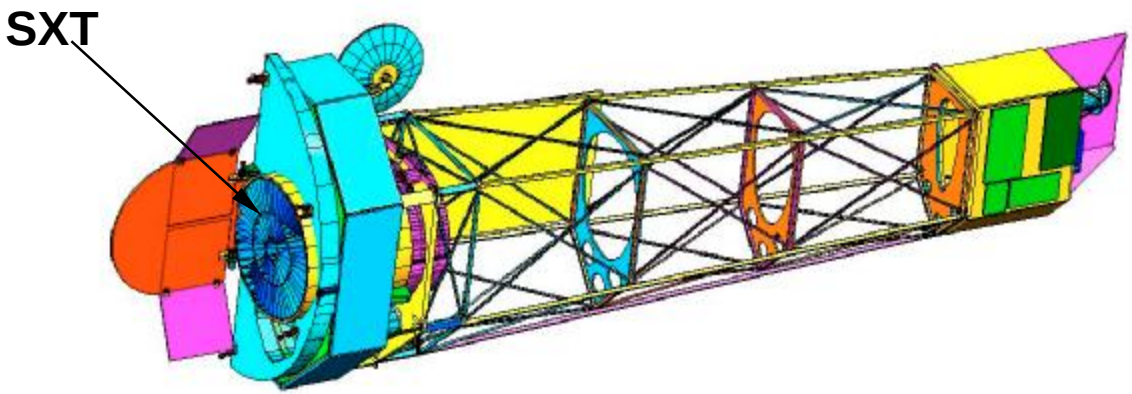
SXT TIM

Mechanical Status



Constellation-X Observatory

Appendix

Ground Support Equipment

PARAT Status

(PARAT=Precision Alignment and Robotic Assembly Tool)

Appendix
PARAT Status

- ***Issues:***
  - ***Design a unique end effecter interface which is compatible with the R19 robots.***
    - ***We are currently working on fixturing for the staging for the 10 robots that will make up the PARAT.***
  - ***Determine the amount of linear travel (within the gripper) without inducing permanent deformation.***
    - ***Steve and Tony will be testing this with the MORE CMM machine.***
  - ***We need to order the balance of the R19 robots as soon as possible to meet the EU schedule.***
    - ***Order needs to be placed no later than 11/3/03.***

Appendix
PARAT (Supporting Information)

- ***ST Robotics R-19 Laboratory Robot Specifications:***
  - ***Drives:***
    - ***High power micro-stepped stepping motors, incremental encoder feedback***
  - ***Reach:***
    - ***max 540mm/21ins, min 120mm/4.7ins***
    - ***Workspace is a cylinder approx 1080mm (40ins) in diameter by 400mm (16ins) high. End effector will affect reach i.e. longer fingers will increase reach. Reach is normally measured to the center-line of rotation of the gripper.***
  - ***Payload:***
    - ***1Kg/2lbs at gripper.***
  - ***Repeatability:***
    - ***+/-0.01mm***
  - ***Resolution:***
    - ***Sub-micron resolution with Rodger's end effector tooling incorporated.***
  - ***Weight***
    - ***20Kg/48lbs (robot only)***
  - ***Power:***
    - ***110/240v ac 250VA (standard controller)***
  - ***MTBF:***
    - ***10,000 hours***
  - ***Controllers/Software***
    - ***Comes "ready to go". Unit is supplied ready to run -- robot, controller, all cables, ROBWIN Windows project management software, ActiveX drivers, on-screen and hard copy manuals.***
  - ***Cost***
    - ***less than $17K per "all-up" unit.***

Appendix
PARAT Status

- ***ST Robotics R-19 Laboratory Robot Features:***
  - *Features Cylindrical format 2 or 4 axes.*
  - *Fully enclosed.*
  - *Simple teach pad.*
  - *Input/output interfacing.*
  - *Non-volatile memory.*
  - *Complete with controller, manuals, software, cables, etc. Ready to go.*
  - *Optional track.*
  - *Optional hazardous area preparation.*
  - *Since the units come with cabling, software and so forth, they will save us considerable time.*
  - *The R19 robots will give us the resolution, the CDA will give us knowledge.*

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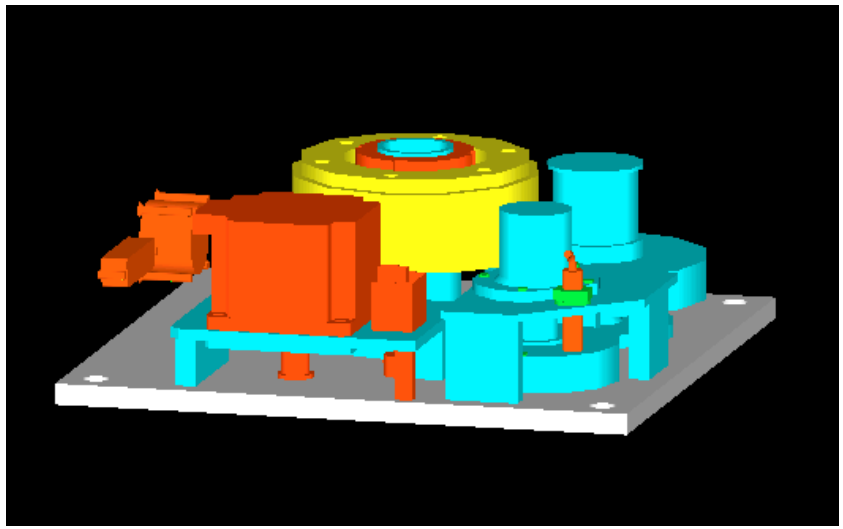
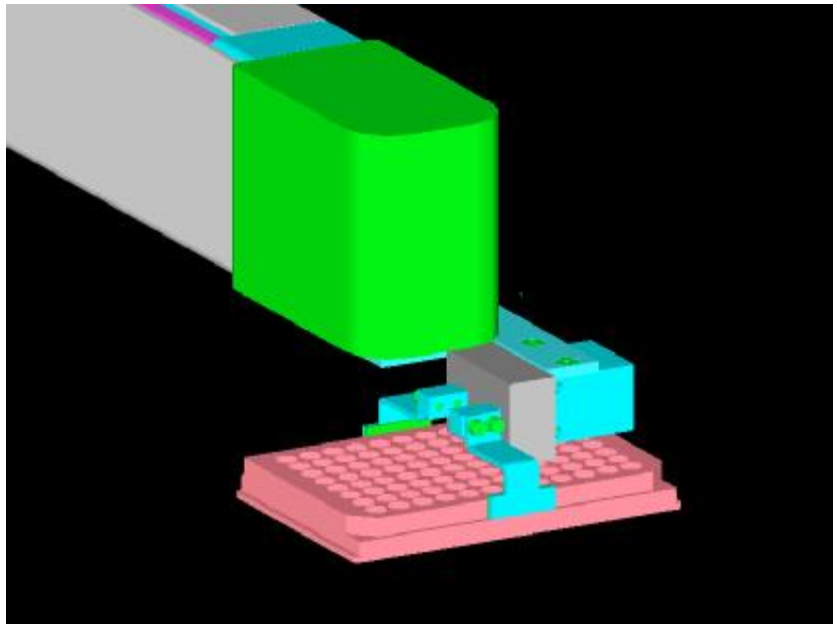
PARAT(Supporting Information)

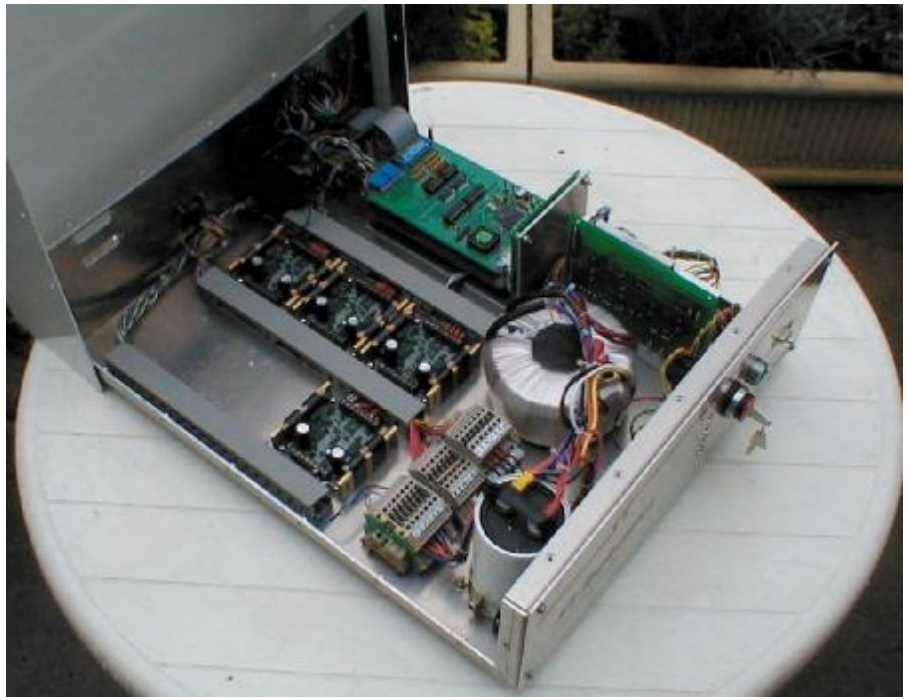
- ***The R19 Design Features:***
  - ***The R19 has a fast, high-tech anti-backlash drive system.***
  - ***Arm adapts to a variety of end effectors.***



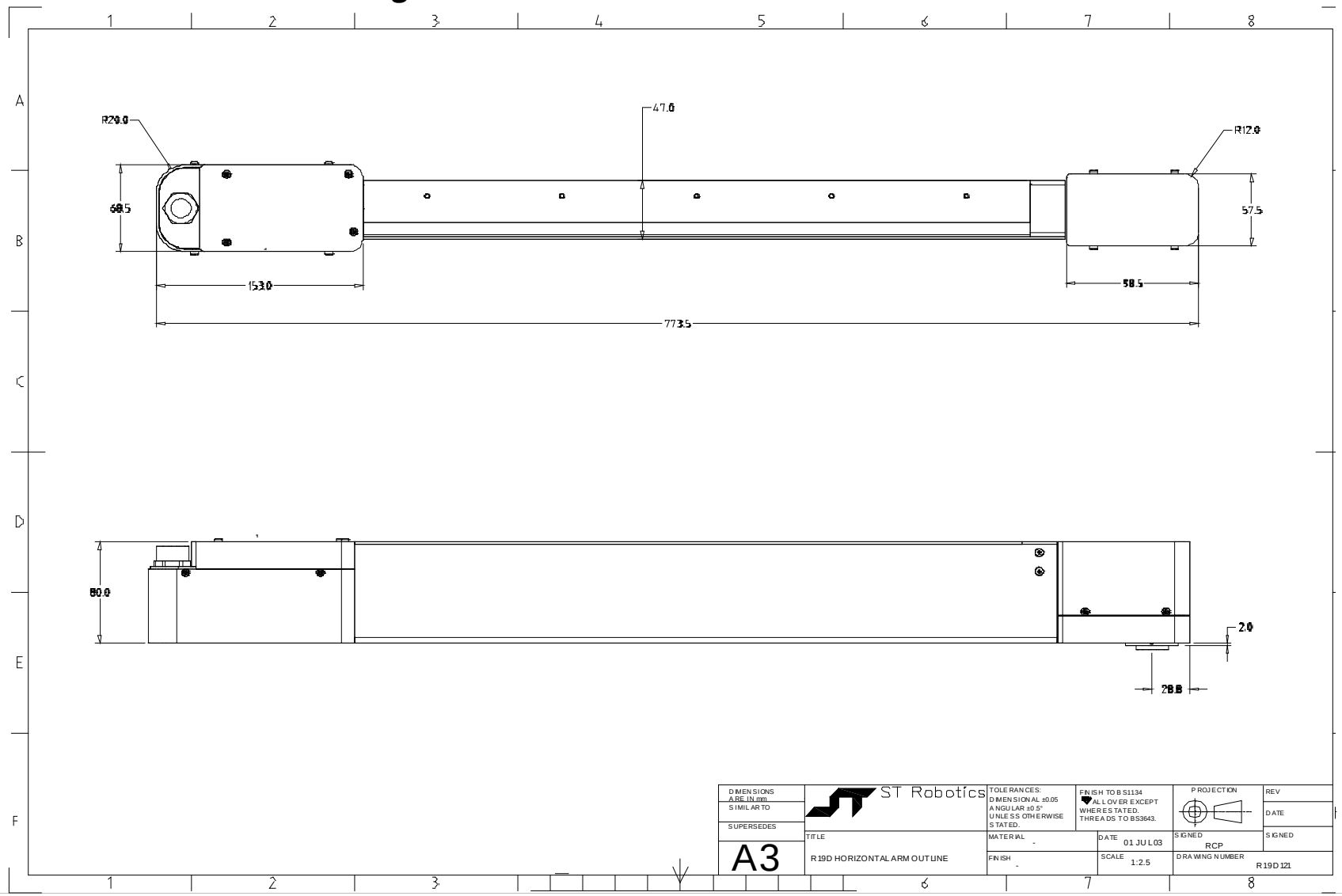


Appendix
PARAT(Supporting Information)

- ***The R19 Controller:***
  - ***Controller with up to 6 channels for the optional track and other device and lots of I/O.***
  - ***A multi-processor design with only 2 logic cards based around the Texas DSP. Software was also refined making it easier to use, stripping redundant functions and enhancing such things as matrix generation and self-teaching - the ability to modify it's own path according to conditions at either end.***

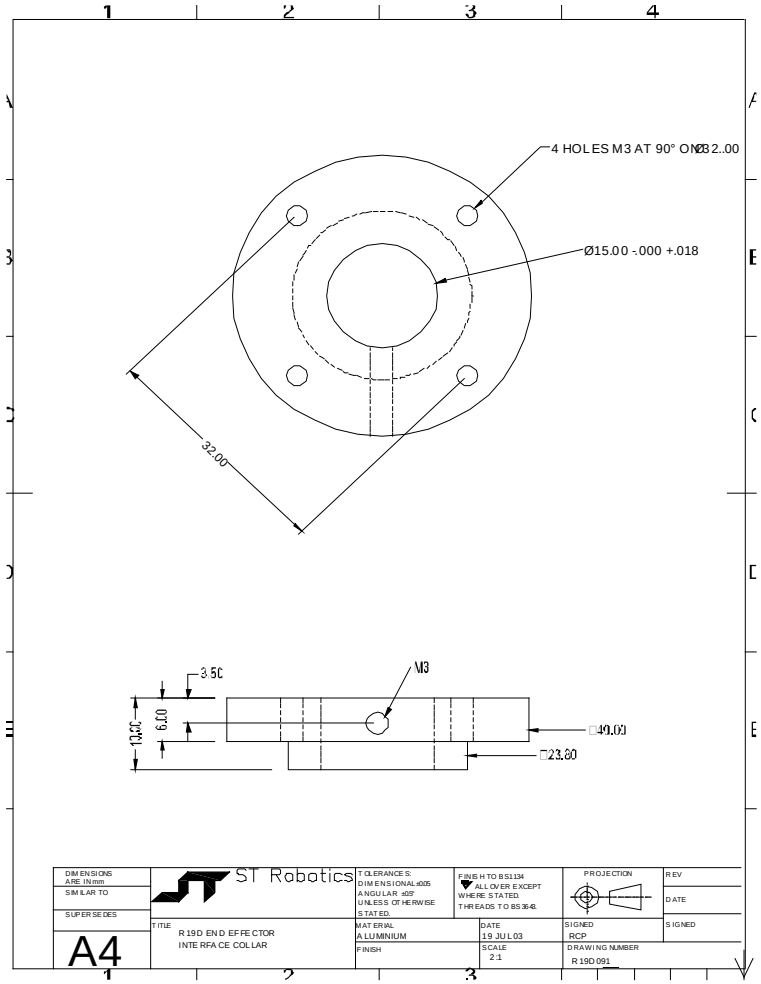


§ R19 Outline Drawing



Appendix
PARAT(Supporting Information)

§ *R19 End Effector Interface:*

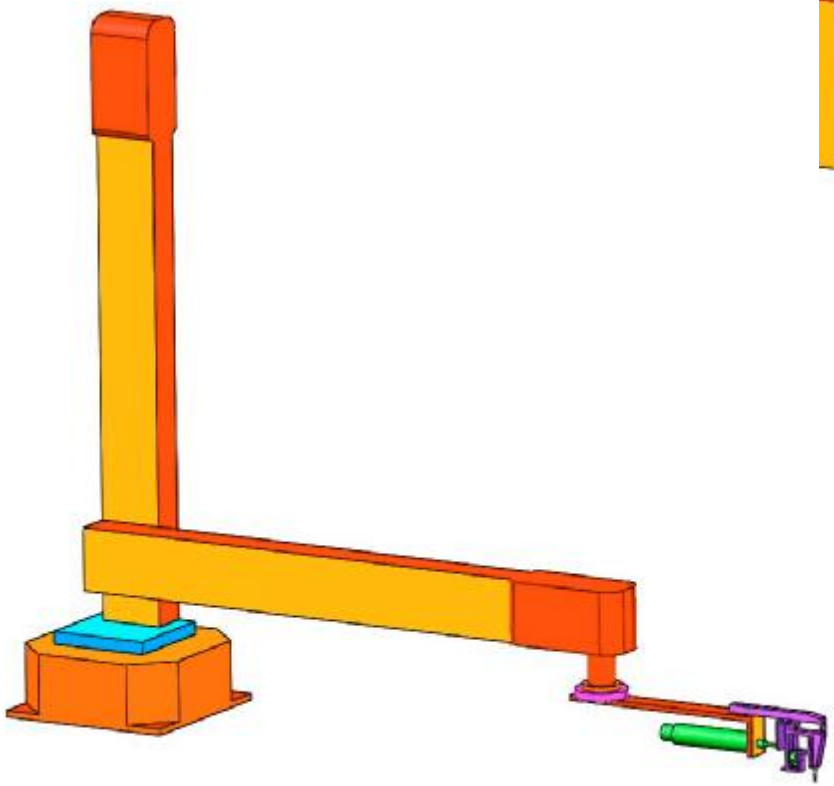


Appendix
PARAT Status

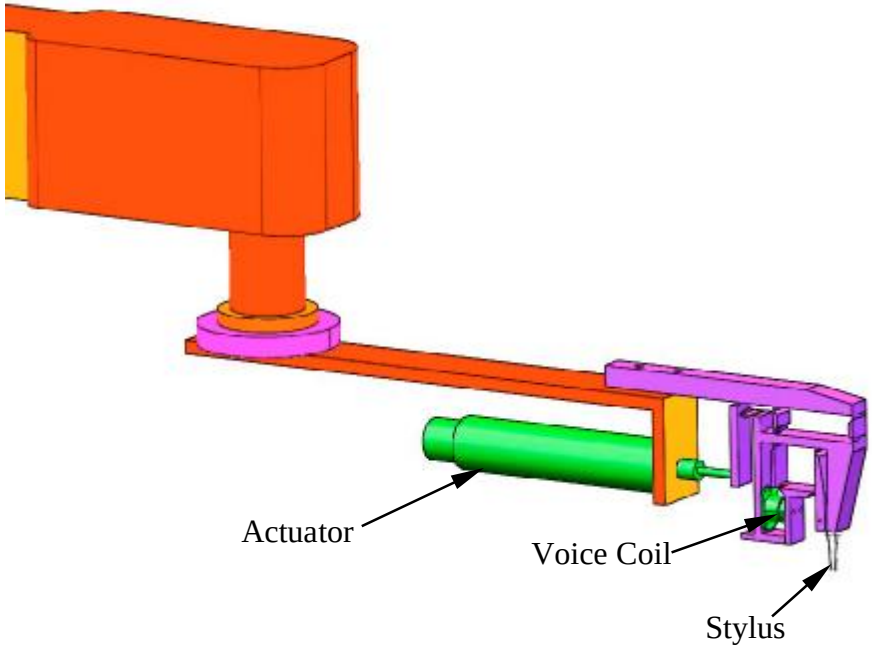
- **Current Status:**
  - ST Robotics has shipped an R16 unit to us. The R16 robot arm was received on7/21/2003.
    - We have been using the R16 arm to assist us with understanding the control software and user interfaces until the R19 units go into production (this month).
    - The R19 unit is an order of magnitude nicer and more capable than the R16 and represents 7 years of development, refinement and feedback from their customers. The 16's control software and interface is nearly identical to the R19, so will be a good training ground should we elect to purchase R19s.
    - David Sands of ST Robotics has sent us detailed information on the end of the R19 arm allowing us to incorporate Rodger's end effector tooling. The controller that comes with both the R16 and R19 units can drive other devices (ie linear actuator and solenoid, etc).
    - David Sands of ST Robotics recently visited Ruby Tuesday's and has concurred with our approach.

Appendix
PARAT Status

§ ***PARAT End Effector:***



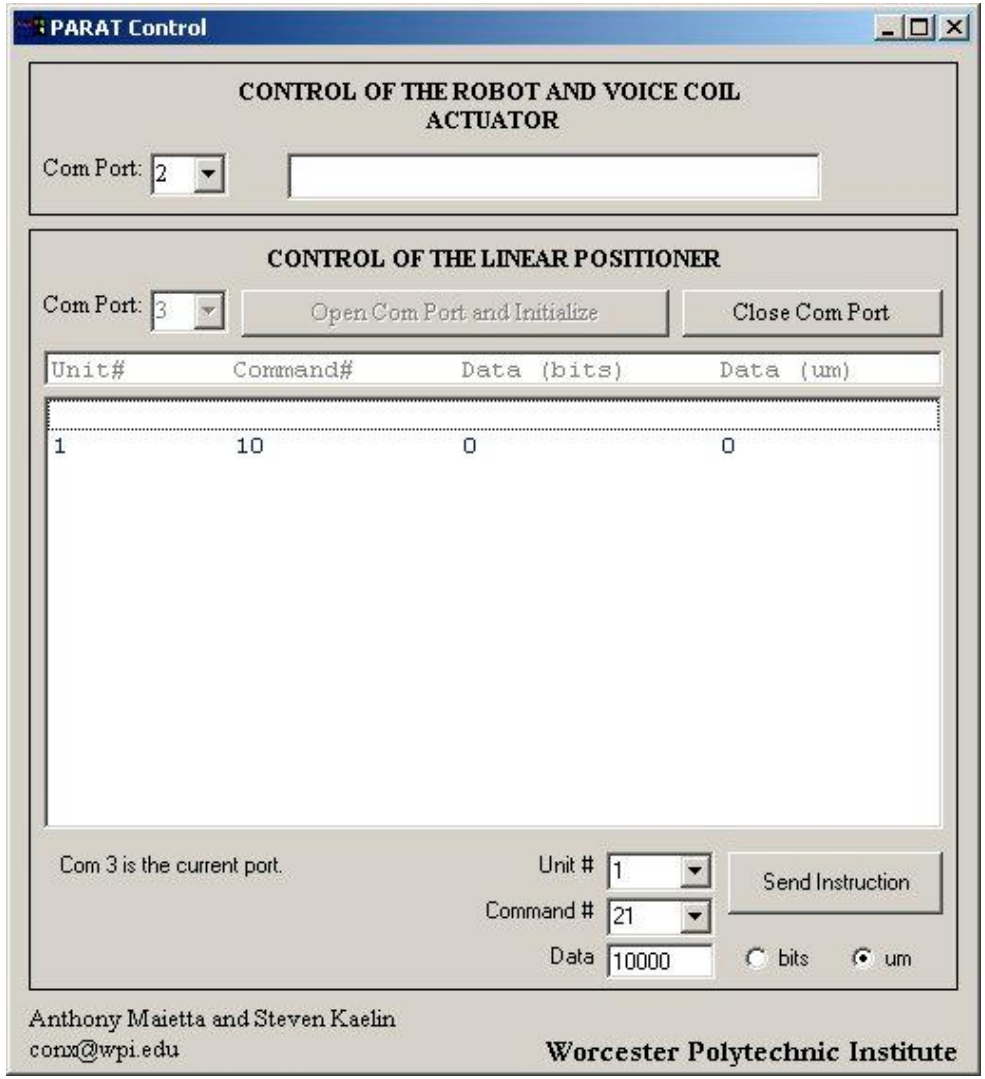
R19 ASSEMBLY



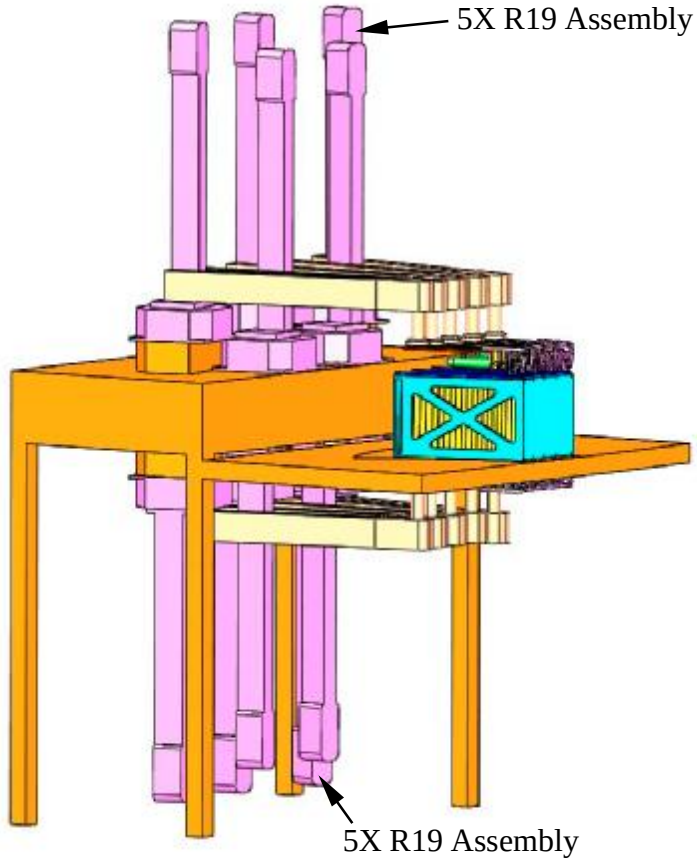
END EFFECTOR

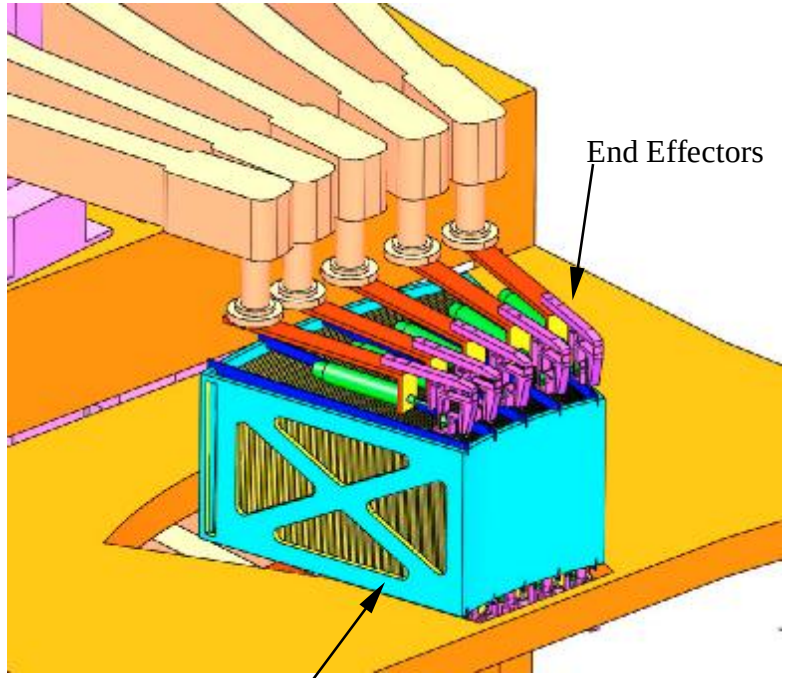
Appendix
PARAT Status

- ***PARAT Control Program controls the robot, voice coil actuator and linear positioner in one program***
- ***Features:***
  - ***Eliminates the need for two separate programs***
  - ***Com Port choice for robot/VCA and linear positioner***
  - ***Displacement of lead screw on linear positioner***
  - ***Upgradeable for closed loop feedback system with new CDA***
  - ***Allows use of all linear positioner commands and robot programming language***



§ *PARAT End Effector Layout:*





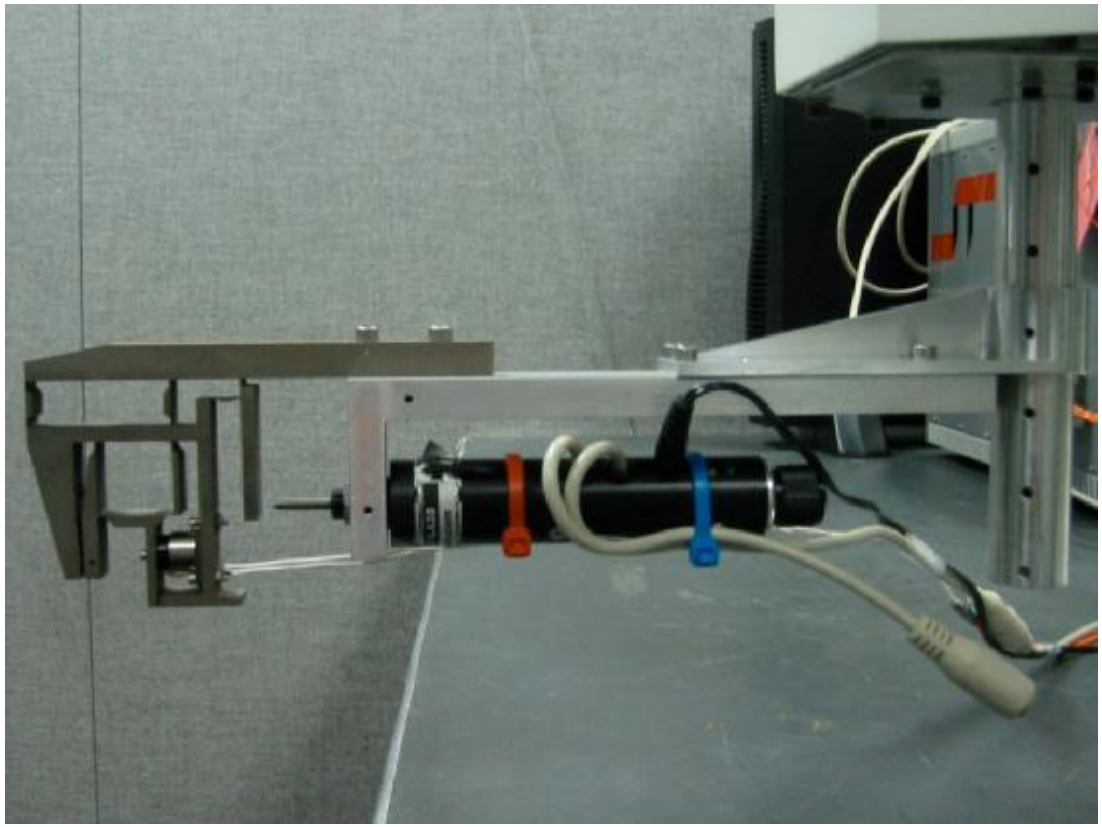
R19 MASS PRODUCTION SETUP

PARAT Status

- ***R16 with Rodger's End Effecter (Overview):***

PARAT Status

- ***R16 with Rodger's End Effector (Close-up of End Effector):***



Appendix
PARAT Status

- ***Plans for the Future***
  - ***Design and fabricate PARAT robot weldment which will be used to hold the 10 robots in position.***
  - ***Delivery of the first R19 unit will be in early 2004. Balance of robots will arrive at a later date pending project approval.***
  - ***Develop a mirror handling fixture to hand off mirrors to the R19 robots used in the PARAT fixture.***
    - ***We are purchasing an R17 robot arm (behaves much like a human arm).***