



# ROBOTICS



IV&V Robotics focuses on advancing the IV&V analysts' domain expertise in robotic & autonomous systems, with the objective to enhance knowledge and contribute to the IV&V goal of assuring mission and safety critical software systems. The JSTAR laboratory supports this effort by providing robotic simulations and hardware utilized for training the IV&V analysts, augmenting IV&V methods for unique robotics behaviors, and testing robotic applications.



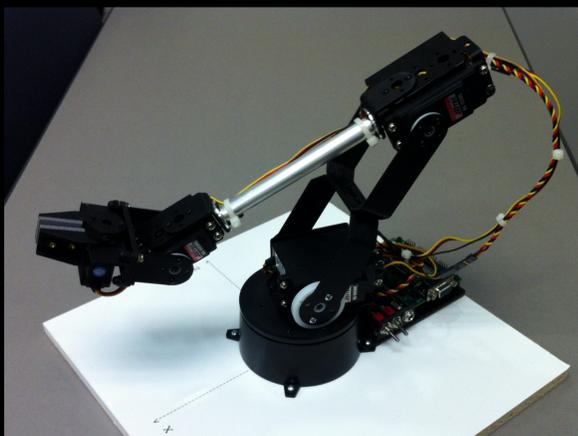
## RoverX: Mobile Robotic Platform

### Purpose:

- A robotic hands-on training tool for IV&V analysts
- An engineering test bed for:
  - Evaluating traversal, navigation, and manipulation software behaviors
  - Exploring teleoperation & autonomy
- A target system for intern and graduate student assignments

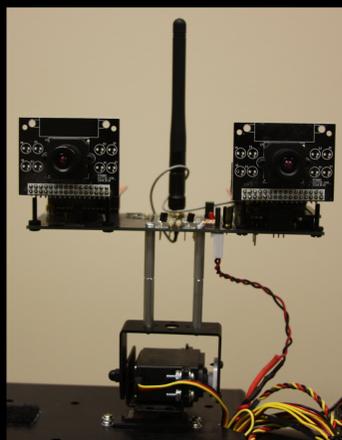
### FACTS:

1. We support the IV&V Program by developing robotics capabilities to help assure robotic and autonomous software systems.
2. We have provided robotics training to the Mars Science Laboratory IV&V analysts.
3. We are currently providing training to the OSIRIS-REx asteroid sample and return mission IV&V analysts.
4. We have developed hands on simulations and subsystem hardware 'work benches' to support these trainings.
5. We also support community outreach, robot competitions, and interaction with the greater NASA robotics community.
6. Our robotics lab is part of the JSTAR.



## Manipulation Workbench

- 5 degree of freedom robotic arm
- Forward and inverse kinematic solvers
- Developed two applications using Flowstone software:
  - Individual joint control
  - Command sequence control (multiple joints concurrently)



## Stereo Vision Workbench

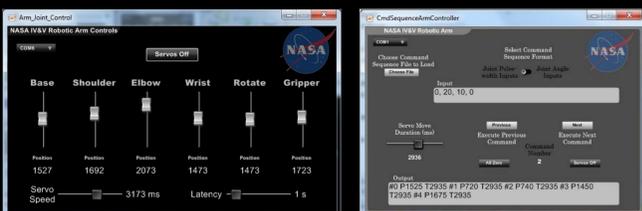
- Stereo Vision System including pan/tilt capability
- RoboRealm software provides vision algorithms (e.g. color filtering, edge detection, blob detection and many others)
- Developed training labs consisting of color tracking and stereo ranging



## Quadcopter Aerial Platform

### Potential Applications:

- Entry, Descent, & Landing (EDL) emulations
- Aerial communications relay (e.g. rover to ground station)
- Aerial reconnaissance (e.g. terrain mapping used for rover path planning)



## Planetary Surface Simulation

The Planetary Surface Simulation (PSS) provides the NASA IV&V Program an environment for testing and evaluation of robotic and autonomous applications. It is intended to inspire and engage students and the public in the advancement of Science, Technology, Engineering, and Math (STEM), while enhancing knowledge and contributing to the IV&V goal of assuring mission and safety critical software systems.



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