Deep Sky mode Live Stacking with DS video cameras and MCSky software

A short time ago I put together a brief explanation of how the **Live Stack module** works in the video circuitry of Mallincam DS cameras (using fields) and in the MCSky software in computers (using frames). However, there were three important aspects that I did not address : (i) the stacking modes (**Planetary *vs* Deep Sky**), (ii) the factors that catalyse the **Pink Floyd** effect in Deep Sky mode (looks like a psychedelic light show), and (iii) how to increase the probability of avoiding it. Now is the time to explain these.

There is no simple cookbook recipe, no one-size-fits-all approach to Deep Sky mode Live Stacking in video. Nonetheless, I can explain how to increase the probability / liklihood of success.

Why "probability" ? Because the process of image capture is bookended between two primary factors: your local **sky conditions** before you capture photons and the **effective processing power** of your laptop / desktop machine to digest all the data you throw at it once your photons have been captured. Everything you do to increase the probability of a successful Deep Sky mode Live Stack ultimately depends on these two primary factors. Given

(a) your **sky conditions**
(b) the parameters related to your **scope**
(c) the construction of your **light train**
(d) your **camera** and its physical parameters and internal settings
(e) the settings you determine in the MCSky software
(f) the resulting firehose of data that you consequently **download** from your camera to your computer

the key question you have to ask is this : *"Is the computing power of your laptop sufficient to handle the data stream?"*. If it is not, then the next question is: *"What do you have to do to improve (likely reduce) the data stream so your computer is not overwhelmed"*. Remember: the Pink Floyd effect is caused by your computer being **overwhelmed** by the data it is trying to process. Of course, you can always simply speed up your computer (for example, dedicate it to astronomy only !), but by how much ?

So, we need to take a systematic look at what's contributing to the **volume of the data stream** from camera to computer. However, before we do that, let's look at the difference between Planetary and Deep Sky modes of Live Stacking in the MCSky software.

Planetary mode is designed to stack frames / images of bright objects like the planets and the Moon. Exposures and stacks will be short and, whatever telescope mount you use (polar aligned or alt-az), image rotation will be minimal. Therefore, Planetary mode Live Stacking aligns frames by shifting them horizontally and vertically, using the broad shape (continuous data) of the object of interest for alignment. It does not correct for frame rotation. For **polar aligned scopes**, this may suffice in order to achieve successful Live Stacking with longer-exposure, longer stack, deep sky objects. However, for **alt-az scopes**, uncorrected frame rotation with deep sky objects will lead to concentric star trails and streaking, especially at high astronomical altitudes (near overhead).

Deep Sky mode, by contrast, is designed to correct for all frame offsets, including rotation. It does so by identifying multiple stars (discontinuous data) in the frame and aligning them. There's a great deal of processing involved here. For example, first, the software has to distinguish stars from background noise, and it has to do this for all channels used. For a colour camera, that could involve 3 or 4

channels, increasing the data load by 200-300% compared with a monochrome camera ... and that's before we look at anything else !

Now, what's contributing to the volume of the data stream from the camera to the computer ?

Sky conditions are immediately pertinent here : sky glow (e.g. downtown light dome, upper atmosphere smoke or ice particles) will decrease the signal to noise ratio of stars in your light frames, making the computer work harder trying to identify stars from noise. If your observing site is providing you with a poor signal to noise ratio, you must allow for that in seeking to reduce the work load of your computer. BTW: I have seen the same impact on the Pink Floyd effect in frames within the Milky Way where the software has to work harder to distinguish very small stars from skyglow, compared with frames from just outside of the MW.

Polar aligned scopes contribute to easing computer work load by reducing frame rotation : they can eliminate it if they are very well aligned. Good polar alignment also reduces the smearing of sky glow, thereby improving the signal to noise ratio of stars in the light frames. BTW : good scope collimation and focus will improve the signal to noise ratio too !

The light train offers lots of room for reducing computer work load. Focal reducers increase both scope speed (optical "sensitivity") and field of view (more stars). Do not understimate the potential importance of focal reduction. With my DS287m on my alt-az 6" SCT, Deep Sky mode Live Stacking in my downtown backyard can be unstable using only a MFR5 focal reducer, but is steady as a rock if I combine the MFR5 (attached to the camera) and a x0.63 focal reducer (attached to the scope). The field of view is exceptionally wide, and I get no vignetting with this configuration.

Light pollution filters may increase the signal to noise ratio of stars in downtown environments, but if your sky is already dark they may reduce the sought-after photons from stars reaching your camera. You'll have to determine whether filters help you reduce computer work load, or not. It's a matter of "swings-and-roundabouts", as they say where I come from !

Your camera is a major work load factor for your computer. The chip on my DS10cTEC is way bigger than that on my DS287m. Given my downtown sky conditions and my laptop computing power, even on my well polar aligned 8" SCT, the DS10cTEC, even at binning 2x2, is sending too much data for successful Deep Sky mode Live Stacking by my computer. However, I get excellent Deep Sky mode Live Stack results with the DS287c on my alt-az 6" SCT. The DS287m has a smaller chip and only one channel : even though I am using bin 1x1 (more data than 2x2), my laptop can handle it.

You'll recall from my recent explanation of how the Live Stack module works that the Number box in the Live Stack window of the MCSky software determines the number of fields that the camera's internal circuitry captures, compiles and downloads to the computer for further processing when Live Stack is engaged. The higher that number, the more the computer work load increases. Rock recommends setting that number to 5 so as to ease the processing load on your computer.

Other parameters in the MCSky software also potentially impact the processing work load of the computer. Sharpening should be turned off for observing / imaging deep sky objects. Frame rate can be reduced if necessary. The histogram Black Point, White Point and Gamma can be fine tuned to improve the contrast between stars and the background sky (thereby improving the signal to noise ratio of stars). Saturation and Gain can be reduced, and Contrast can be increased, all to similar effect.

In short, learn how to fine tune your camera using the MCSky software in the context of the rest of your astro equipment and sky conditions ... and remember that ***any*** of the above factors could be determinant in getting successful Deep Sky mode Live Stacking. !

The bottom line is that Deep Sky mode Live Stacking using DS cameras and MCSky software works. If you are very close to overwhelming your computer, realise that your success could vary from night to night on the same object, or from object to object on a given night. However, you can tune your system to achieve solid stability, ***within the limits imposed by your sky conditions and your computer processing power***. I have had great success under dark skies (DS10TEC on polar aligned refactor) and under light polluted downtown skies (DS287m with double focal reduction on alt-az SCT), but I have to stick to Planetary mode with my backyard observatory scope (DS10cTEC on polar aligned SCT), simply because the way I choose to image with that scope (filters, colour, large chip etc) overwhelms my computer. However, that's my choice.Your mileage may vary from mine !

So, why put yourself through all this when you can simply use other software (e.g. Deep Sky Stacker Live) to obtain frame rotation, alignment and on-the-fly stacking without the risk of the Pink Floyd effect ? Quite simply, because this is video astronomy. Other stacking programs just treat individual saved frames as images, but Mallincam is a video system that compiles and processes fields in the camera circuitry in such a way as to enhance the signal of the deep sky objects you are observing / imaging before downloading the group of fields to the computer as a frame for further processing and stacking. Using third-party software means you will miss out on the "magic" performed within the camera circuitry. However, that's also a choice we have to make.

That's as far as my limited technical knowledge will allow me to take this. I hope it helps others better understand what their cameras and software are doing, and how to get the most out of them.

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