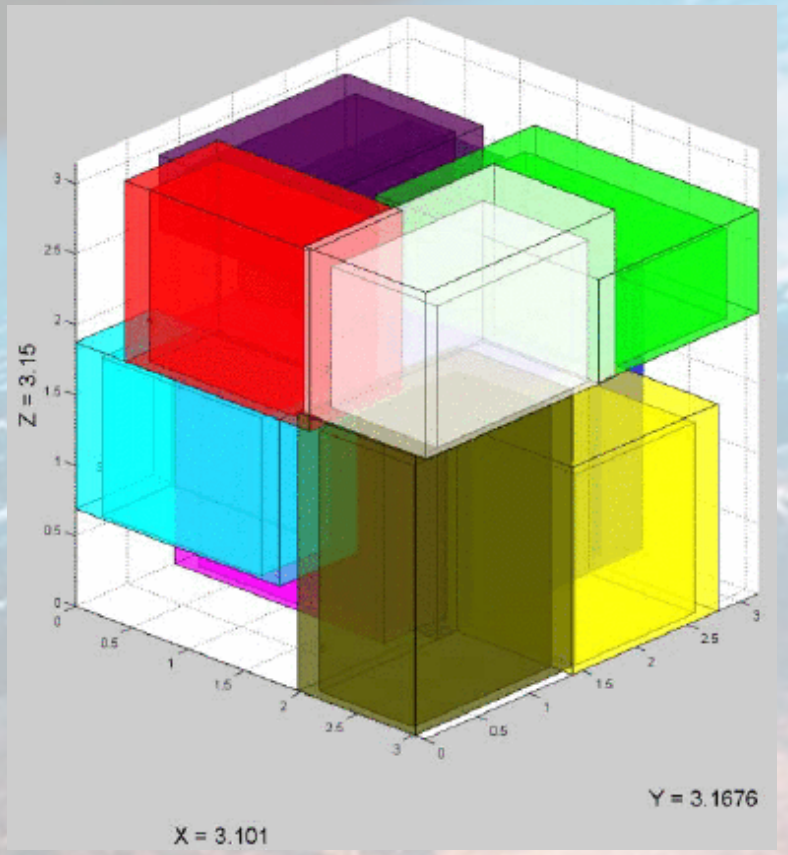
3D Volume Optimization

- First, determine most likely tasks for each zone
  - Exercise: treadmill, resistive exercise device, etc.
- Overlap tasks to create single rectangular volume



3D Volume Optimization

- After multiple individual zones created, optimize layout using scientific optimization software
- Allow some overlap between zones
  - Not all will be occupied simultaneously



Orion Displays & Controls

- Work closely with the Rapid Prototyping Lab (RPL)
  - Quickly create hardware mockups using 3D printing, off-the-shelf components, in-house-developed software
  - Create prototype software that can be handed over to prime contractor for production
  - Work with flight software systems experts to determine what is shown on display screens

Orion Displays & Controls

- Crew Evaluations
  - Depending on complexity, bring between 3-10 astronauts into the lab to try various displays
  - Can be looking at static displays or fully interactive scenario
  - Record feedback on usability, layout, ease of use
  - Feed comments back to display designers
  - Rinse, repeat.

Orion Displays

Mission Complete

Any questions?

Feel free to contact me

richard.m.morency@nasa.gov

(281) 244-0113