08/21/04

PALAO Experiment Plan

Experiment name: Calibrate and check new location of SSMs
Experiment PI: Mitchell Troy

Brief description of problem or theory this experiment is addressing:

On ~August 17, 2004 the SSMs, active WFS, field stop and Acq. System where moved to new locations. The new SSM locations are the final location for installation of the MGSU. The AWFS and FS will need to be moved/rebuilt when the MGSU is installed.

The purpose of this "experiment plan" is to.

A. Determine the calibration parameters for the new SSM locations, insure they work and determine the dither ranges to the extent that can be done in the lab.
B. Document the tests needed for the software build to be released once the new calibration parameters are determined.
C. Document any on sky tests required. The next run is a science run, so at this point it is unclear when they would be executed, but we document them here for completeness.

Any previous analysis/experiments that has been done:

Need to put some text here about how far and where the SSMs where moved.

Experimental section (there may be multiple experimental sections):

Experiment #1: Determine Calibration parameters

Estimated Time: 2 hr
Perform in the AO lab/On telescope during the day/On telescope at night: In AO lab
Weather/Seeing/AO Performance Requirements: None
Other Special Needs: Pharo cold

Description:

Step by step instructions for conducting the experiment:

1. Determine the SSM ratio that gives pure pupil motion
    a. acquire white light, lock t/t
    b. Take and save PHARO image, note image location
    c. Move SSM1_a 600 units and SSM2_a 1200 units.
    d. Take a PHARO image, move ssm2_a until image is in original location
    e. Make a note of ratio, verify by moving SSMs back to original location.
    f. Repeat (b-e) for SSM1/2_a in negative directions
    g. Repeat (b-e) moving SSM1_B 600 units and SSM2_B -1200 units
    h. Repeat (b-e) for SSM1/2_b in negative directions

i. Repeat all of the above for motions of SSM1 of 50 units
j. Determine average move ratios, they should be the same for X and Y and for small and large moves.
k. Update PUPIL_X_RATIO, PUPIL_Y_RATION in proc_cmd.c in a test build.

2. Determine magnitude of pupil motion
    a. acquire white light
    b. register DM by hand, (or use automatic algorithm)
    c. Determine how many pupil_x units it takes to move 2 cols
        1. Two ideas, determine by looking at poke map, or run fine registration algorithm and let it "lock" on in correction position and then inspect final vs initial SSM positions.
    d. Repeat for pupil_y
    e. Update PUPIL_X_PER_1_COL_SHIFT and PUPIL_Y_PER_1_ROW_SHIFT in ccregerr.c in a test build.
3. Determine parameters for fine automatic pupil registration. The algorithm needs to now how to convert the measured centroid motion to SSM motion
    a. A first order estimate is to scale the old values by the new SSM pupil motion calibration.
        1. for X: 1.485* (new PUPIL_X_PER_1_COL_SHIFT)/ (old PUPIL_X_PER_1_COL_SHIFT=263)
        2. for Y: 1.485* (new PUPIL_X_PER_1_COL_SHIFT)/ (old PUPIL_X_PER_1_COL_SHIFT=288)
        3. Update values in cfregerr.c in test build
    b. Validate values by
        1. Acquire white light
        2. register DM by hand, (or use automatic algorithm)
        3. Move pupil 0.25 of a Column in X
        4. Run fine algorithm and note first motion of pupil.
        5. Repeat for pupil motion of 0.25 of a row in Y
        6. Adjust parameters as needed.
4. Validate pupil registration works
    a. Verification for small offsets
        1. Acquire white light at 500Hz
        2. run fine algorithm, if successful compare by putting check map on DM
        3. Move pupil ~1/4 col in x and y, repeat step B.
        4. Move pupil ~-1/4 col in x and y, repeat step B.
    b. Verification for large offsets
        1. Acquire white light at 500Hz
        2. run automatic coarse and fine pupil registration, compare by putting check map on DM
        3. Move pupil ~2 cols in x and y, repeat step b.
        4. Move pupil ~-2 cols in x and y, repeat step b.
        5. Move pupil ~+/-2.5 cols in x and y repeat step b.
    c. Test various frame rates
        1. Repeat test 2 above at 100Hz and 2000Hz.

5. Insure image motion is pure, this was and should still be true.
    a. Acquire white light, reg. pupil, lock DM and TT
    b. move white light position and track by dithering ssms, move as far as possible
    c. Put pupil pattern on DM to estimate amount of pupil motion
    d. Register pupil motion noting the amount of SSM motion
6. check magnitude of image motion
    a. Dither star, and record PHARO images for the following relative dithers (units arcseconds):
        1. Make 4 steps of +image_x moves of 10 units, move 8 steps - image_x and back 4 steps +image_x
        2. Repeat for image_y
    b. Fit a line and determine the average image motion (in arcseconds) per SSM image unit
    c. Update ImageMotionPerVirualMotion in tao.h in a test build.
    d. Using test build test motor accuracy for small moves
        1. Try to position star behind 0.41" coronagraph stop, note difficultly/backlash
        2. Center on PHARO
        3. Dither star, and record PHARO images for the following relative dithers (units arcseconds):
            1. Move East 4 steps of 0.005arcseconds, move west 8 steps of 0.005 arcsec and back East 4 steps of 0.005 arcseconds
            2. Move North 4 steps of 0.005arcseconds, move South 8 steps of 0.005 arcsec and back North 4 steps of 0.005 arcseconds
7. Check range of image motion
    a. Note SSM maximum positions and nominal (aligned values)
    b. Open loop Dither North, in 5 arcsec steps. After each move check for motor hitting limit
    c. Record the total motion when limit is hit
    d. Repeat steps a and b moving East, South and West.
    e. If range of motion not sufficiently centered then adjust SSM coarse positions. Range should be greater then 45" in all directions.
8. Do we need to check PHARO/DM pupil alignment?

Experiment #2: Testing of new software build.

Estimated Time: 2 hr
Perform in the AO lab/On telescope during the day/On telescope at night: In AO lab
Weather/Seeing/AO Performance Requirements: None
Other Special Needs: Pharo cold

Description:

Step by step instructions for conducting the experiment:

1. Validate SSM pupil motion does not move image.
    a. acquire white light, lock t/t

b. Take and save PHARO image, note image location
c. Move image_x 500 units (TBR)
d. Take a PHARO image, note image location
e. Move image_x -500
f. Take a PHARO image, note image location
g. Repeat (b-e) for negative image_x motion
h. Repeat (b-e) for image_y motion
i. Repeat (b-e) for negative image_y motion
j. Repeat all of the above (b-i) for motions of 50 (TBR) units of image motion

2. Validate pupil registration works
    a. Verification for small offsets
        1. Acquire white light at 500Hz
        2. run fine algorithm, if successful compare by putting check map on DM
        3. Move pupil ~1/4 col in x and y, repeat step B.
        4. Move pupil ~-1/4 col in x and y, repeat step B.
    b. Verification for large offsets
        5. Acquire white light at 500Hz
        6. run automatic coarse and fine pupil registration, compare by putting check map on DM
        7. Move pupil ~2 cols in x and y, repeat step b.
        8. Move pupil ~-2 cols in x and y, repeat step b.
        9. Move pupil ~+/-2.5 cols in x and y repeat step b.
    c. Test various frame rates
        10. Repeat test 2 above at 100Hz and 2000Hz.
3. Insure image motion is pure, this was and should still be true.
    a. Acquire white light, reg. pupil, lock DM and TT
    b. move white light position and track by dithering ssms, move as far as possible
    c. Put pupil pattern on DM to estimate amount of pupil motion
    d. Register pupil motion noting the amount of SSM motion
4. check magnitude of image motion
        a. Dither star, and record PHARO images and note image location for the following relative dithers (units arcseconds):
            i. Move East 4 steps of 0.2 arcseconds, move west 8 steps of 0.2 arcsec and back East 4 steps of 0.2 arcseconds
            ii. Move North 4 steps of 0.2arcseconds, move South 8 steps of 0.2 arcsec and back North 4 steps of 0.2 arcseconds
    a. Dither star, and record PHARO images for the following relative dithers (units arcseconds):
        1. Move East 4 steps of 0.005arcseconds, move west 8 steps of 0.005 arcsec and back East 4 steps of 0.005 arcseconds
        2. Move North 4 steps of 0.005arcseconds, move South 8 steps of 0.005 arcsec and back North 4 steps of 0.005 arcseconds

Experiment #3: On Sky Tests

Estimated Time: <1 hr
Perform in the AO lab/On telescope during the day/On telescope at night: Night time on telescope
Weather/Seeing/AO Performance Requirements: None
Other Special Needs:

Description:

Step by step instructions for conducting the experiment:

1. Insure PHARO's 45" field is not vignetted
    a. Acquire and center bright GS on PHARO (don't lock AO loops)
    b. Take and save pupil and image images.
    c. Move star (open loop) to NE corner of PHARO chip (in 40 mas plate scale), repeat step B looking for vignetting in the pupil or a decrease in star intensity.
    d. Repeat step c, moving star to NW, SW, and SE corners of PHARO chip.
2. Range of Motion before vignetting
    a. Acquire and center on PHARO bright <8th mag GS
    b. Determine and note limits of SSM motors.
    c. Dither North, in 5 arcsec steps. After each move check for:
        1. motor hitting limit
        2. WFS vignetting
        3. PHARO vignetting
    d. Continue until one of the above conditions occurs, record the total motion.
    e. Repeat steps c and d moving East, South and West.
3. Measure/check dither accuracy of dithers
    a. Large moves
        i. Acquire and look on a bright guide star
        ii. ~Center the star on PHARO, take and save image, note image location
        iii. Dither star 15" East (in several smaller steps), take and save image, note image location
        iv. Dither star 15" North (in several smaller steps), take and save image, note image location
    b. Small motions
        i. Try to position star behind 0.41" coronagraph stop, note difficultly/backlash