Nightly AO on-sky checkout

Issue - 3.5

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1 Introduction

This document provides the procedure for an AO On-Sky check-out. This procedure is to be used immediately after sunset on LUCI/AO nights, but should not delay the upcoming science observing. The procedure references documentation on the wiki.\textsuperscript{1}

Background material is given in appendix B.

2 Scope

The OSAs are the intended audience for the procedure given in section 3. The material given in the appendix, Background Material, is for a broader audience at the observatory.

3 Procedure

1. 30 minutes before opening the chamber:\textsuperscript{2}
   
   (a) Bring up the AO software and initialize AO for the night. Details are given in the first 3 subsections of Greg’s Operational AO manual:
   
   i. Open Eng. GUIs
   ii. Ready AdSec

\textsuperscript{1} Each text item that appears in light blue is a hyperlink that will bring up the referenced web page.

\textsuperscript{2} Other steps to possibly include later: (1) Check system functionality using Greg’s script (Details TBD) (2) Tell anyone following along in Tucson to use scry in /lbt/observer/bin/ to eavesdrop on the OSA screens.
iii. *Prepare WFS*

(b) Prepare for using IDL as follows\(^3\)
   i. Open a new xterm
   ii. Login as LBTO@obs2 (3, 4, or 5)
   iii. `idl`

(c) Using the *IIFGUI*, authorize for LUCI/LUCI as usual.

(d) Wait for the indication in *IIFGUI* that the authorization is complete, then ...

(e) In the IDL xterm, type: `IDL> iif.register,/TCS`\(^4\)

(f) Confirm LUCI config:
   i. N30 Camera
   ii. N30 field stop in the FPU
   iii. Mirror selected
   iv. Filter wheels set to blind/blind.\(^5\)

(g) On the LUCI *Readout* GUI:
   i. Change \(N_{DIT}\) to 1.
   ii. Select "Cube" from the *Save* drop down menu.
   iii. Select LIR mode.
   iv. Hit *Submit* to save these changes by taking a frame.

(h) While the blind/blind filters are in LUCI, collect a dark frame as follows:
   i. Go to the WFS Control GUI.
   ii. In entry field to the left of "Acquire PISCES Dark" enter the number of frames (usually just 1).
   iii. Click the "Acquire PISCES Dark" button.
   iv. In the log text box the tracking number (TN) will be displayed. Record this in your log.
   v. The LUCI image name (e.g., `luci1.20180505.0078.fits`) will appear in the log box on the LUCI interface. Also record this in your log.

**After opening the chamber:**

1. **Wait for sunset + 10 minutes (if necessary).**

2. **Establish Pointing and Collimation**
   (a) Restore the last known IE/CA for LUCI/LUCI.

   (b) Choose a bright pointing star (9-10th mag) with a bright guide star (see later), acquire using the normal procedure. Reduce exposure time to minimum (200ms). See AO449 as a good example.

   (c) Collimate using the normal procedure.\(^6\)

3. **Acquire the AO reference star**
   (a) Just like step 1b above. Use the same command, but with these parameters:

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\(^3\) These steps were taken from Doug’s IDL Twiki Page for Preset.
\(^4\) This IDL command checks with TCS to learn which instrument is authorized, and then sets up accordingly.
\(^5\) To protect from persistence. They should be switched to the crossed filter set up that reduces about 7 magnitudes before AO loops are closed to avoid light entering through other filters as they rotate into position.
\(^6\) Alternatively, perform by-eye active optics on defocussed pointing star.
i. TELMODE = Adaptive
ii. AOmode = ACE (case sensitive)
iii. AOref = 0 (case sensitive)
iv. Choose a bright guide star ... GS = #78
v. PA = 90

4. Close the AO loops
   (a) Set up for intervention mode. Details are given in the Get Ready for Preset section of the Greg’s on line document to force intervention mode on the next preset.
   (b) Use the following IDL runAO

   IDL> iif_binoc_runao,type=repoint

   or, if forced to work single-sided in monocular mode for some reason:

   IDL> iif_runao, type=repoint

   (c) Follow steps 2.2 through 2.5 of the GT on line doc.

   i. Center Star
   ii. Center Pupils
   iii. Check Flux
   iv. Close Loop.

   (d) Optionally complete steps 2.6 and 2.7.

   i. Optimize Gain
   ii. Apply Optical Gain

5. Measure and Record IQ
   (a) Take LUCI images to measure AO performance as follows:

   i. Put FeII + Clear in for the LUCI filters.
   ii. Bring up an AOeng@flao-dxwfs (or sx) terminal.
   iii. $ cd /home/aoeng/auxloops/scripts
   iv. $ ./luci_take_three.py. (This will collect a LUCI image and, simultaneously, AO telemetry data.)
   v. In the terminal output, the TN will be displayed. Record this in your log.
   vi. The LUCI image name (e.g., luci1.20180505.0078.fits) will appear in the log box on the LUCI interface. Also record this in your log.

   (b) Measure IQ: Work with the assigned ISA to measure and record the FWHM and Strehl of the star as seen in the sky-subtracted LUCI image. Record that information in your log.

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7Since we are still in early twilight, the ACE preset still needs to find an off-axis star before we can start the runAO sequence.
8 Note that we do not set PA since IRAF/newpoint will put the GS on the Y axis. If you choose to set the PA explicitly, choose an appropriate PA for the selected GS.
9 These last two steps are optional because they could be a waste of time training-wise. Once Arectri has automated these two steps the procedure for the OSA will change. The advantage would be that the IQ would be more valid and so monitoring could start earlier. So this needs some discussion.
**A  Conclusions from 30-31 March On-Sky Tests**

At the beginning of two engineering nights in late March, 2018, we (Steve, Doug, Al) ran through earlier versions of the procedure. The key result from these tests was a change to the collimation procedure. We determined that of these two choices:

1. Collimate by-eye using the CCD-47.
2. Collimate using the off-axis guider and the standard method.

the latter is the better choice. Although the former allows an earlier start, the latter is faster and more reliable in the end. This is largely due to the smaller field of view offered by the CCD-47.

A side benefit of this decision is that, for the collimation step, it is not necessary to develop an IIF command driven procedure (IDL or IRAF), nor to train the OSA in its use.

For the AO portion of the procedure an IIF command driven method is still required. The procedure currently is written to use IDL, but this will likely change once the IRAF IIF interface has been extended to provide the necessary AO functionality.

**B  Background Material**

These sections appeared at the beginning of the document originally, and are now just retained as an appendix for historical purposes.

**B.1 Potential Benefits**

Potential benefits will be realized because the on-sky AO checkout will:

1. Further familiarize the OSA on the operation of the AO system and continue training.
2. Serve as a preventative maintenance program; discovering hardware and software problems before they are found on-sky at the expense of science.

**B.2 Targets**

Initially we would use a bright star, however, the possibility to someday include targets of scientific monitoring interest (e.g., Titan or Io) exists.

**B.3 Performance Monitoring**

A decision whether to use a paper-only, semi-electronic, or fully electronic system (e.g., SQL database) for recording data and analyzing trends will have to be made. A fully electronic solution would likely require support from software engineering.

**C  Revision History**

- v3.3, 08-May-2018, ARC, Step 1(a) expanded to reference 3 sections instead of one.
- v3.4, 31-May-2018, ARC, Changes to 3.5 to reflect Doug’s new script and corrections following the 21-May-2018 run through.
- v3.5, 03-Jun-2018 Changes following the 02-Jun-2018 run through.