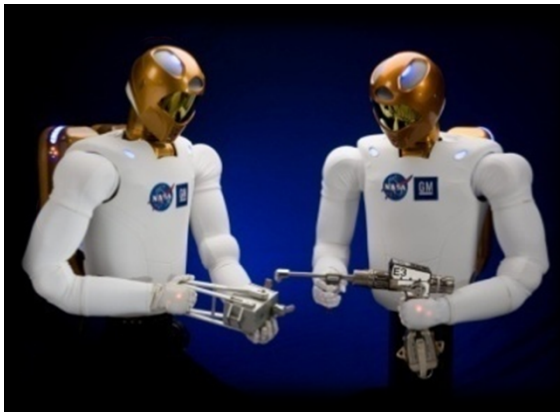




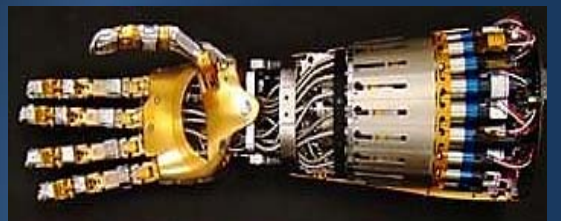
NASA/JSC Exoskeleton Technology

Robotic Systems Technology Branch

02/26/2014



Robonaut2 is creating
new possibilities for
how we live and work in
space





Through key partnerships
exoskeleton technology derived from
Robonaut2 is also improving how we
live and work here on Earth

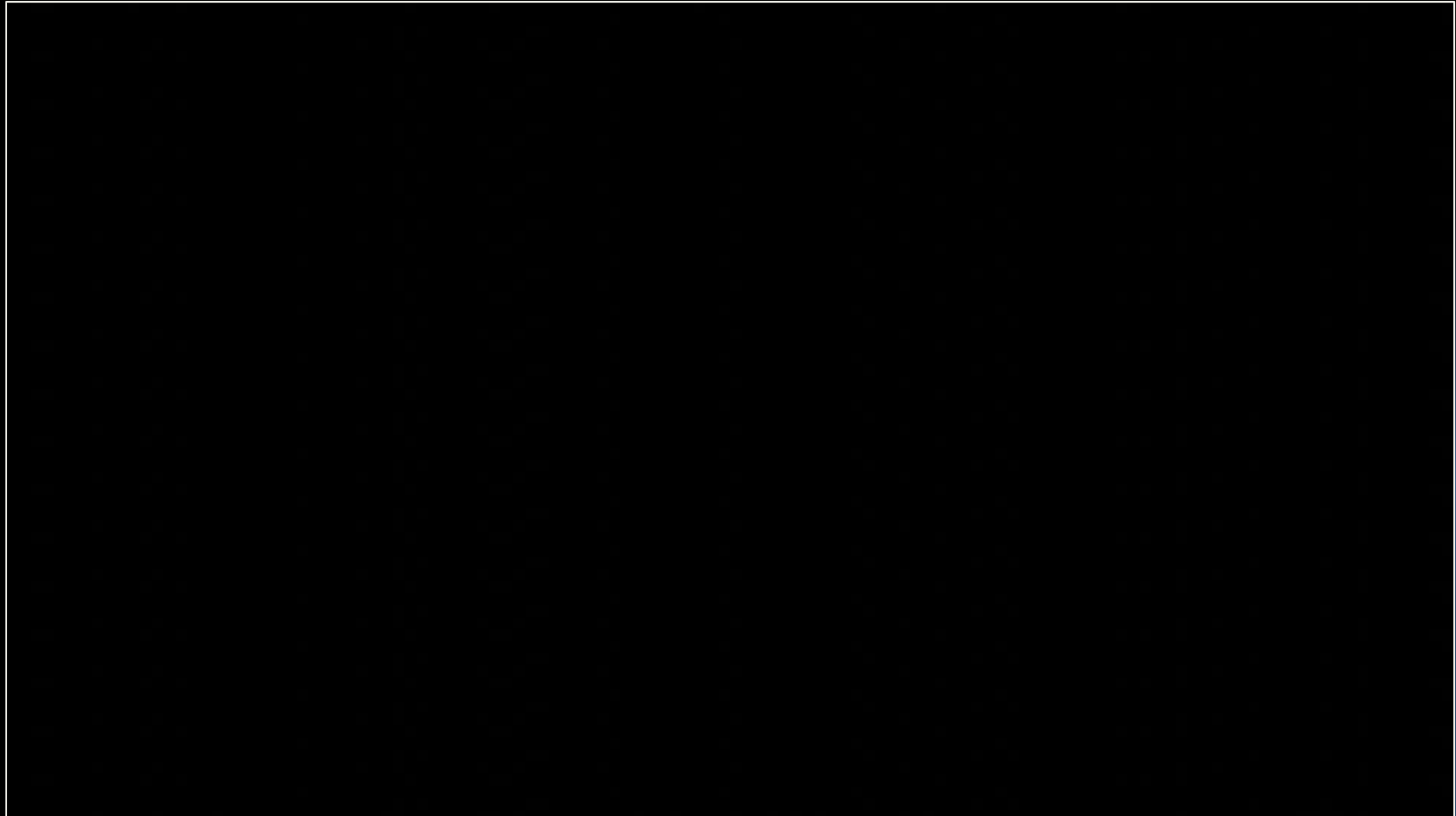




NASA Wearable Robotics -
Bringing humans and robotics
together in unique ways



X1- Exoskeleton





X1- Exoskeleton

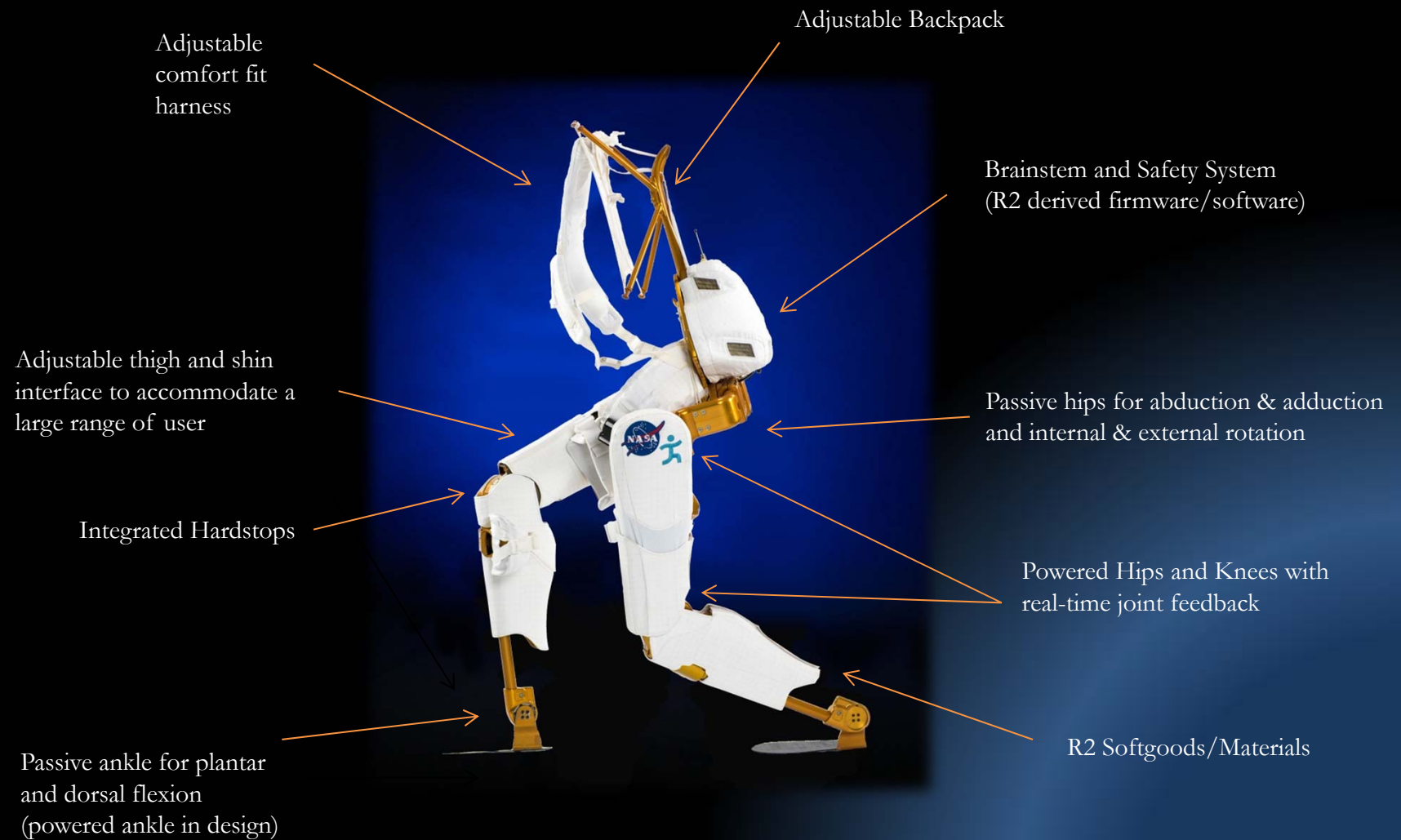


- Co-developed with Institute for Human and Machine Cognition (IHMC)
 - Robonaut2 joint and control system technology spinoff
 - NASA applications
 - Exercise (rich data collection)
 - Dynamometry
 - Strength augmentation
 - Medical applications
 - Assistance for persons with paraplegia
 - Rehabilitation (rich data collection and fine control)
 - BMI (EMG/EEG)





X1

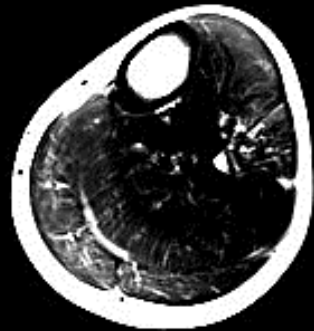




Exercise/Dynamometry

- Powered ankle evaluated as an exercise device
 - MRI T2 analysis
- Formal dynamometry studies have been performed with multiple test subjects
 - Knee and ankle

MRI: right calf cross-section



Pre-exercise



Post-exercise





Medical Applications

- Assisted Mobility
- Rehab/BMI

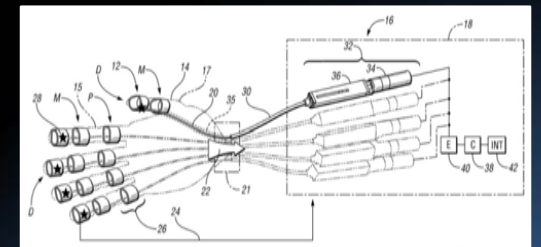




RoboGlove



- Co-developed with General Motors
 - Robonaut 2 hand technology spinoff
 - NASA applications
 - Reduce spacesuit glove resistance
 - Industrial applications
 - Reduce fatigue, ergonomic stress
 - Augment workers on reduced duty
 - Medical applications
 - Assistance for persons with spasticity due to stroke or weakness due to injury
 - Evaluated by subjects at Palo Alto VA



Grasp Assist Concept





Additional Activities

- Telemedicine with R2
- Exo expansion to include ankle
- Foot force/pressure sensing
- Warrior Web for upper body rehabilitation