Development and Deployment of Robonaut 2 to the International Space Station

Abstract:

The development of the Robonaut 2 (R2) system was a joint endeavor with NASA and General Motors, producing robots strong enough to do work, yet safe enough to be trusted to work near humans. To date two R2 units have been produced, designated as R2A and R2B. This follows more than a decade of work on the Robonaut 1 units that produced advances in dexterity, tele-presence, remote supervision across time delay, combining mobility with manipulation, human-robot interaction, force control and autonomous grasping. Design challenges for the R2 included higher speed, smaller packaging, more dexterous fingers, more sensitive perception, soft drivetrain design, and the overall implementation of a system software approach for human safety.

At the time of this writing the R2B unit was poised for launch to the International Space Station (ISS) aboard STS-133. R2 will be the first humanoid robot in space, and is arguably the most sophisticated robot in the world, bringing NASA into the 21st century as the world's leader in this field. Joining the other robots already on ISS, the station is now an exciting lab for robot experiments and utilization. A particular challenge for this project has been the design and certification of the robot and its software for work near humans. The 3 layer software systems will be described, and the path to ISS certification will be reviewed.

R2 will go through a series of ISS checkout tests during 2011. A taskboard was shipped with the robot that will be used to compare R2B's dexterous manipulation in zero gravity with the ground robot's ability to handle similar objects in Earth's gravity. R2's taskboard has panels with increasingly difficult tasks, starting with switches, progressing to connectors and eventually handling softgoods. The taskboard is modular, and new interfaces and experiments will be built up using equipment already on ISS. Since the objective is to test R2 performing tasks with human interfaces, hardware abounds on ISS and the crew will be involved to help select tasks that are dull, dirty or dangerous.

Future plans for R2 include a series of upgrades, evolving from static IVA (Intravehicular Activity) operations, to mobile IVA, then EVA (Extravehicular Activity).

Key Words:

Robot, Dexterity, Safety, Manipulation, Humanoid, Space

Mug Shot: