



MULTIPLE MIRROR TELESCOPE OBSERVATORY

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Subject: Evaluation of TCS Autostacking Routine during engineering run
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- A. Setup. The stacker was selected as the spectrograph entrance aperture. This reflecting surface at the telescope focal plane has a pair of 6 holes to permit beam switching the unstacked images between spectrograph channels. The acquisition TV provides a video image of the stacker to the operator and to the TCS computer.
- B. The Test. Define the procedure for using the autostacking routine with the stacker and evaluate for ease of use and accuracy.
- C. The Procedure. Assume that data collection is taking place with each of the 6 telescope images lined up with an aperture. The images are seen to be drifting out of the apertures indicating that accumulative error in the open-loop coefficients has caused a tracking error. To use the autostacking routine, it is necessary to perform the following steps:
 1. Stop observing and close the spectrograph shutter.
 2. Enter the command "+CCD" on the TCS computer terminal. This will restack the images.
 3. Select "manual" on the OSS/secondary control paddle mode switch and manually stack the images if necessary. Manual restacking would only be required if the "stack" had badly fallen apart (more than 3 arc seconds separating the individual images).
 4. Using the control paddle, manually move the OSS so that the stacked image is at least 30 arc seconds away from the line of apertures. This is necessary so that none of the images disappear in one of the apertures during the autostack procedure.
 5. Perform the autostack by returning the control paddle mode switch to "computer", then entering the command "ps" on the TCS terminal.
 6. Return the images to the respective apertures by entering the command "ZAZL" on the mount computer terminal, and the command "+MMT" on the TCS terminal. "ZAZL" returns the OSS to the original position, and "+MMT" spreads the images out in a line.
 7. Select "manual" on the control paddle and move the OSS so that the images line up perfectly with the apertures, and return the mode switch to "computer".
 8. Open the shutter and resume observing.

D. Discussion. The procedure for autostacking takes longer to describe than to execute, yet the words "stop observing" and "resume observing" are attention flags regardless of what falls between. In practice, the operator manually guides where the open-loop corrections fail to keep the images in the apertures. The frequency of guiding corrections is a function of the aperture diameter, the velocities of EL and AZ, and the accuracy of the coefficients for the area of the sky being observed. For this experiment, little or no guiding was required over an interval of 20 minutes as observed on several objects. Seeing was 3 arc seconds; the apertures were also 3 arc seconds.

Specifically, the following measurements were made from the profile of the stacked and individual image between the estimated FWHM points. Clouds necessitated varying intensifier voltage during the test.

| <u>Time</u> | <u>Stacked FWHM</u> | <u>Individual FWHM</u> | <u>AZ Vel</u> | <u>EL Vel</u> |
|-------------|---------------------|------------------------|----------------------|-----------------------|
| Start | 2.2 ^{''} | | 1 ^{''} /sec | 12 ^{''} /sec |
| 7 min | 2.6 ^{''} | | | |
| 10 min | 2.5 ^{''} | | | |
| 15 min | 2.5 ^{''} | | | |
| 20 min | 2.5 ^{''} | 2.3 ^{''} | | |

When guiding is required, the operator must switch from "computer" to "manual" on the OSS secondary control paddle, select the secondary to be guided, make the corrections, and return the mode switch to "computer". Failure to return the mode switch to "computer" will prevent the proper updating information calculated from the open-loop coefficients from reaching the secondaries. The fact that open-loop is in operation and the individual corrections applied to each secondary are continuously displaced on the TCS status monitors.

E. Conclusions:

1. The autostacking procedure for the spectrograph should be automated so that with a single command, the images are restacked, the stacked image automatically moved away from the aperture for the autostacking procedure, and the images returned to their original positions. This procedure will still only be useful, however, between objects so that observing is not interrupted.
2. Autoguiding will reduce or eliminate the need to guide during observations; however, autoguide with the existing Top Box optical configuration will only be useful under very special situations where a guide star of sufficient magnitude is within 50^{''} of the object star, and located so that none of the telescope images from the guide star fall on any of the apertures, or outside the field of view. The new Top Box with its planned offset guide capability will extend the use of autoguiding to a wider range of operational situations.