Lunar Telescope Deployment

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Milestones

Planned

Pointing demonstration with 10 arcsec precision

Design Reference Mission document

Achieved

Pointing with 24 arcsec precision

Design Reference Mission document completed and reviewed by Mark Colavita, JPL

Scope of Work

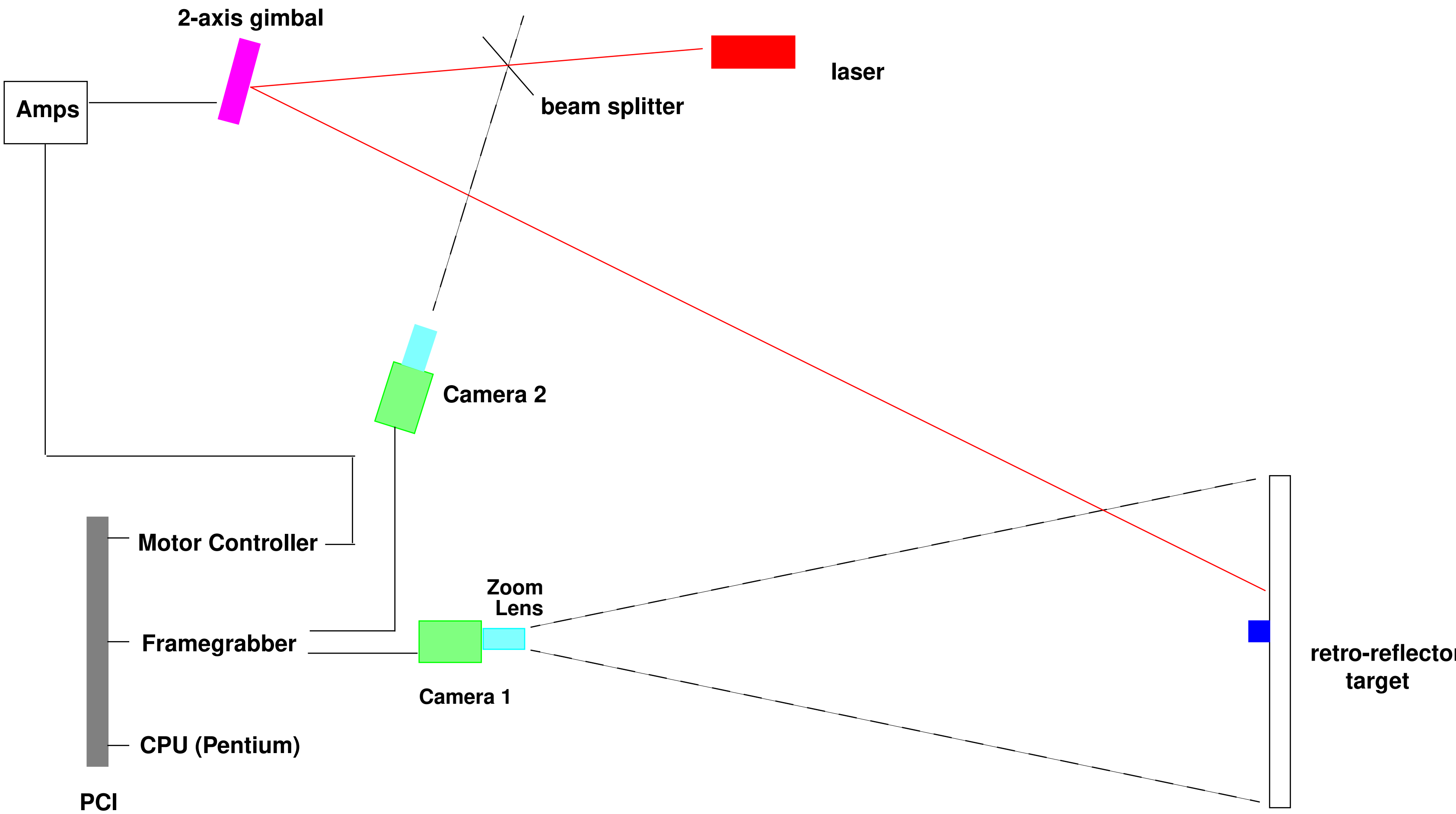
General issues for telescope deployment

- Surface mobility
- Precise pointing and alignment of elements
- Precise metrology
- Supervised autonomous operation

Determined to address pointing first, because it drives mobility and autonomy

- Need to know exactly what needs deployment before working vehicles

Setup


2-axis gimbal
Amps
beam splitter
laser
Camera 2
Motor Controller
Framegrabber
CPU (Pentium)
PCI
Zoom Lens
Camera 1
retro-reflector target

Pointing Process

Manually point laser near target

Move laser to 4 or more random points on target to determine system kinematics

Repeat until laser hits target

- Grab image
- Process image to find laser and target positions
- Compute required motion
- Steer gimballed mirror

Results

Baseline Distance (meters)	Target Size (arcsec)	Number of Trials	Hit Rate (Percent)
4.5	91.7	19	89.5
6.2	66.5	9	100.0
9.2	44.8	7	100.0
16.9	24.4	11	81.8
38.0	10.9	1	0.0

Baseline distance measured from target to gimbal

Observations

Strengths

- System does not require fine alignment
  - Robust to alignment errors and ‘drift’
- Hits target typically in 3 or fewer moves

Limitations

- Key limitation of current setup is laser intensity
  - Simply not detectable at 40 meters
- Low software system reliability

Future

Achieved pointing precision of 24 arc sec in lab

No difficulty expected in reaching 1 arc sec

Next small steps to improve system software reliability and laser intensity

Next big step to mount gimbal on vehicle and point in field

Equipment

Laser

Beam splitter

Gimballed mirror

Aerotech Unidex 500 Motion controller

Retro-reflector target

Sony XC-75 black and white CCD camera, with 8-48 mm zoom lens

Pentium-166 MHz, Windows 3.1 computer

Matrox Meteor framegrabber

MIL-16 image processing software

Sony PVM-14N2U 13” Monitor

Setup Details

Baseline distance 4.5 m

- Laser spot area covers 70 pixels in boresight image, 140 pixels in direct target image
- Laser spot diameter is 1 cm at target
- Target area covers 1000 pixels in boresight image, 1700 pixels in direct target image
- Target outer diameter is 4 cm, inner mirror diameter is 2 cm
- Centroid of spots determined to 1 pixel