

Mikael Svalgaard, www.leif.org/mikael



Telescope: 11"SCT, $f=2794\text{mm}$ (belongs to Michael Rask)

Camera: Lumenera 2-2M or Lumenera 2-2C

without barlow: image scale= $0.324''/\text{pixel}$

with 1.8x barlow: image scale= $0.180''/\text{pixel}$ (used below unless noted otherwise)

with 3x barlow: image scale= $0.108''/\text{pixel}$

First I will explore different alignment methods in Registax using a 3000frame SER file of Capella through a green filter with IR reject (capella_green.ser).

Using standard Registax settings and choosing different quality estimator methods. Quality estimator method 'gradient', 'local contrast', 'compress' did not succeed in selecting best frames (very poor result!). Methods 'human estimator' and 'classic' worked best. For best results you must choose a good image to be used as ref for the actual run (i.e. first do a align/sort run and then choose a good image).

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alignboxsize=64, singlepoint

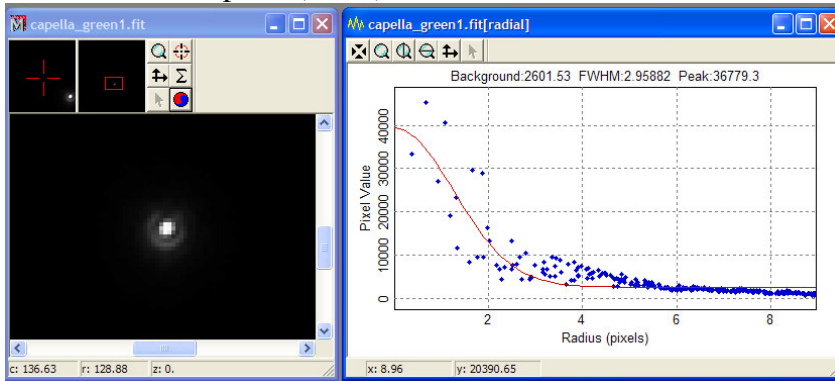
human estimator

used first image as ref, aligned and sorted,

manually selected 47 best images from sorted list

stacked and saved as 'capella_green1.tif'

=> FWHM=2.96pixel (0.53")



alignboxsize=64, singlepoint

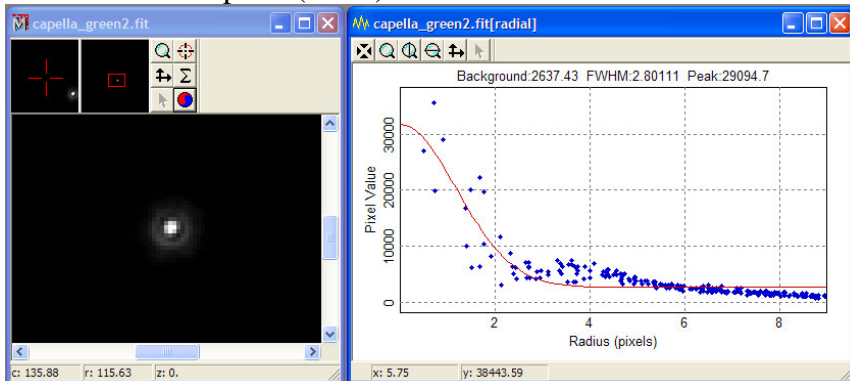
'human' estimator

chose one of the best images from above as ref, aligned and sorted

selected top 47 images from registax list

stacked and saved as 'capella_green2.tif'

=> FWHM=2.80pixel (0.50")



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alignboxsize=64, singlepoint

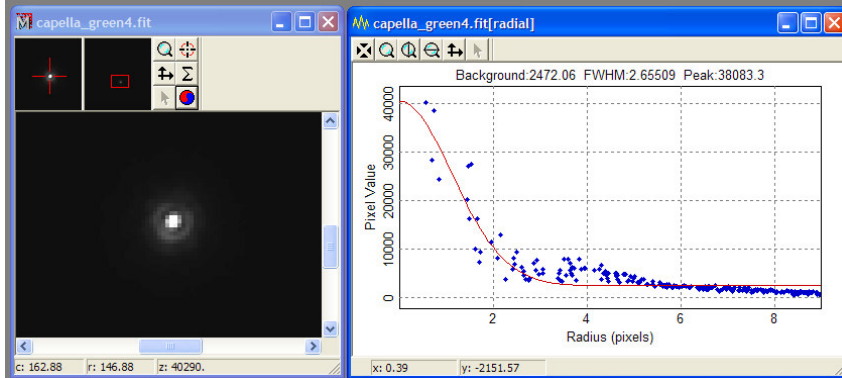
'classic' estimator

chose one of the best images from a pre-run as ref, aligned and sorted

selected top 47 images from registax list

stacked and saved as 'capella_green4.tif'

=> FWHM=2.67pixel (0.48")



alignboxsize=64, singlepoint

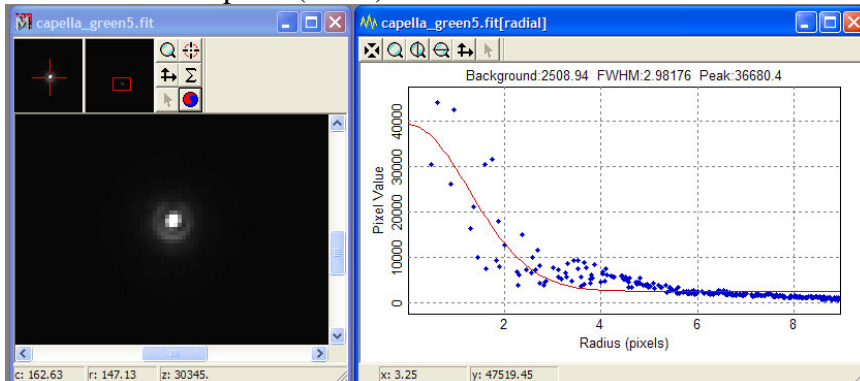
'classic' estimator

chose one of the best images from a pre-run as ref, aligned and sorted

manually selected 47 best images from sorted list

stacked and saved as 'capella_green5.tif'

=> FWHM=2.98pixel (0.54")



The quality estimator method 'Human' with automatic selection of best images is best in this case (highlighted in red).

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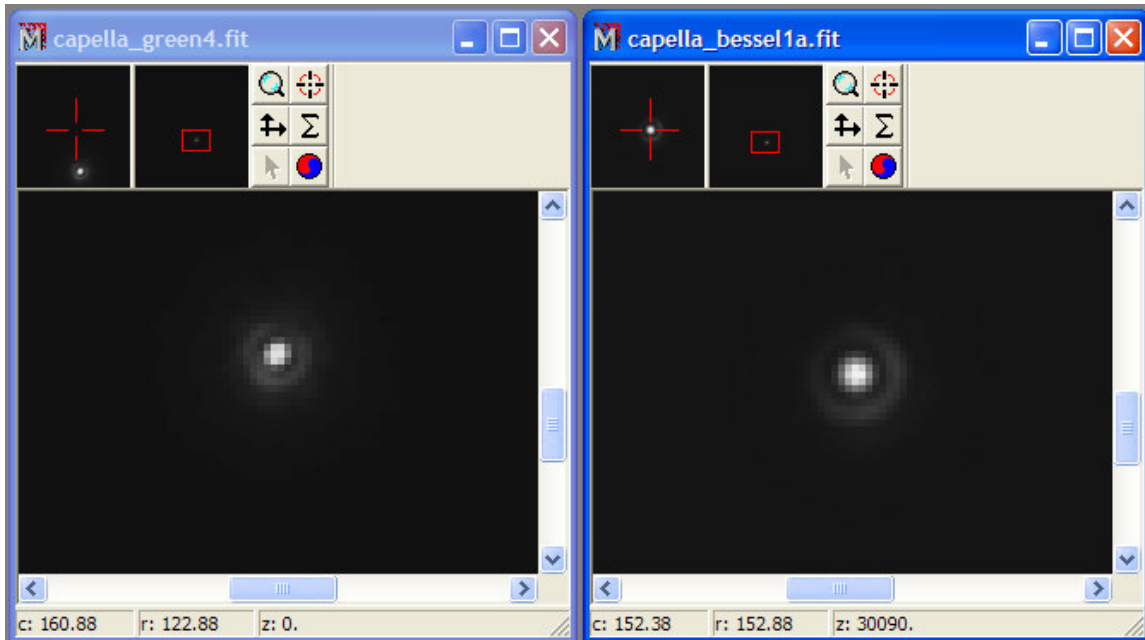
Let's use this method now and compare the use of a green filter with a Bessel IR filter. Some people say that IR is better for reducing air turbulence.

Green filter ('capella_green.ser')

=> FWHM=2.67pixel (0.48")

Bessel filter ('capella_bessel1.ser')

=> FWHM=3.62pixel (0.65")



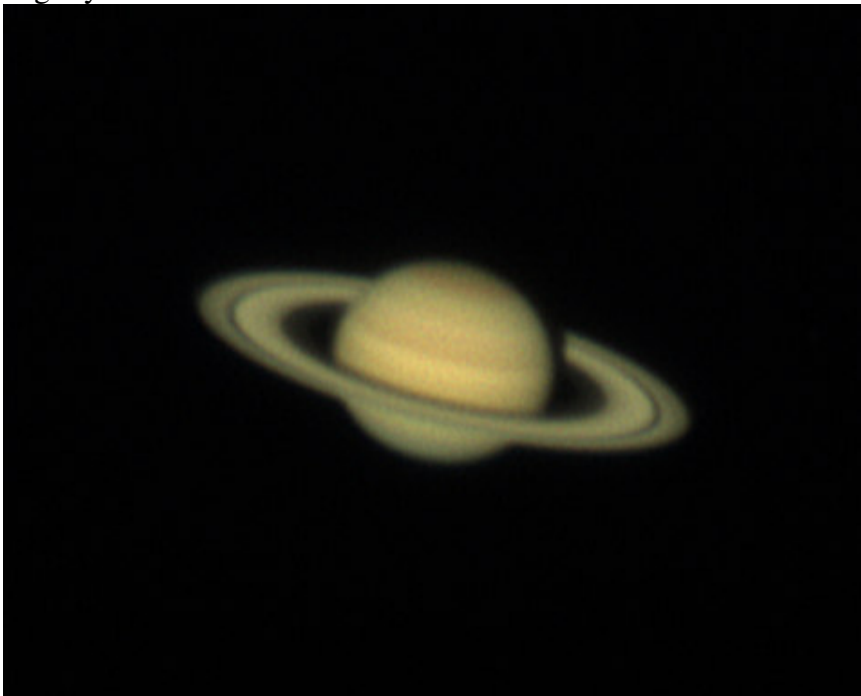
The increased FWHM with Bessel IR filter corresponds roughly to the increase in wavelength. **Use of Bessel IR filter is thus not recommended for maximum resolution.**

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Let's try Venus through the green filter. Here the 'gradient' quality estimator seems to work OK, will use. Manually selected best 16 images for stacking since there seemed to be quite a lot of ripples in many images. Applied wavelets (1,1,1,2.4,18.6,28).

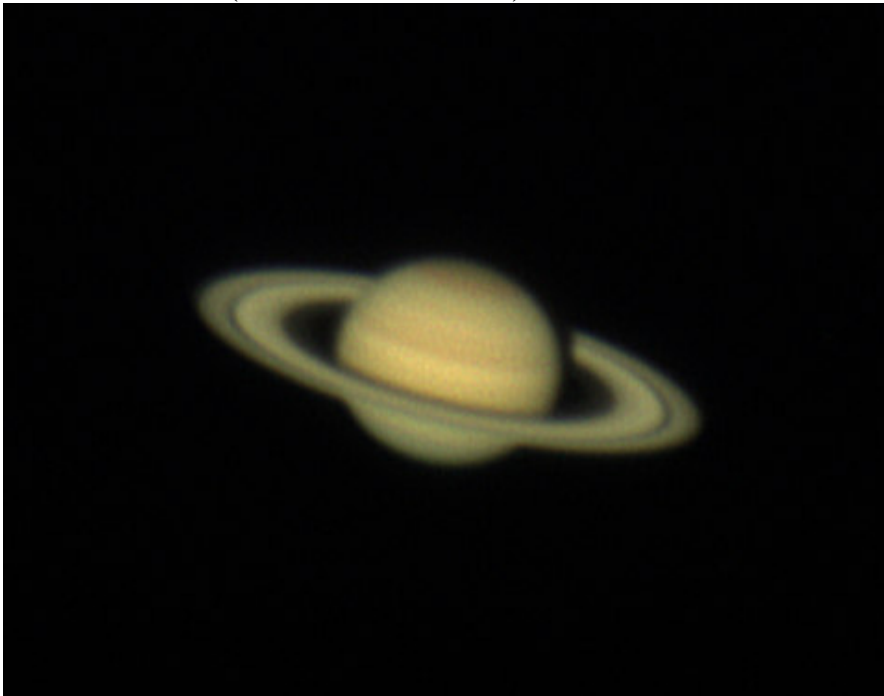


Let's look at Saturn with IR reject filter ('saturn2.ser'). Used 'gradient' estimator. Manually selected 56 best images from sorted stack. Applied wavelets similar to those used above for Venus. Used photoshop to align R,B frames and to boost brightness very slightly. Saved as 'saturn2a.tif'



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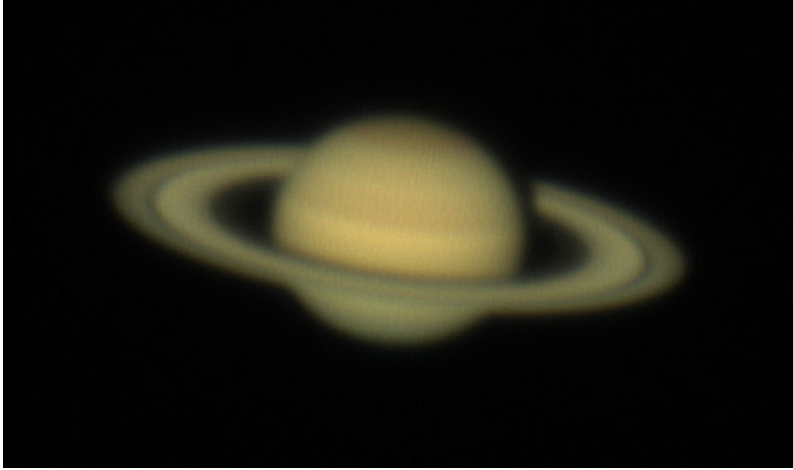
Below I used same processing, except I used first 56 images from sorted stack; i.e. no manual selection (saved as 'saturn2b.tif'):



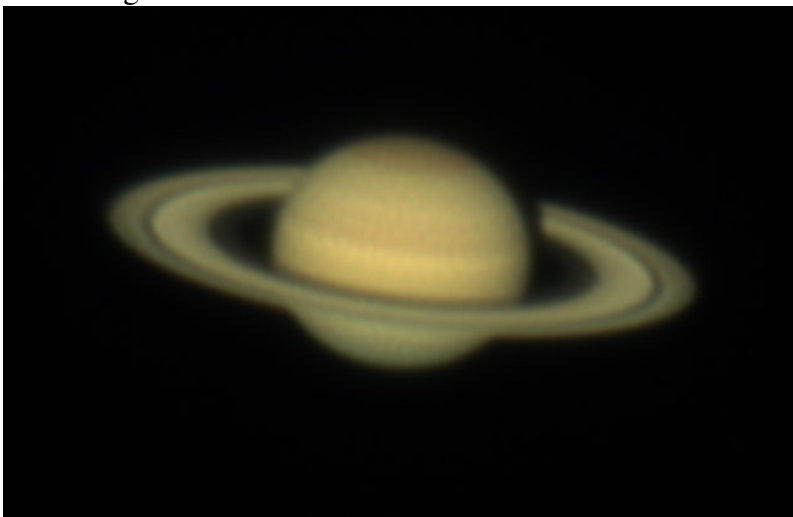
The difference is not large, but the manually selected image stack is best.

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Below is an image obtained with a 3x barlow (gradient estimator, 512 size box, good ref frame, LRGB=on, manually selected 63 frames from ordered list (among the best 600frames), in photoshop: aligned R,B; applied unsharp mask):



This image has less noise, but is slightly less sharp than 'saturn2a.tif'. Did 5 x LR deconv. on it using MaxIm:



This is the best Saturn image I got so far!

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Lunar images.

Test file: moontest3.ser (1.8xbarlow, bessell filter, monochrome camera, 1000frames, 123msec)

Quality estimator=gradient, alignboxsize=variable, multipoint alignment, normalized intensity over frames, feather=10pixels, multipoint stacking options: fast method=off,

stacksize for each area=64-74:

made these versions: no wavelet processing, 'karsten_luna1e.tif'
wavelet processing, 'karsten_luna1e-wavelets.tif'

stacksize for each area=17:

made these versions: no wavelet processing, 'karsten_luna1f.tif'
wavelet processing, 'karsten_luna1f-wavelets.tif'

stacksize for each area=9:

made these versions: no wavelet processing, 'karsten_luna1g.tif'
wavelet processing, 'karsten_luna1g-wavelets.tif'

64-74



17



9



A stacklist of 17 is significantly better than 64-74; stacklist of 9 is noticeably more noisy than 17 and does not have significantly higher resolution.

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moontest1:

excluding images above 2GB limit
found image with OK sharpness

Quality estimator=gradient
alignboxsize=variable
multipoint alignment (~17)
normalized intensity over frames
feather=10pixels
multipoint stacking options: fast method=off
creating reference image and re-optimizing

saved as moontest1a.fit (no wavelets)

With 1.8x barlow and green filter I got FWHM on processed star image of 2.7pix. Hence, on moontest1 where no barlow was used I expect a resolution FWHM= $2.7/1.8=1.5$ pix.

Doing LR deconv. (5 iterations), with varying PSF gaussian radius:

r=0.7



r=1.1



r=1.5



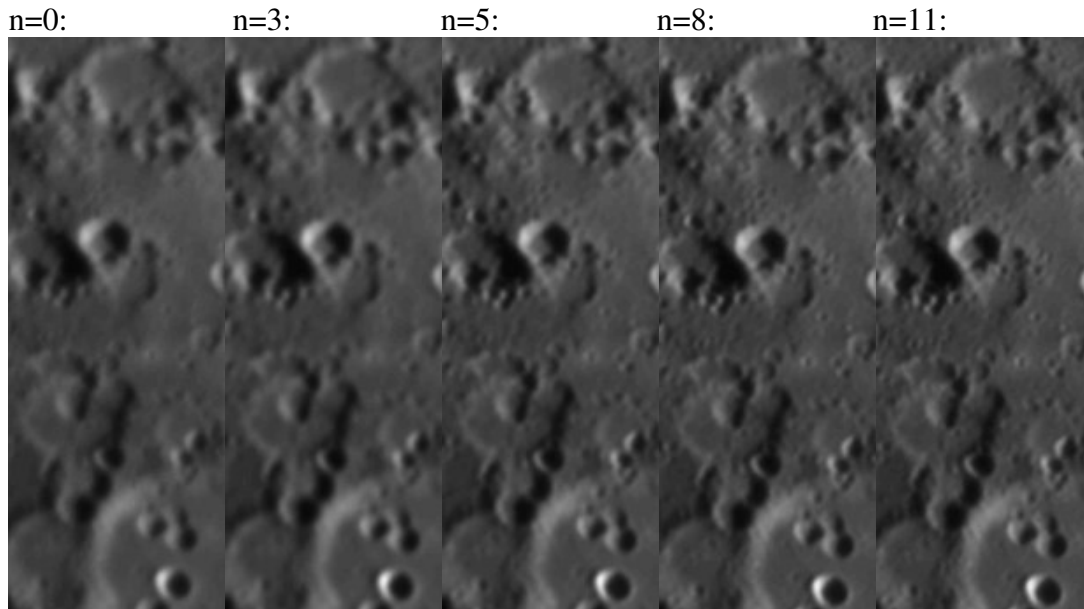
r=1.9



From this I estimate that r=1.4 is best.

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Let's look at how the image quality varies with number of iterations ($r=1.4$):



From this sequence I conclude that alot of iterations produce good results. Below is an image made with 30 iterations and it looks even better:



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moontest5:

excluding images above 2GB limit

from first attempt identified images that are too bright (confuses Registax):

94
137
220
379
392
400
432
502

excluded these also.

found image with OK sharpness (34)

Quality estimator=gradient

alignboxsize=variable

multipoint alignment (24)

normalized intensity over frames

feather=10pixels

multipoint stacking options: fast method=off

creating reference image and re-optimizing

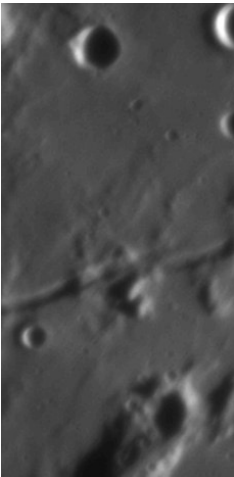
stacking 18-20 images for each alignment point (71 image frames in total out of ~550

image 2GB sequence)

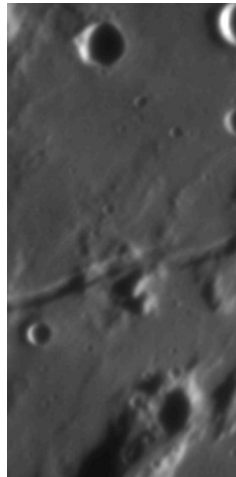
saved as moontest5a.fit (no wavelets)

With 1.8x barlow and green filter I got FWHM on processed star image of 2.7pix. Let's try 7 cycles of LR using a different gaussian radius:

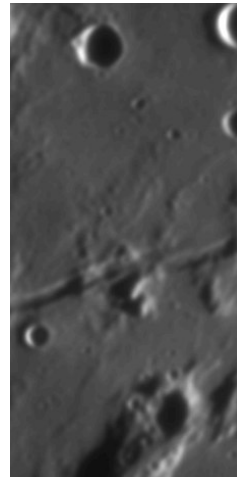
1.2



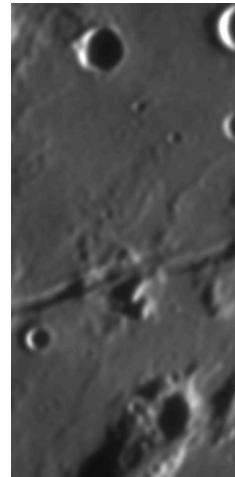
1.7



2.2



2.7



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Of these, I'd say that $r=1.7$ looks best. Choosing the correct radius is very important for the success of LR deconvolution. A systematic optimization should be done in each case. When a good radius is chosen the image can take more iterations before artifacts (such as brighter centers in shadowed craters) arise.

Doing 30 iterations of LR deconv. with PSF gaussian radius = 1.7.

Next steps:

Maxim: DDP filtering (no sharpening)

Photoshop: mild curves, mild brightness/contrast adjust?

smallest visible craters have a diameter of $4\text{pixels}=0.7''=1.3\text{km}$