Automated Imaging with CCDAutoPilot 5
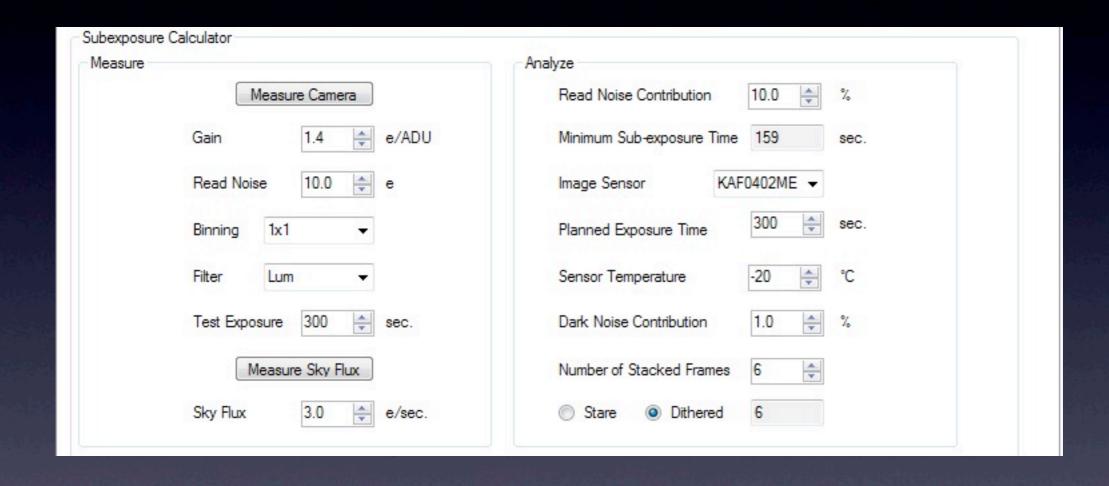
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November 4, 2011

It's All About Signal-to-Noise Ratio

- Signal is fixed so minimize noise

- Read noise is also fixed by camera design

- Skyglow noise is also fixed by location
  - square root of sky glow signal in e, not ADU

- Broadband: Bury read noise in Skyglow noise

- Narrowband: Take longer exposures

Sub-Exposure Calculator

- Measure camera read noise

- Determine sky glow

- Determine number of dark frames

- Investigate impact of dithering

- Investigate impact of temperature

Sub-Exposure Calculator

Focus Is Critical - Impacted by

- Temperature

- Filter

- Optical path stability

- Focuser repeatability

Focus frequently or strategically

Focus Strategically

- Determine Critical Focus Zone (CFZ)
  - Translate into focuser counts

- Determine focus for each filter

- Temperature coefficient of focus

- Number of focus runs vs. amount of data

CCDAutoPilot Tools

- Calculate CFZ

- Measure filter offsets

- Determine focuser repeatability

- Determine temperature coefficient of focus

- Many options.

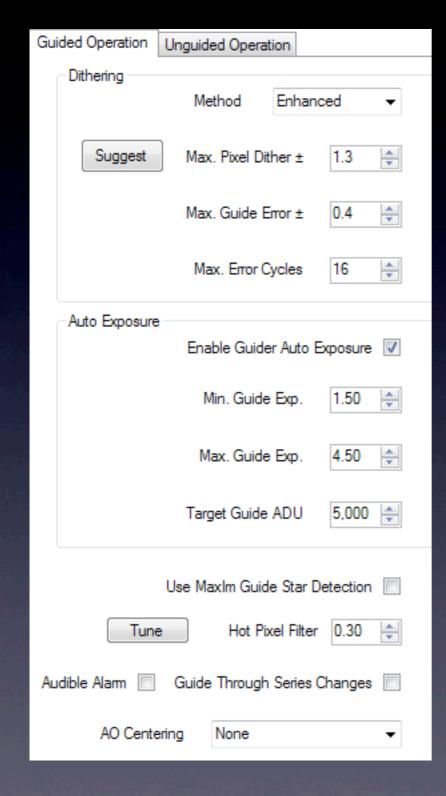# Focusing

Guiding

- Find a suitable guide star

- Determine guide star exposure

- Always dither

- Specify minimum and maximum move

CCDAutoPilot Tools

- Automatic guide exposure

- Hot pixel filter

- Suggested dithering amount

- Additional guide options

Guiding

Session Planning

- Make maximum use of good nights

- Pre-define targets

- Maximize imaging data

- Flats every night

Target And Data Definition

- Frame target in TheSky

- Specify data series

- Introducing templates

- Start and end time per target

- Flat frames for each target

Session Planning

Goal-Oriented Imaging

- How many frames?

- Of what quality?

- File rejects separately

Data Assessment

A Typical Result

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Data Assessment Results
         File Name                           FWHM          Stars      Aspect Ratio    Background

20:56:13 Lum600s_N7331_237E.02814.fit        2.72 a-s      1661       8.0%            1996 ADU
21:07:17 Lum600s_N7331_237E.02815.fit        2.97 a-s      1480       8.0%            1982 ADU
21:18:25 Lum600s_N7331_237E.02816.fit        2.60 a-s      1885       9.0%            1974 ADU
21:31:48 Lum600s_N7331_237E.02817.fit        2.57 a-s      1915       13.0%           1967 ADU
21:43:02 Lum600s_N7331_237E.02818.fit        2.45 a-s      2045       13.0%           1958 ADU
21:54:11 Lum600s_N7331_237E.02819.fit        2.69 a-s      1808       11.0%           1944 ADU
22:05:24 Lum600s_N7331_237E.02820.fit        2.53 a-s      1933       12.0%           1915 ADU
22:18:49 Lum600s_N7331_237E.02821.fit        2.83 a-s      1599       11.0%           1884 ADU
22:29:56 Lum600s_N7331_237E.02822.fit        3.05 a-s      1438       13.0%           1869 ADU
22:40:57 Lum600s_N7331_237E.02823.fit        2.93 a-s      1552       13.0%           1853 ADU
22:52:05 Lum600s_N7331_237E.02824.fit        2.89 a-s      1557       13.0%           1845 ADU
23:06:58 Lum600s_N7331_237W.02825.fit        2.95 a-s      1517       12.0%           1827 ADU
23:28:26 Blu1200s_N7331_237W.02826.fit       2.78 a-s      1123       11.0%           1472 ADU
23:49:30 Blu1200s_N7331_237W.02827.fit       2.68 a-s      1214       10.0%           1467 ADU
00:10:38 Blu1200s_N7331_237W.02828.fit       2.79 a-s      1079       11.0%           1467 ADU
00:31:42 Blu1200s_N7331_237W.02829.fit       2.76 a-s      1079       13.0%           1466 ADU
00:53:11 Grn1200s_N7331_237W.02830.fit       2.71 a-s      1303       13.0%           1548 ADU
01:14:09 Grn1200s_N7331_237W.02831.fit       2.61 a-s      1368       14.0%           1547 ADU
01:35:08 Grn1200s_N7331_237W.02832.fit       2.69 a-s      1306       15.0%           1546 ADU
     Moved to C:\Astro\20110923\Data Files\Failed\
01:56:28 Grn1200s_N7331_237W.02833.fit       2.54 a-s      1339       14.0%           1547 ADU
02:17:52 Red1200s_N7331_237W.02834.fit       2.81 a-s      1177       12.0%           1471 ADU
02:39:00 Red1200s_N7331_237W.02835.fit       2.73 a-s      1240       14.0%           1476 ADU
03:00:09 Red1200s_N7331_237W.02836.fit       3.23 a-s      790        13.0%           1479 ADU
03:21:22 Red1200s_N7331_237W.02837.fit       3.50 a-s      693        15.0%           1484 ADU
     Moved to C:\Astro\20110923\Data Files\Failed\
```
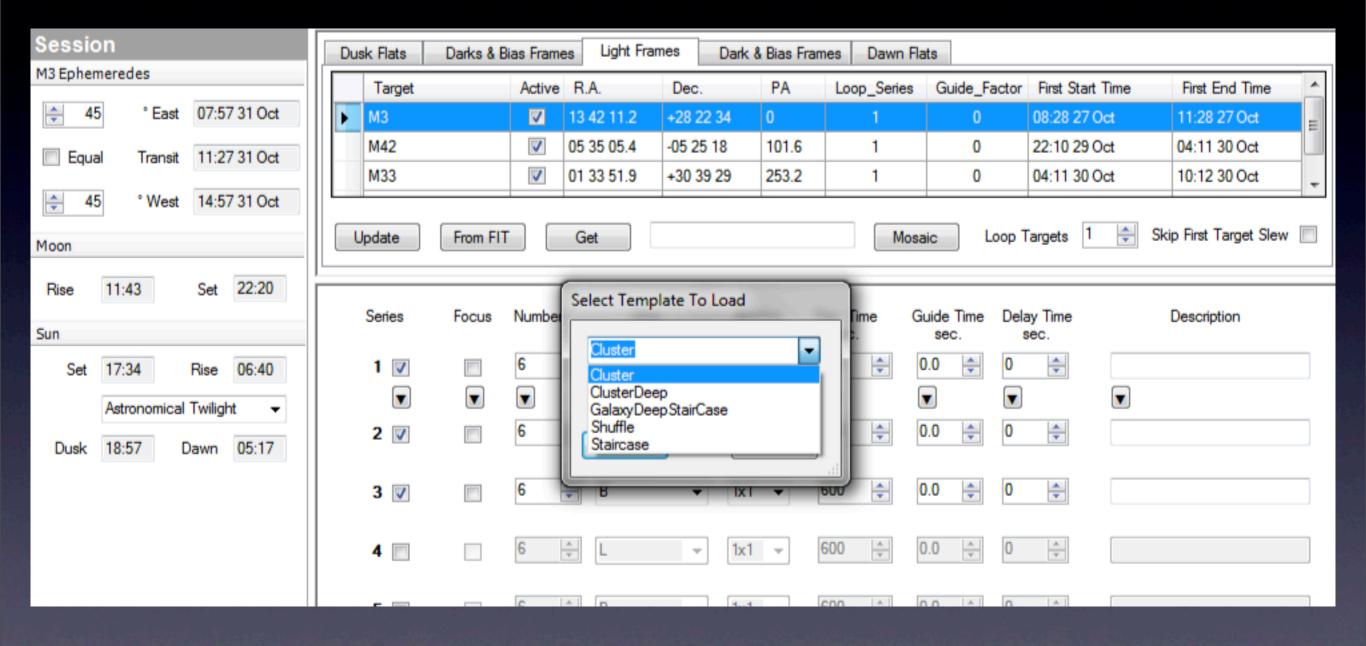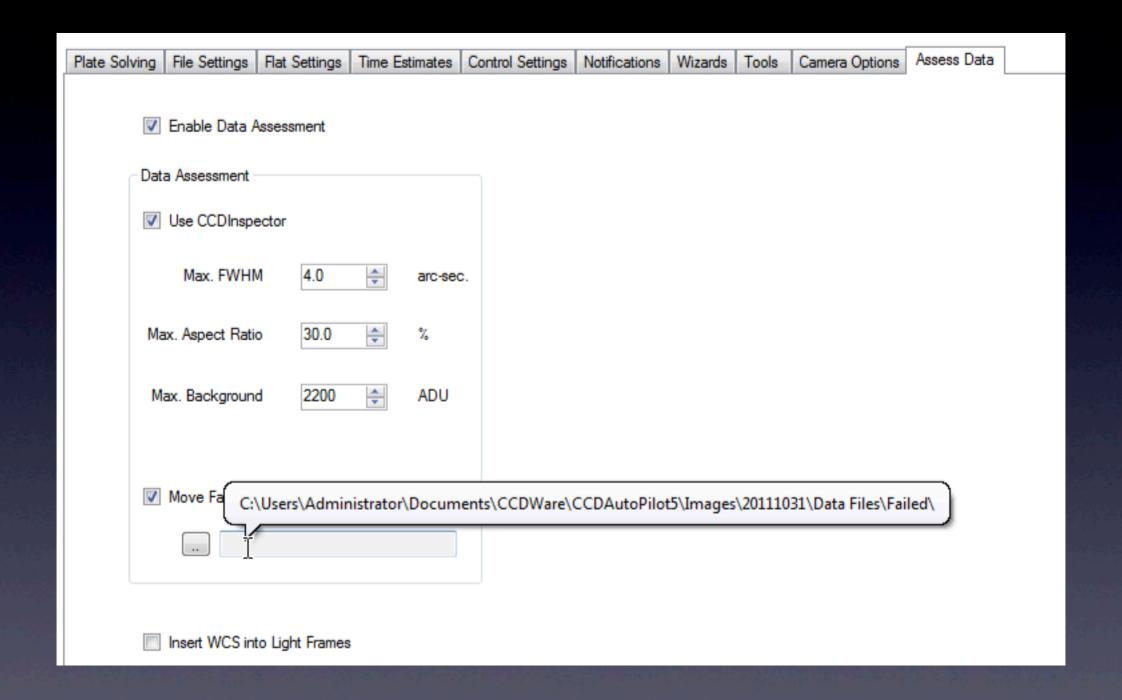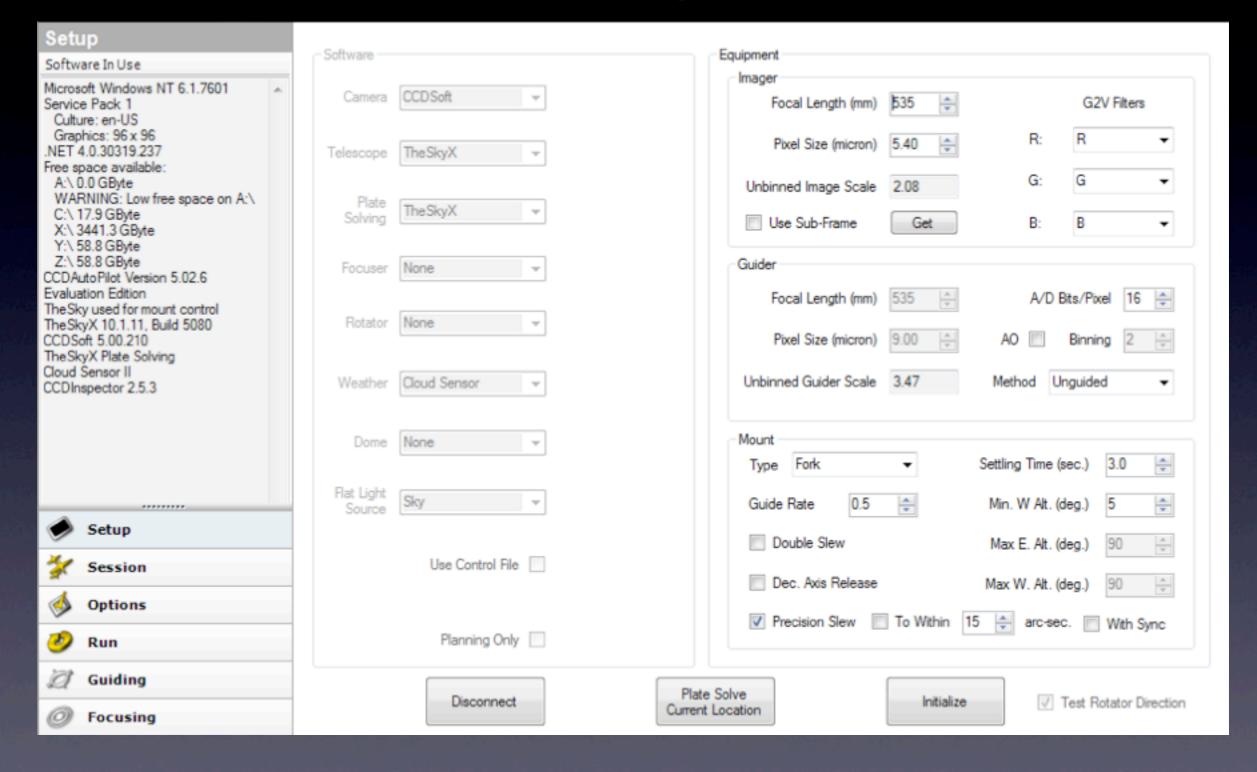
Setup

Options

Startup tab:

| Startup | Data Acquisition | Shutdown |

- ☐ Begin Session at   21:00 22 Feb ▾
- ☑ Begin Session   -10   Min. Relative to Sunset Before (-). After (+)
- ☐ Open Dome
- ☑ Cooler Start Delay of   10   min.
- ☑ Set Imager Cooler   -40   °C
- ☑ Set Guider Cooler   -10   °C
- ☑ Wait for   10   min. for Coolers to Reach Setpoint(s)
- ☐ Run 1   [...]   arg

Data Acquisition tab:

| Startup | Data Acquisition | Shutdown |

Dusk Flats
- ☑ Wait for Civil Dusk

Darks before Light Frames
- ☐ Run 2   [...]   arg
- ☐ Focus before Target Run Start

Light Frames
- ☑ Park Telescope
- ☐ Telescope Tracking Off
- ☐ Run 3   [...]   arg
- ☐ Close Dome before Darks and Dawn Flats
- ☐ Run 4   [...]   arg

Darks after Light Frames
- ☐ Run 5   [...]   arg

Dawn Flats
- ☐ Run 6   [...]   arg

Shutdown tab:

| Startup | Data Acquisition | Shutdown |

- ☐ Abort Light and Dark Frames at Dawn
- ☑ Park Telescope after Dawn Flats
- ☐ Telescope Tracking Off after Dawn Flats
- ☐ Run 7   [...]   arg
- ☑ Park Rotator at   155.0
- ☐ Close Dome after Dawn Flats
- ☑ Raise Cooler Set Point by 30°C
- ☑ Run 8   [...]   C:\Astro_scripts\SlewTo   arg

Settings

Thanks and have a good night's sleep while imaging!