Automated Imaging with CCDAutoPilot 5

John Smith November 4, 2011



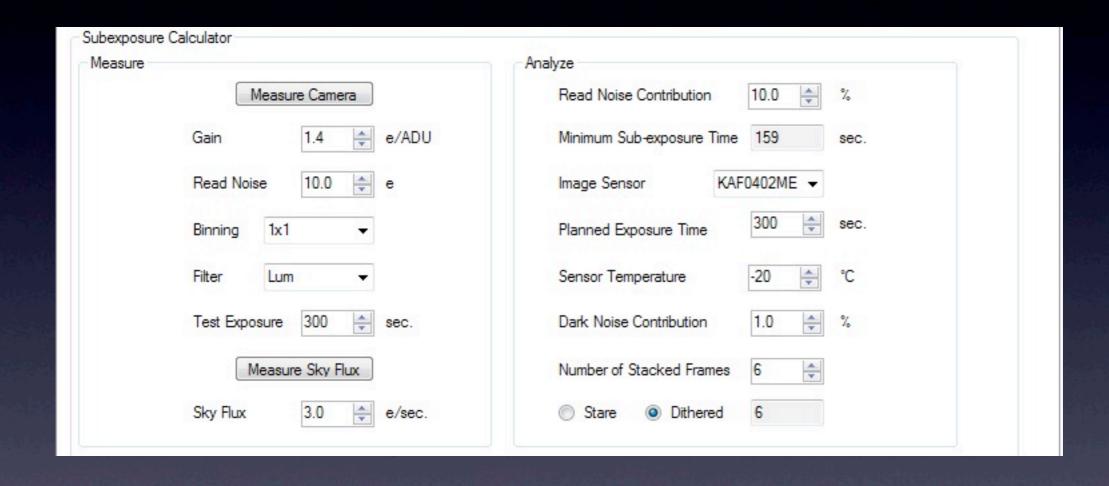
It's All About Signal-to-Noise Ratio

- 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

Focusing	(2) N				_	
Critical Focus Zone	Focusing					Focus Now
Color: Green ▼ Focal Ratio: 8.0 ♣	Focus Method None		Filter Factors Filter Name	Focus	Focus	Calibration
Focal Ratio: 8.0	Focus Star Position X: Y:			Offset	Exposure	Magnitude
CFZ: 0.0022 in.			R	0 💠	1.0	7.5 😩
Dust Donut Calculator	Magnitude Range 4 to 7			▼		•
Binning: 1X1 ▼	Center Focus Star within 300 🚖	arc-sec.	G	0 💠	1.0	7.8
Size: 100 🖨 pixels	Min. Focus Star Altitude 60 💠		В	0	1.0	7.3
Distance: 0.14 in. Units	Refocus Every 0	min.	L	0 💠	0.2	8.1
English	☐ Filter for Focusing: R ▼		Н	0	0.2	6.0
	Post-Focus Offset 0		OIII	0	0.2	5.5
Setup	Focus Timeout 5	min.				
Session Session						
Options	Temperature Dependent Refocus					
Run	Temperature Source None ▼					
☐ Guiding	Focus on Temp Change of 0.0					
⊘ Focusing	Use Temp. Slope of 0.0					

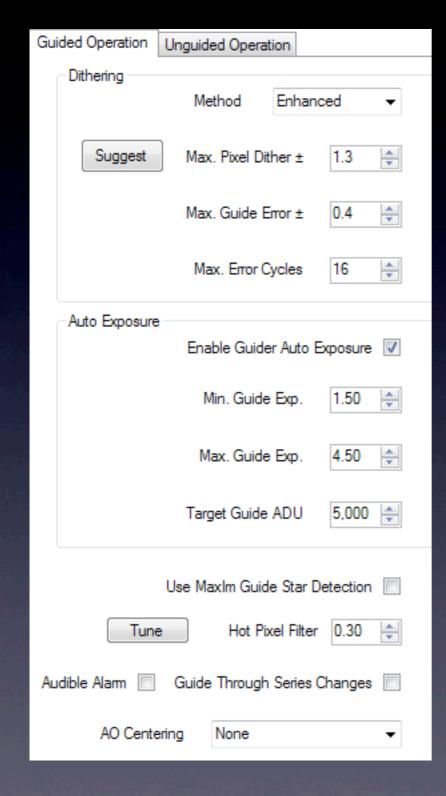
Guiding

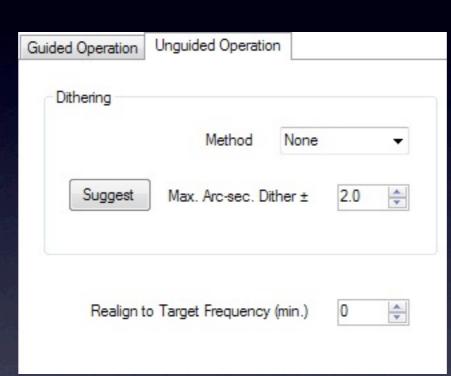
- Find a suitable guide star
- Determine guide star exposure
- Always dither
- Specify minimum and maximum move

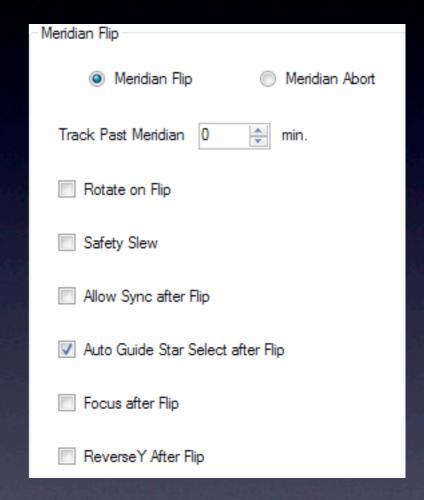
CCDAutoPilot Tools

- Automatic guide exposure
- Hot pixel filter
- Suggested dithering amount
- Additional guide options

Guiding







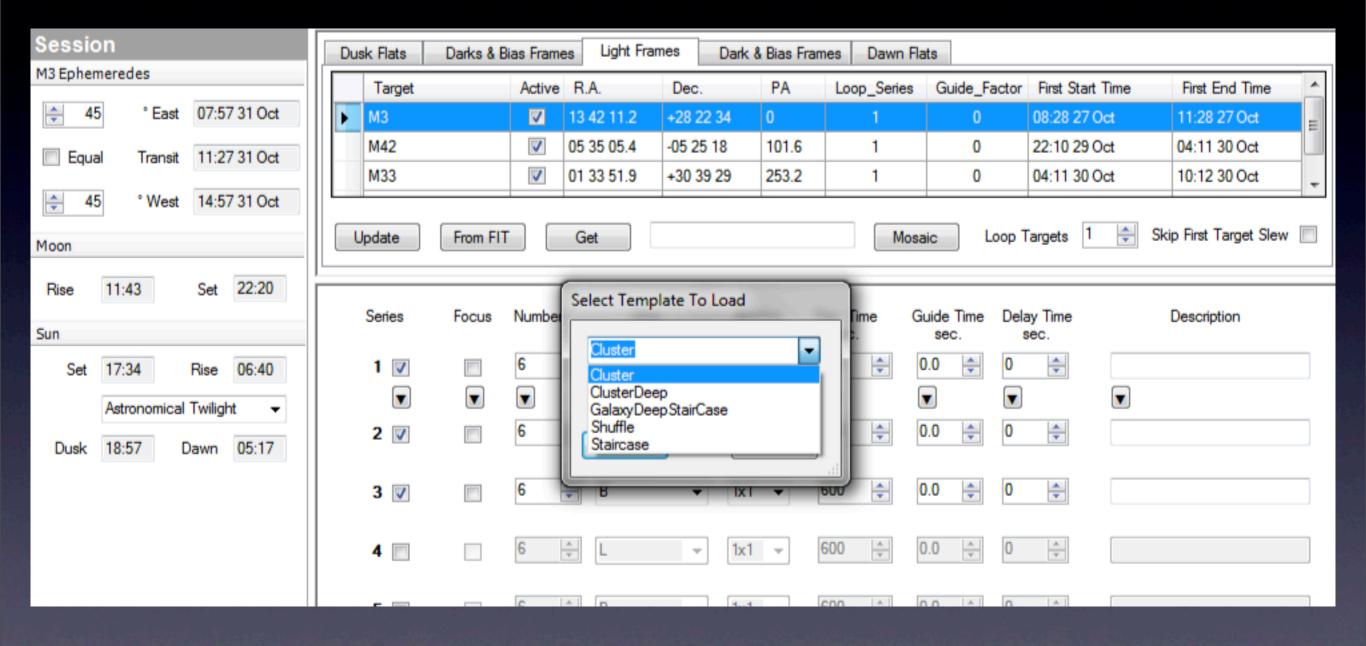
Session Planning

- 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

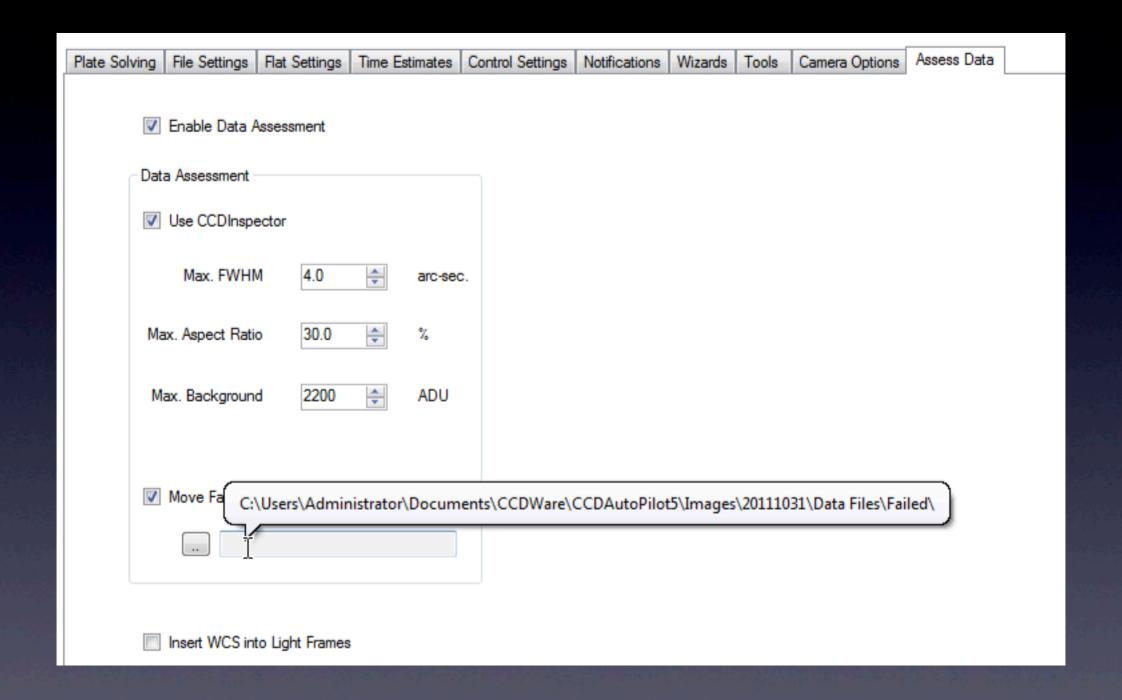
Session Planning



Goal-Oriented Imaging

- How many frames?
- Of what quality?
- File rejects separately

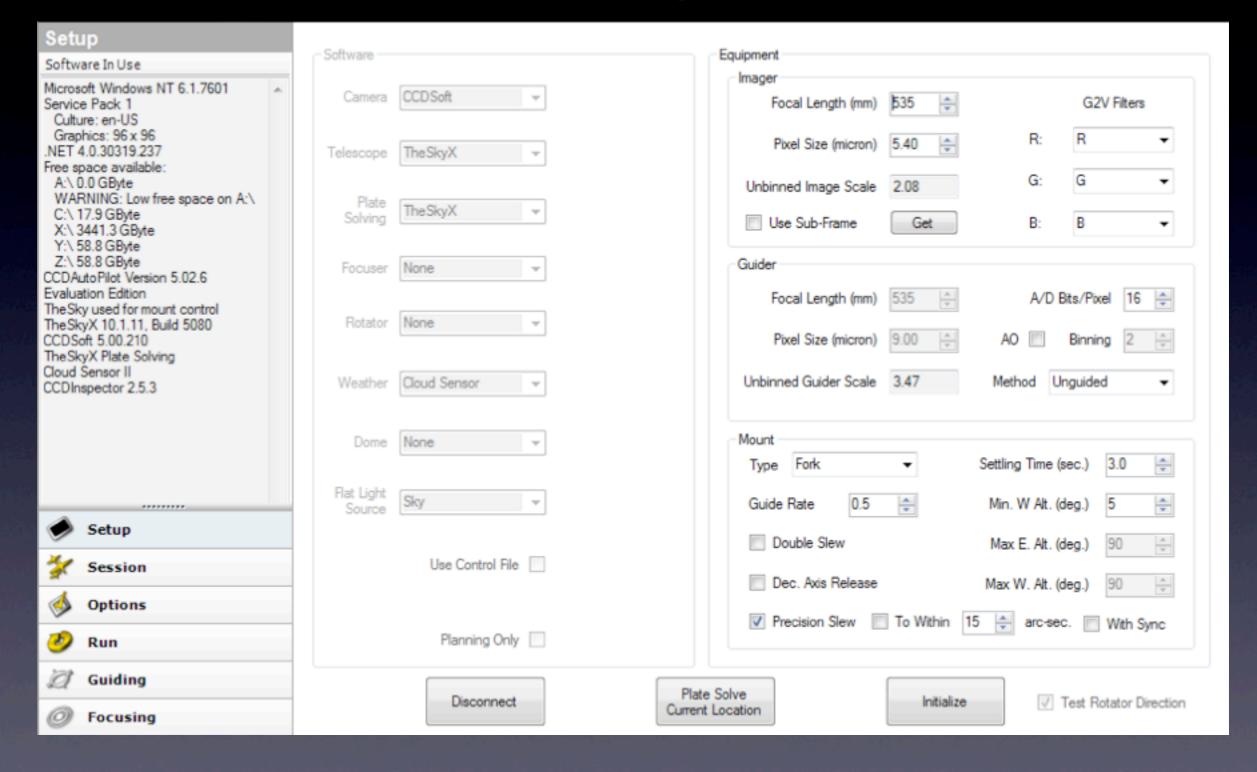
Data Assessment



A Typical Result

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\F	ailed\								
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\F	ailed\								

Setup



Options

tartup	Data Acquisition Si	hutdown	Startup Data Acquisition Shutdown		Startup	Data Acquisition	Shutdown		
	Begin Session at	21:00 22 Feb	Dusk Flats Wait for Civil Dusk		At	bort Light and Dark	c Frames at Da	wn	
V	Begin Session	-10 Amn. Relative to Sunset Before (-). After (+)	Darks before Light Frames		▽ Pa	ark Telescope afte	r Dawn Flats		
	Open Dome		Run 2	arg	<u> </u>	elescope Tracking	Off after Dawr	n Flats	
V	Cooler Start Delay of	10 🖨 min.	Focus before Target Run Start		■ R	un 7			arg
V	Set Imager Cooler	-40 ♣ °C	Light Frames				155.0		
V	Set Guider Cooler	-10	✓ Park Telescope		V Pa	ark Rotator at	155.0 🚖		
7	Wait for	10 🖨 min. for Coolers to Reach Setpoint(s)	Telescope Tracking Off			ose Dome after Da	awn Flats		
	Run 1	arg	Run 3	arg	✓ R	aise Cooler Set Po	int by 30°C		
			Close Dome before Darks and Dawn Flats	S. C.	 R	un 8 C:V	Astro_scripts\S	SlewTa	arg
			Run 4	arg					
			Darks after Light Frames	9					
			Run 5	arg					
			Dawn Flats						
			null o	arg					

Settings

Plate Solving	File Settings	Flat Settings	Time Estimates	Control Settings	Notifications	Wizards	Tools	Camera Options	Assess Data
								75 1	
G2V Ca	alibration								
R	Red		1.00						
G	Green		1.00						
В	Blue		1.00						
V	Auto Star Se		Abort						
Focus (Offset Measure	ment							
R	eference Filter	Lum	•						
М	leasurements/l	Filter	5 🚖						
	Meas	sure	Abort						

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

