Characterizing Swing Arm Kinematics

Prerequisites:

1. Both Exlar actuators received [mid-May]
2. Swingarm fabricated and assembled [mid-Sept]
3. Dummy aluminum mirror assembly complete [mid-May]
4. Small mirror mounted to front side of dummy mirror ~2-3 inches diameter
5. Upper bipod weldment fabricated[mid-August]
6. Compliant hinge assembly complete [mid-August]
7. Canoe sphere mounts complete
8. Design and fabrication of LVDT Mounts (machined parts that mount to bipods with screws)
9. Design and fabrication of LVDT contact pads (polished) mounted to swing arm
10. Need to mount Galil, RIO, power supplies, signal conditioners, and HP data acquisition to hex fixture or table nearby
11. Sun workstation moved
12. Need to make sure outer drum defining points have proper torque on acme nuts
13. Need to make sure inner drum does not move relative to outer drum , bearing clamp rings must be fully torqued, design verified that there is no play between inner and outer drum
14. Bipods installed on inner drum, fully torqued
15. Clamps must be lined up with canoe sphere axes
16. All swingarm screws must be fully tight
17. Software: Slave motor method should be complete and tested per Will Deich's test and integration test plan
18. Preliminary standalone swingarm software tests are complete (see Will's plan)
19. Cable assemblies are complete (includes linear transducer signal conditioner wires, RIO, second actuator, clamp end point detectors). Cables do not need to be at exact length or installed on inner drum, but this would be beneficial
20. Hand paddle will save significant time and interaction with Will since it would allow the person conducting the test (Christopher or Alex or Jim) to move the swingarm without software intervention

Characterize mirror/swing arm kinematics [2]:

Goal/requirement:

1. Verify as designed kinematic coupling is repeatable at 23 degrees deploy angle using final design parts
    a. See if clamping sequence affects repeatability, choose sequence that gives best repeatability –short test
    b. Check long term deploy repeatability
    c. Vary Temperature and check repeatability
2. Verify kinematic coupling is stable and does not slip for gravity vector varying from 0 to 90 degrees

Additional materials/equipment:

1. LVDT's and associated signal conditioners
2. Will need to glue or screw small zerodur or M2 pucks to dummy mirror or LVDT contact points on the swing arm

3. May need to bolt hexagonal fixture to the floor –will likely need to do this to align to sub-arcminute accuracy/repeatability.
4. Will need to balance (to some degree) the K1DM3 assembly about the rotation axis of the hex fixture

Preparations and Procedure:

1. Align all canoe spheres and v-blocks
    a. Shim and adjust jack screws so all contacts are clearly sphere on flat, use feeler gauges and bright light to check, make shim stock as needed
    b. Verify compliant hinge shaft is within 1mm of nominal position when clamped, easy to measure with depth gauge from two sides of hinge, compare to CAD
    c. Adjust dummy mirror to be 45 degrees from gravity vector (or possibly bottom surface of bipod weldment ring) try to achieve 45 degrees within .005 degrees (~16 arcsec), this will ensure we do not have to make a major move of kinematic surfaces in the future. We should probably use a mirror glued to the dummy mirror. We can do our fine adjustment with the groove plate.
    d. Mirror adjustment sub-procedure:
        i. Mount Leica L2P5 in front of mirror bonded to dummy mirror
        ii. Turn on "x" laser sheets and vertical plumb laser
        iii. Adjust tip and tilt until reflected laser sheet and plumb laser beam parallelism is within 2mm over a 25m distance (length of shop) -may be able to do better with alignment telescope, may not be able to do as well as 16 arcseconds given the stability of the hexagon support -may need to clamp hex fixture to concrete and also clamp axis of rotation on both sides.
2. Install LVDT's
    a. Install machined mounts to bipod tubes or near v-block to support LVDT's. We will need to minimize spans and maximize rigidity, we do not want a varying gravity vector to affect their readings. We could probably make some simple fabricated mounts as we did with the test bed, likely machined aluminum that screws onto bipod weldment.
3. Preliminary check of deploy/retract and LVDT functionality

<u>Test 1: Nominal position tests</u>

a. With rotation mechanism at nominal kinematic coupling engage position (23 degrees), deploy and retract with our best known method. Software cycle at least 100 cycles for first round of testing if everything functions as intended and there are no mechanical or software problems. Use LVDT's to measure position repeatability of swing arm.
b. Mirror face repeatability test: May use a laser aimed at a vertical mirror mounted (screwed clips) to the dummy mirror (90-45-45 prism) with a CCD detector receiving the reflected laser beam. Deploy/retract/deploy and check to see how much spot centroid moves. Hexagon fixture would need to be bolted to concrete and rotation axis fixed/clamped

<u>Test 2: Varying gravity vector deployed</u>

a. With swingarm deployed rotate hexagon fixture from 23 degrees to point to zenith and then to horizon -repeat several times
    i. Note any hysteresis -should be none, if yes, either clamping force is too low or something in assembly is not tight
    ii. Note flexure values of LVDT's
    iii. Repeat above ~10 times
    iv. Repeat again at -5 C ~10 times