The WIYN One Degree Imager: Updates and recent progress

Ralf Kotulla
University of Wisconsin – Milwaukee
02/18/2013 @ UW Madison
Content

- What is pODI
- User interfaces
- Image products
- What works and what doesn't
- Pipeline, Portal & archive
- Quicklook pipeline
What is pODI

- Original plan (~2002-05):
- 1 square degree
- 64 OTAs with 4Kx4K → ~1 GPixel
- OT shifting as ~semi-adaptive optics to improve seeing
- Focus sensors to maintain perfect focus
ODI: Specs

Field of view:
~25x25 arcmin in center
+ 4x 8x8 “guide fields”

Pixelscale: 0.11"

Readout-time: 7s

Filters: SDSS griz + SDSS u, Hα, OIII
+ all Mosaic filters on request
User interface
ODI exposure GUI
OTA Listener and Guide star tool
What does data look like?

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Log File</th>
<th>Metadata XML</th>
<th>Image Files</th>
<th>Text Files</th>
</tr>
</thead>
<tbody>
<tr>
<td>o20121220T044346.0</td>
<td>exposure.log</td>
<td>metaInf.xml</td>
<td>o20121220T044346.0_00.bin64.jpeg</td>
<td>o20121220T044346.0_00.fits</td>
</tr>
<tr>
<td>o20121220T044346.0</td>
<td>exposure.log</td>
<td>metaInf.xml</td>
<td>o20121220T044346.0_01.bin64.jpeg</td>
<td>o20121220T044346.0_01.fits</td>
</tr>
<tr>
<td>o20121220T044346.0</td>
<td>exposure.log</td>
<td>metaInf.xml</td>
<td>o20121220T044346.0_16.bin64.jpeg</td>
<td>o20121220T044346.0_16.fits</td>
</tr>
<tr>
<td>o20121220T044346.0</td>
<td>exposure.log</td>
<td>metaInf.xml</td>
<td>o20121220T044346.0_16.bin64.jpeg</td>
<td>o20121220T044346.0_16.fits</td>
</tr>
<tr>
<td>o20121220T044346.0</td>
<td>exposure.log</td>
<td>metaInf.xml</td>
<td>o20121220T044346.0_22.bin64.jpeg</td>
<td>o20121220T044346.0_22.fits</td>
</tr>
<tr>
<td>o20121220T044346.0</td>
<td>exposure.log</td>
<td>metaInf.xml</td>
<td>o20121220T044346.0_22.bin64.jpeg</td>
<td>o20121220T044346.0_22.fits</td>
</tr>
<tr>
<td>o20121220T044346.0</td>
<td>exposure.log</td>
<td>metaInf.xml</td>
<td>o20121220T044346.0_23.bin64.jpeg</td>
<td>o20121220T044346.0_23.fits</td>
</tr>
<tr>
<td>o20121220T044346.0</td>
<td>exposure.log</td>
<td>metaInf.xml</td>
<td>o20121220T044346.0_23.bin64.jpeg</td>
<td>o20121220T044346.0_23.fits</td>
</tr>
</tbody>
</table>

→ Each exposure is a directory full of files
A closer look at OTA 3,3

1 OTA = 64 cells (w/ 64 overscan regions/gains/etc) = 1 fits w/ 65 extensions.
Calibrations: Bias and dark
readout glow and detector glow
Trailing at low background levels

Potential problem for frames with background levels < 50-70 counts:

- short exposures: guiding, U-band during dark time
- narrow-band data
Flat-fields: pupil ghost
ODI Pupil Ghost Images: Non-sequential Results

The model shows that the pupil ghost happens during the double passes between the filter and field lens.
ODI Pupil Ghost Images: Change Filter Position Can Reduce The Intensity of The Pupil Ghost Image.

Move filter 31 mm forward, the diameter of the pupil ghost increase to 128.6 mm (the first filter position)

Move filter 31 mm backward, the diameter of the ghost pupil increase to 91.2 mm (the third filter position)
Comparing L2 and L1 flats
Image of pupil ghost template and before and after
# Standard Calibration Plan

## ODI Standard Dome Calibrations

### Dark & Bias:
- 10 x Bias
- 3 x 600 sec dark

### Flat Fields:
- 5x Dome Flat g'
- 5x Dome Flat r'
- 5x Dome Flat i'
- 5x Dome Flat z'
- 5x Dome Flat U'
- 5x Dome Flat g'
- 5x Dome Flat g'
- 5x Dome Flat g'

Start Exposure
OT shifting

Principle:
(charge in) pixels follows image motion

Modes:
• Fast guiding (>= 1 guide star)
• Coherent guiding (>= 3 guide stars)
• Local guiding (>1 guide star per OTA)
OT shifting: Pros

- Better seeing or at least rounder stars
- Reduced windshake in windy conditions
pODI Coherent Correction Mode
First Light Jan 23 2013

No OT-correction: Elongated stars due to telescope drift.
OT-correction applied: Round stars, telescope drift is compensated.

pODI Image o20130123T224451.0
OT shift history
OT shifting: cons

- Traps cause image artefacts
- Slightly smaller detector area (shift pixels off chip)
- Needs (many) bright guide stars
- For now: Guide readout too slow to make OT shifting effective (work in progress)
- Data reduction trickier: Need to convolve calibration files with shift history
OT shifting artefacts
OT shifting artefacts
OT shifting artefacts
Atmospheric dispersion corrector

- Two rotating prisms
Photometric calibration

ODI photometry - Zeropoint (linearity) 600s
Photometric calibration
Color terms ODI vs SDSS
Portal, Pipeline & Archive (PPA)

- portal.odi.iu.edu
- Run by Indiana U.
- Frontend to access/download/manipulate data → demo
- Official pipeline still under construction
  Rumours: Release at end of month
pODI Quickreduce pipeline

- Basic reduction directly at telescope (overhead, bias, dark, flat, [WCS], [[photometry]])
- Help judge data quality
- Written in Python, publicly available
- No IRAF/pyRAF
- Made in Wisconsin :-(
Data reduction facility at UW

Local pODI reduction:

- 8-core machine
- 54 GB memory
- External Raid disk with ~10 TB capacity
- Raid-0 Solid State Drives with 1 GB/s read/write speed
- Talk to me for account
Things that (don't) work (yet)

- Working: Imaging/Dithering, guiding, data reduction, most GUIs, ADC
- Kinda working: pipeline, OT shifting
- Not working: Focus sensors
Some pretty pictures

M33, quickreduce reduced
Some pretty pictures

M33, quickreduce reduced
Bubble nebula, pipeline reduced
Horsehead nebula in Halpha
Thank you!