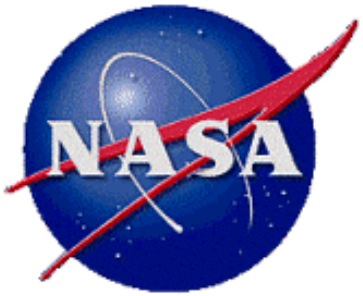
VALKYRIE, NASA'S NEW HUMANOID



Nicolaus Radford, NASA
Valkyrie Project Manager

Welcome

NASA – Johnson Space Center

- ER- Software, Robotics and Simulation
  - ER4 – Robotic Systems Technology Development Branch

Robotics Challenge Team Bunker

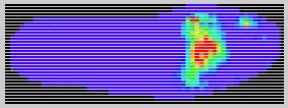
Design and Development

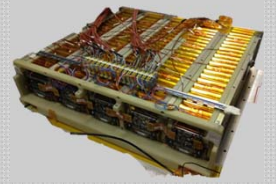
Hand Electronics derived from RoboGlove

Hip and knee actuators derived from X1 Exoskeleton

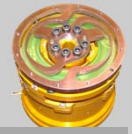
Motor Controller is an improved version of R2 Climbing Legs and X1 Exo

Force Sensing Shoe is derived from X1 Exoskeleton shoe

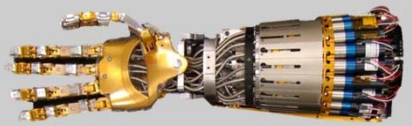




Battery and BMS based off R2 battery for International Space Station



Arm Actuators derived from R2 Robonaut - improved SEA design

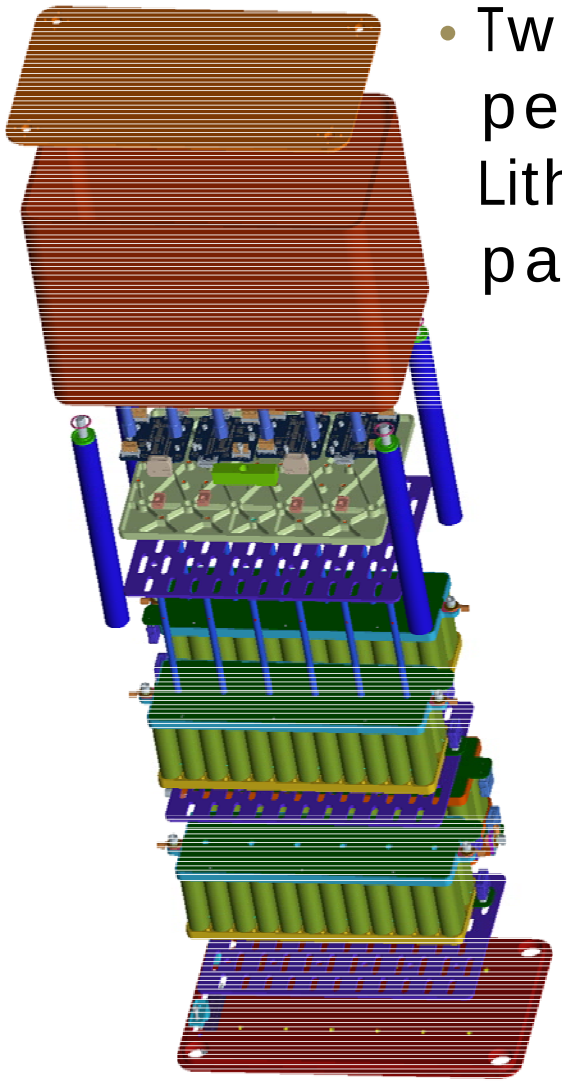


Hand derived from R2 hand

Valkyrie (‘Val’)

- 44 Degrees of Freedom
- 2 KWhr Battery
- 3 Core i7 Computers
- 1 Carma GPU
- 3 IMUs
- 3 LIDARs
- 2 6-axis Force/Torque
- 2 Pressure Sensing Shoes
- 2 3-axis accelerometers
- 4 Digital HD Cameras
- 6 Depth Map Cameras
- 10 single-axis force sensors
- 44 Motor Controllers
- Wifi Enabled

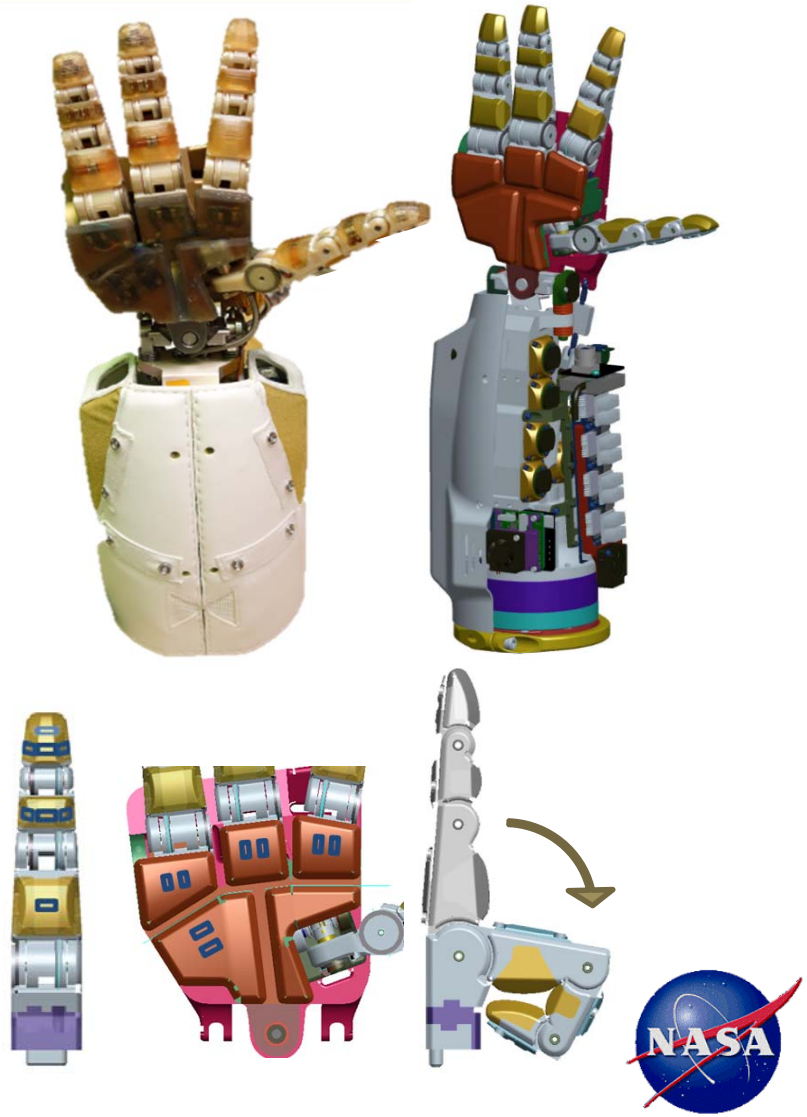
Energy Storage System



- Two high performance Lithium Ion battery packs.

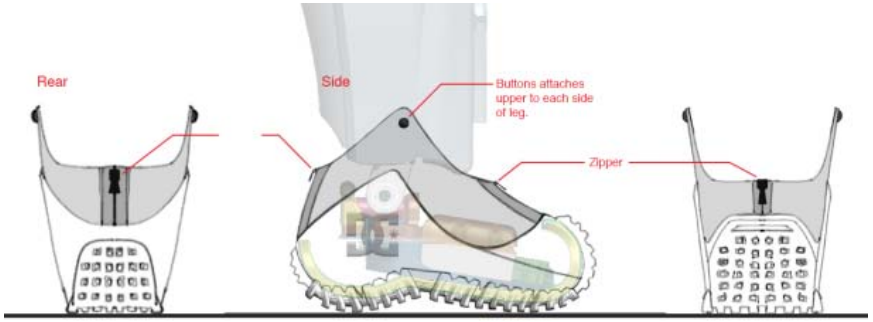
Design and Development Forearm and Hand

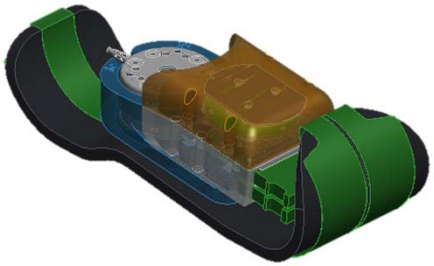
- Small integrated and light weight structure:
  - 3.6 Kg,
- Joint torque control, series elastic wrist roll
- Two modular four axis motor driver and system control nodes
- One single axis motor driver and power distribution node
- Single sensor collection node
  - 24 hand tactile sensors distributed throughout fingers and palm
  - 13 joint position sensors
  - Three axis accelerometer and gyro

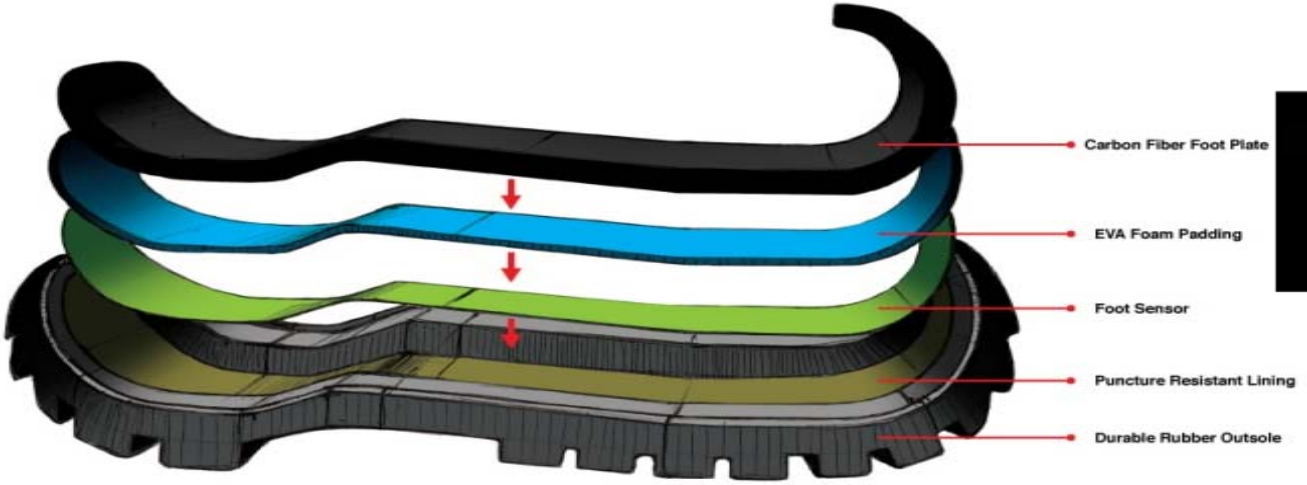


Design and Development
Modular, Flexible, Force-Sensing Foot

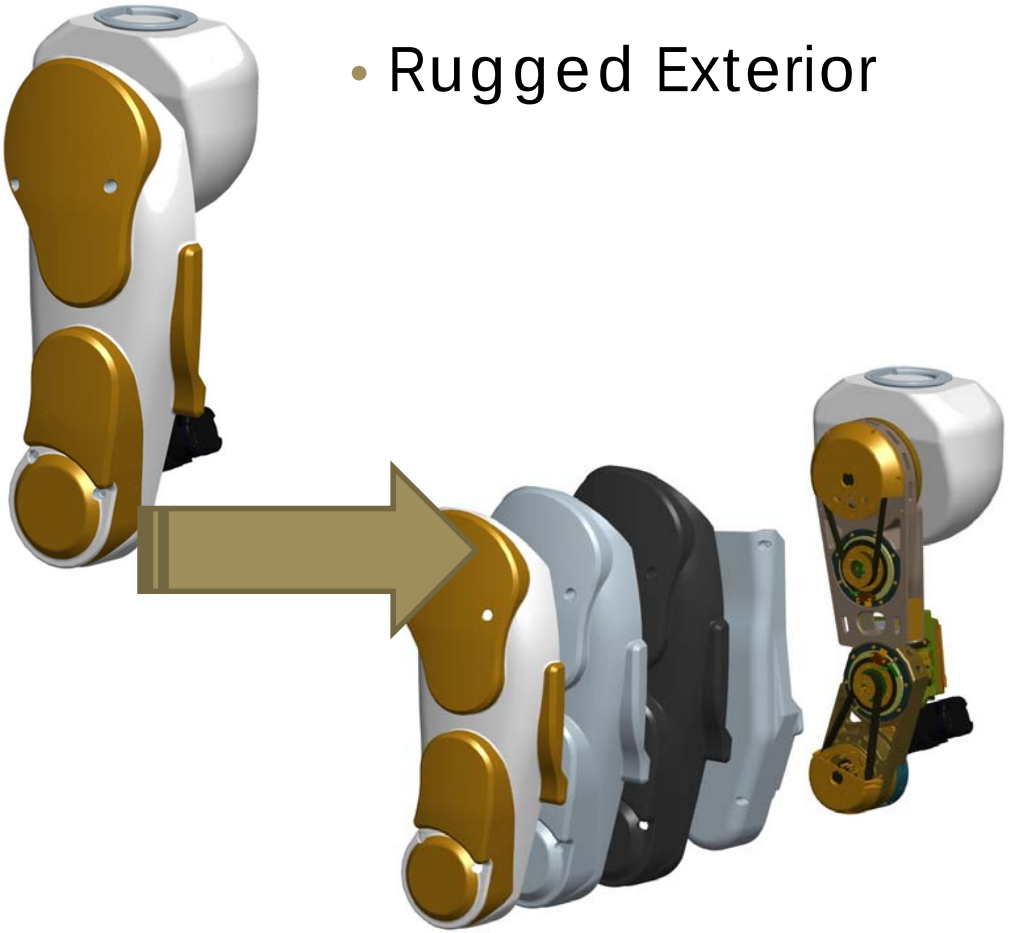
- Integrated sensors
  - 6 axis force transducer bellow ankle
  - Contact sensor array across sole of foot
  - 3 axis accelerometers and gyro
- Carbon fiber foot plate
  - Flexibility for foot roll
  - Spring for heal strike and toe off







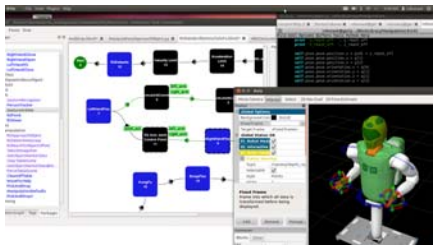
Design and Development
Fall Protection



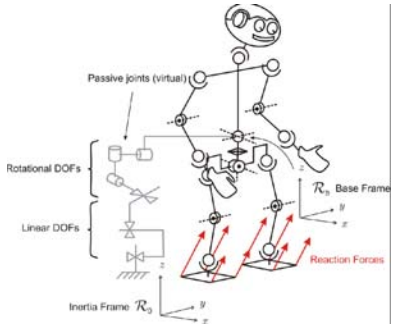
- Rugged Exterior

Software and Control

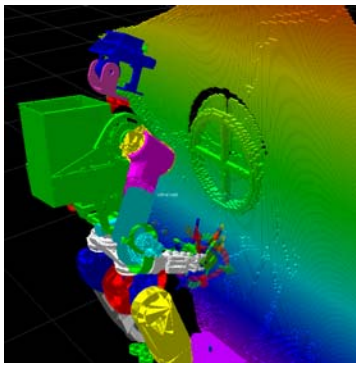
Gazebo – Existing simulation framework geared toward robotics



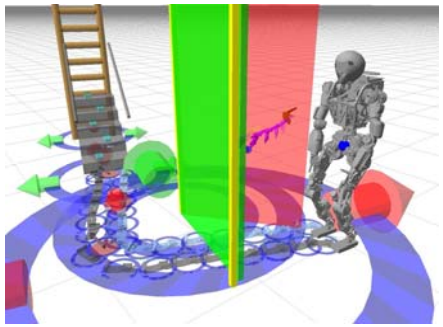
Extended RTC for real-time, localized application development suitable for writing high-performance control-programs



Improved and generalized R2's control scheme using Whole Body Control



Rviz for operator awareness and data visualization



Affordance templates built on top of ROS' interactive marker system

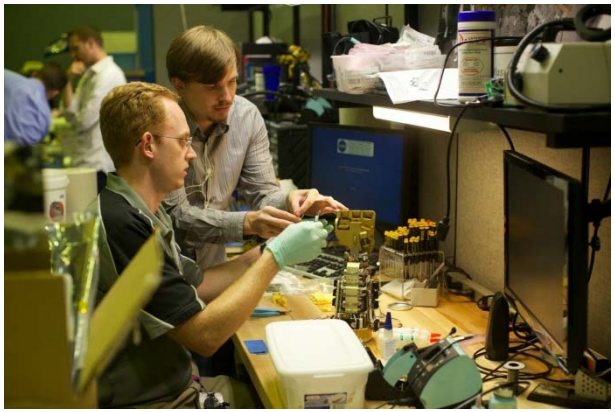
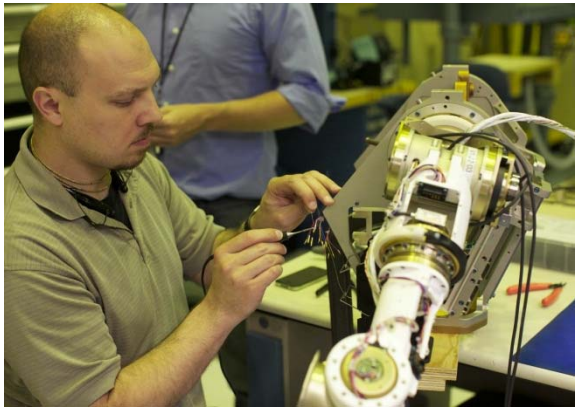
Use of proven perception hardware and algorithms

Robot Skills

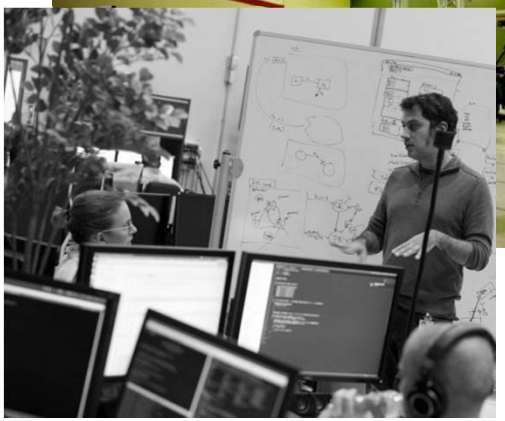
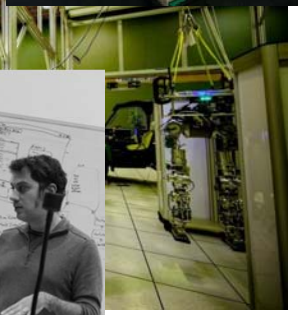
Affordance Templates

Car Ingress

Amazing Team

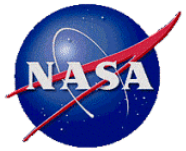





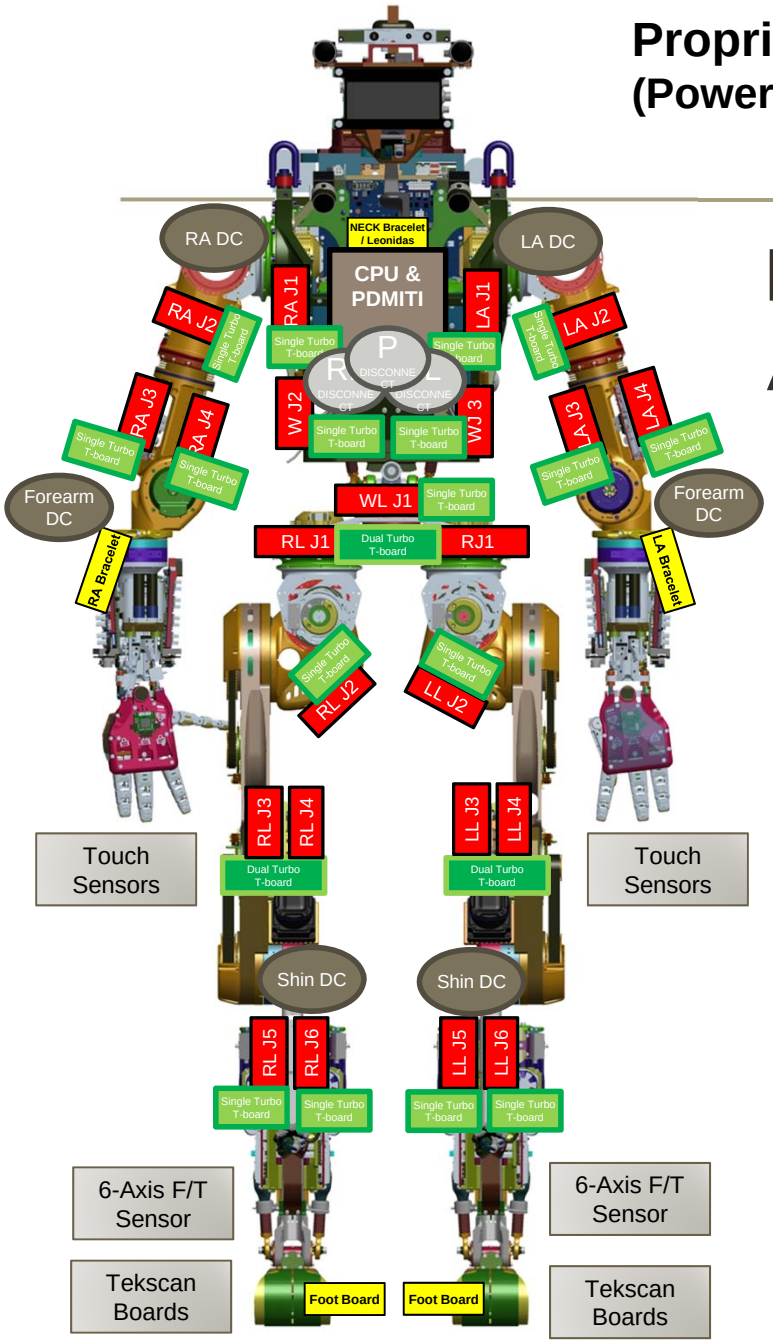





Thank
You

B a c k U p



Proprioceptive System
(Power and RoboNet enabled sensors)



Hardware Architecture

Bundle	
	HV Power (150-109V DC)
	LV Logic Power (12V-9V DC)
	24V Power (24V DC)
	ROBONET (MLVDS)
	PARALLEL COMMUNICATION (MLVDS)
	ARM SENSORS (USB)

Dual Turbo T-board

Single Turbo T-board

In-Line DISCONNECT

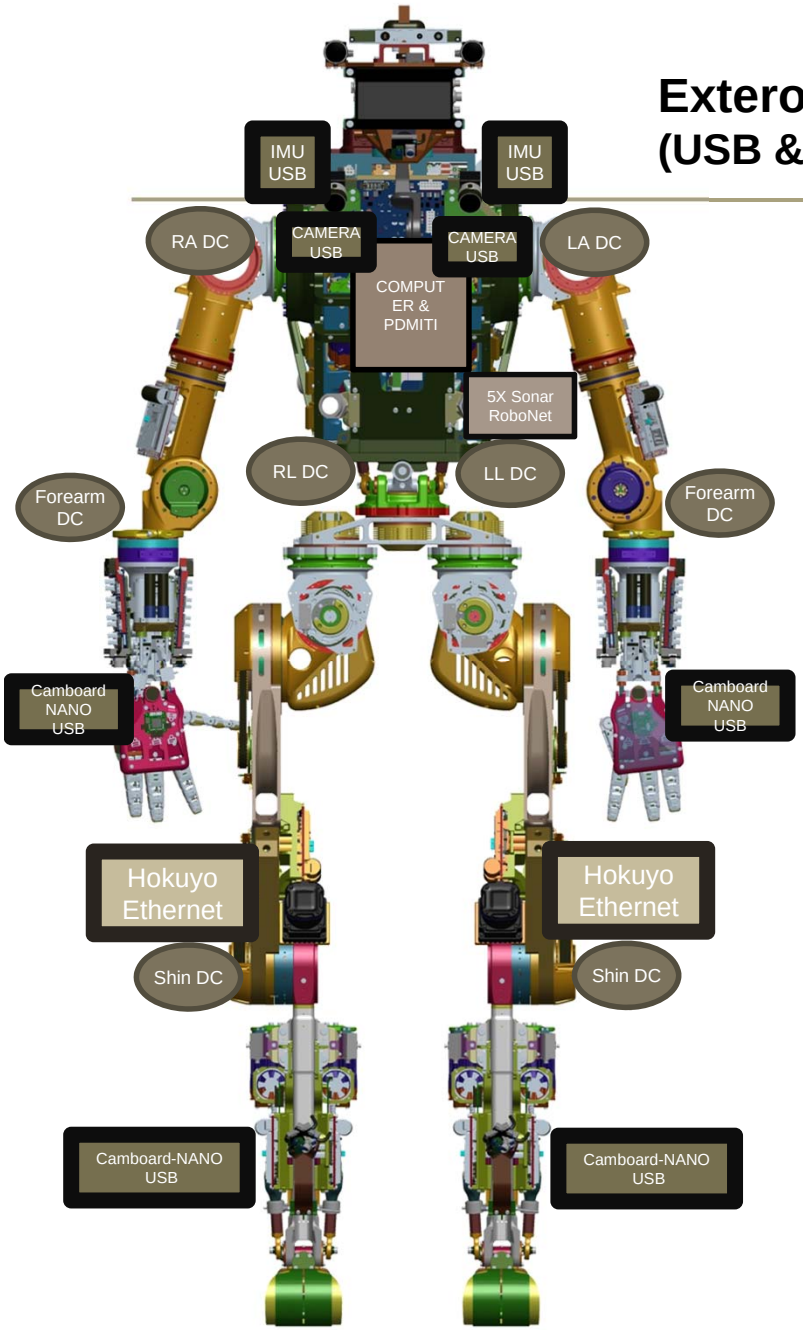
Turbo Driver Motor Controller

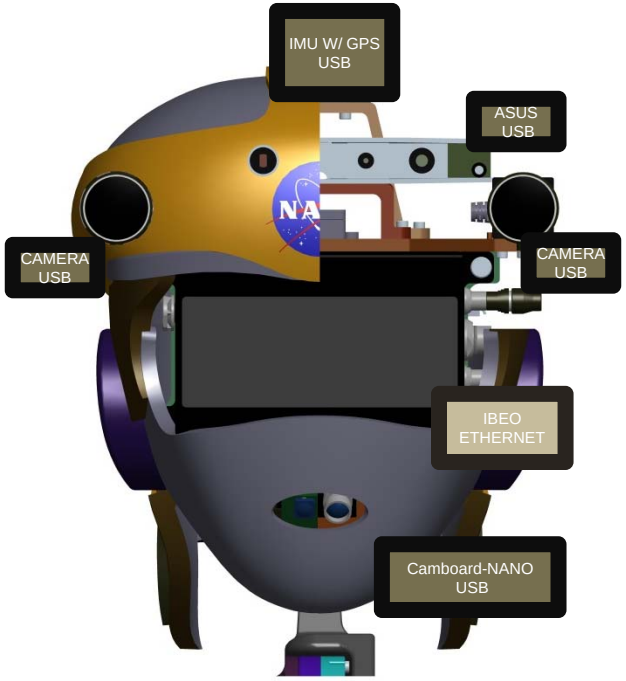
End Effector Motor Drivers / Sensor Boards

Touch Sensors

Exteroceptive System
(USB & Ethernet enabled vision sensors)

Hardware Architecture



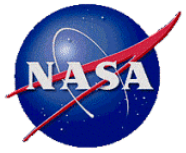


Ethernet Sensors

USB Sensors

In-Line DISCONNECT

RoboNet Sensors


NASA