

Multiple imaging cameras in Maxim DL – tomh@tomhow.me.uk

## **Multiple Camera Operations in Maxim DL**

The Curdridge Observatory  
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## Introduction

Successful astrophotography depends on having a large number of high quality sub frames which build up a large integration. One approach to increasing the yield of sub exposures in a given imaging session is to turn to multiple telescopes and cameras on the same telescope mount.

A common requirement when gathering sub frames is to dither the sub exposures. Dithering means that each sub the pointing of the scope is randomly adjusted by a few pixels. This means that hot pixels and other unwanted artefacts do not appear on exactly the same pixel on each sub. When a number of dithered subs are stacked we use numerical methods reduce remove these problems.

The Maxim DL environment combines autoguiding and image capture. A sequence of sub exposures (perhaps 10 frames @ 10 minutes) can be defined. Between each exposure Maxim will implement the dither function by adjusting the autoguider aim point.

This is possible because Maxim has complete control over the guider camera, imaging camera and autoguiding function. It can perform the dither shift between sub-exposures.

A single instance of Maxim DL supports one imaging camera and one autoguider.

Whilst each mount will only ever need a single autoguider, adding a second imaging camera requires you to use a second computer running a second instance of Maxim DL.

However, Maxim DL does not contain a function to synchronise the imaging cameras across multiple computers. When doing a run of multiple sub exposures over a period of hours it is difficult to have both imaging exposures start at the same time on every frame – leading to the strong risk that the dither will happen mid-exposure on the secondary computer.

The purpose of this software is to detect the start of a sub exposure on the 1<sup>st</sup> computer and automatically start the sub exposure on the second computer. Assuming that all exposures are the same duration, dithering will work.

This software is not designed to coordinate the efforts of multiple telescope mounts.

## Target Audience

These instructions are aimed an the accomplished astrophotographer who is familiar with the operation of Maxim DL and is comfortable with installing software.

## Architecture

We define an architecture thus:

There is one telescope mount.

The MASTER computer is running the instance of Maxim that runs the 1<sup>st</sup> imaging camera and the autoguider and does the dithering for the telescope mount.

One or more SLAVE computers also run Maxim dl imaging with the 2<sup>nd</sup> and 3<sup>rd</sup> etc imaging cameras. The slave computers are not connected to the autoguider or telescope mount.

Our software comes in two parts. On the MASTER computer a program runs that detects the start of an imaging sub exposure. It then signals another piece of software running on each SLAVE to start an exposure.

For example, if I have two telescopes and two cameras plus 1 autoguider, I will have two computers, one is the MASTER and one is the SLAVE.

If I have three telescopes and three cameras, I would need three computers. 1 MASTER and 2 SLAVES.

Currently the software is limited to two slave computers - three cameras in total. If you wish for additional slaves please contact me on tomh@tomhow.me.uk

Please refer to the demo video here <http://youtu.be/dmqxgDJBmX8> which must be viewed in HD. Note, this is a slightly older version of the software.

### **Networking requirements.**

All of the computers involved must be networked together with a TCP/IP network. Whilst explaining networking is beyond the scope of this document, it is normally the case that all computers are plugged into a hub or router – normal windows networking will then put all the computers on the same TCP/IP network.

The software has features to tell you the network names of the slaves and checks that the master can connect to each slave, warning if there are problems.

### **Firewalls**

During initial runs of the software firewall software (e.g. windows firewall, zonealarm) will warn that either the MASTER or SLAVE software is making a network communications attempt. Naturally all such warnings should be accepted. Without unrestricted network communications the software is unable to function.

### **Installing the software**

There are two installers. One for the slave and one for the master. Do not install both on the same computer.

The MASTER installer should be installed on the designated master computer (the one in charge of autoguiding)

The SLAVE installer should be installed on each SLAVE computer.

In all instances I strongly recommend accepting the default options on the installers.

## Unlocking the software

Once the master installer is run, the master software can be started from Start>>Programs>Curdrige Observatory> WaspMasterSync

It will open a window containing an installation ID. Copy and paste this installation ID into an email and send it to me at [tomh@tomhow.me.uk](mailto:tomh@tomhow.me.uk). I will then reply with an unlock code which must be entered into this window for the software to function.

If you change your hard disk then you will have to email me for a new unlock.

No unlock is required for the slave software.

## Evaluation software

The software can be run without an unlock in evaluation / trial mode.

The software in evaluation mode will **not** stop running after a certain date – this is impractical in the world of astronomy. Each time start is pressed, the software will run for 15 minutes before needing to be restarted. This will allow you to evaluate with short exposures (e.g. 60s) and evaluate the software.

The software can be restarted after 15 minutes for an unlimited number of times.

Various “nag” prompts are also present in the evaluation period. You will be prompted for an unlock each time the master software opens.

These restrictions allow you to prove the software will work on your system – if you wish the software to be unlocked please contact [tomh@tomhow.me.uk](mailto:tomh@tomhow.me.uk) for payment details.

## Setup Summary

Setting up the software is summarised as follows:

1. Install the software running as evaluation or unlocking it – see above.
2. Setup the names of the slave computers on the master computer
3. Setup the SEQ files on the slave computers
4. Setup the sequence on the master computer
5. Start the master software
6. Start the slave software
7. Start the sub exposures.

## Configuring the software: Setting up slave names

The master software needs to know the names of the slave computers.

When the slave software is opened on the slave computer (start>programs>curdrigeobservatory>WaspSlaveSync) it will open a window and display

its computer name in the “My name” field.

On the Master computer, running the software will open a window that has two fields for slave computer 1 & 2. The names of the slave computers must be entered into these fields. If you only have one slave, leave the second box blank.

The names of the slaves entered into the master software will automatically be remembered.

### Configuring the software: Setting up the slave SEQ files.

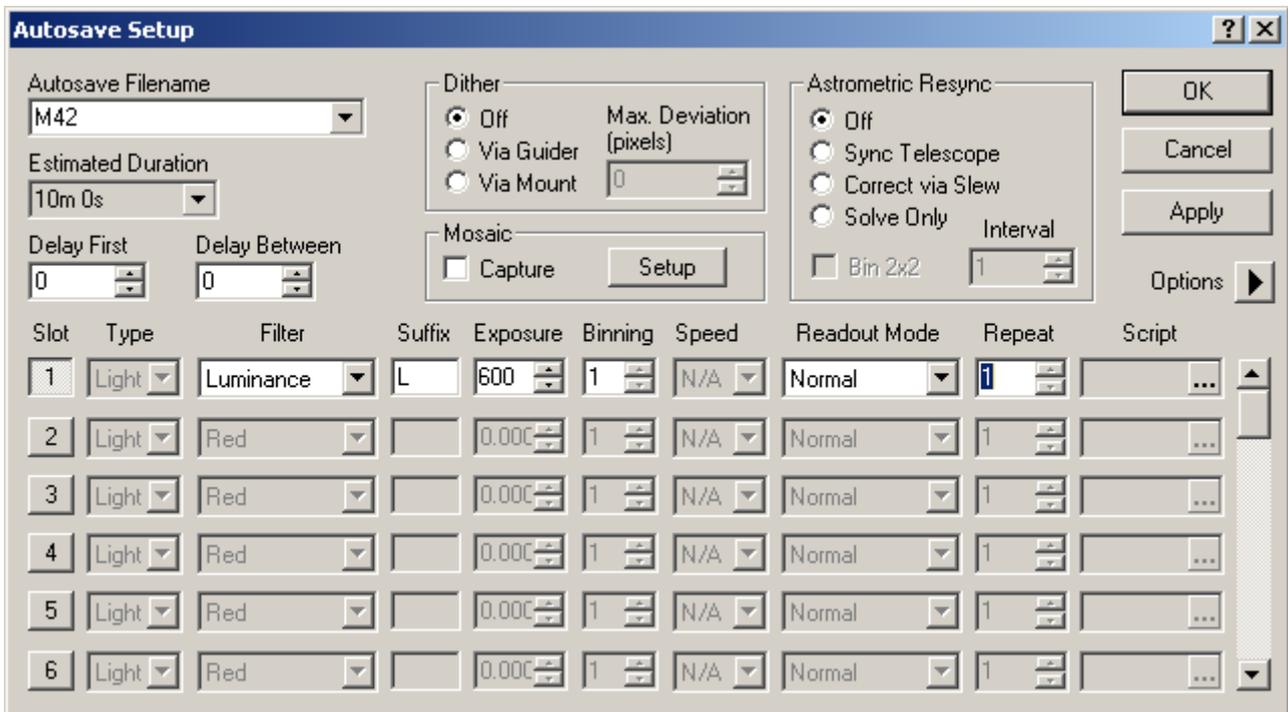
When the master software sends a start-exposure message to the slaves, the slave software will run a single sub exposure defined in a saved sequence file. Sequence files are defined in Maxim DL from the Autosave Setup window.

The sequence (1 exposure) must be saved as a maxim SEQ file on the slave.

On each slave computer you must setup the sequence for 1 single exposure of the required duration. Dithering will be off as the slaves do not have autoguiders.

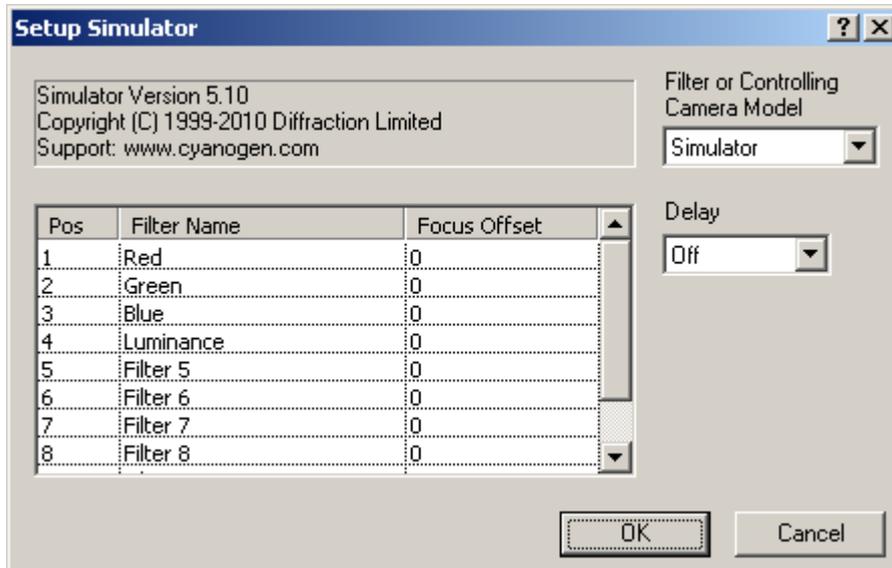
Although the sequence is only specified with 1 repeat, our software will execute this sequence multiple times.

I strongly recommend using the same exposure duration on all slaves and the master. e.g. 600s in this example. (note: during evaluation a maximum of 60s applies)

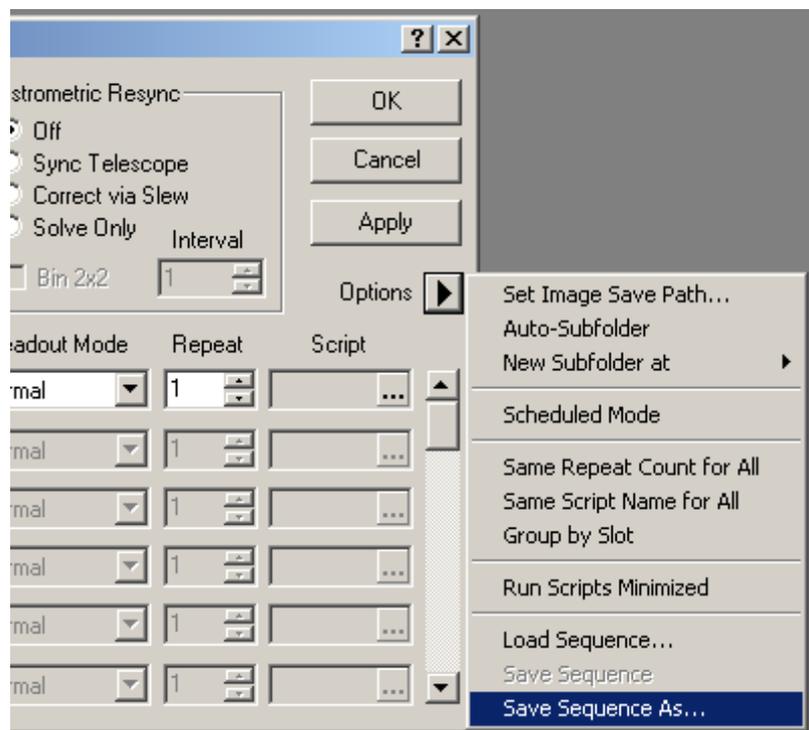


When Maxim receives remote messages to run SEQ files, a filter wheel must be setup to

avoid errors. If you do not physically have a filter wheel, please configure Maxim to use the simulator filter wheel. On the setup page of the simulated filter wheel you must set the delay option to off. If using this simulator option, be sure to take your flats with the same filter as the lights.



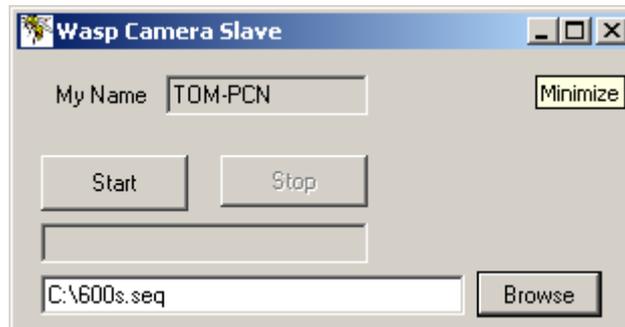
The sequence must then be saved in a sequence file using the menu choice in Maxim



The the seq file to some each to find location, e.g. [c:\600s.seq](#)

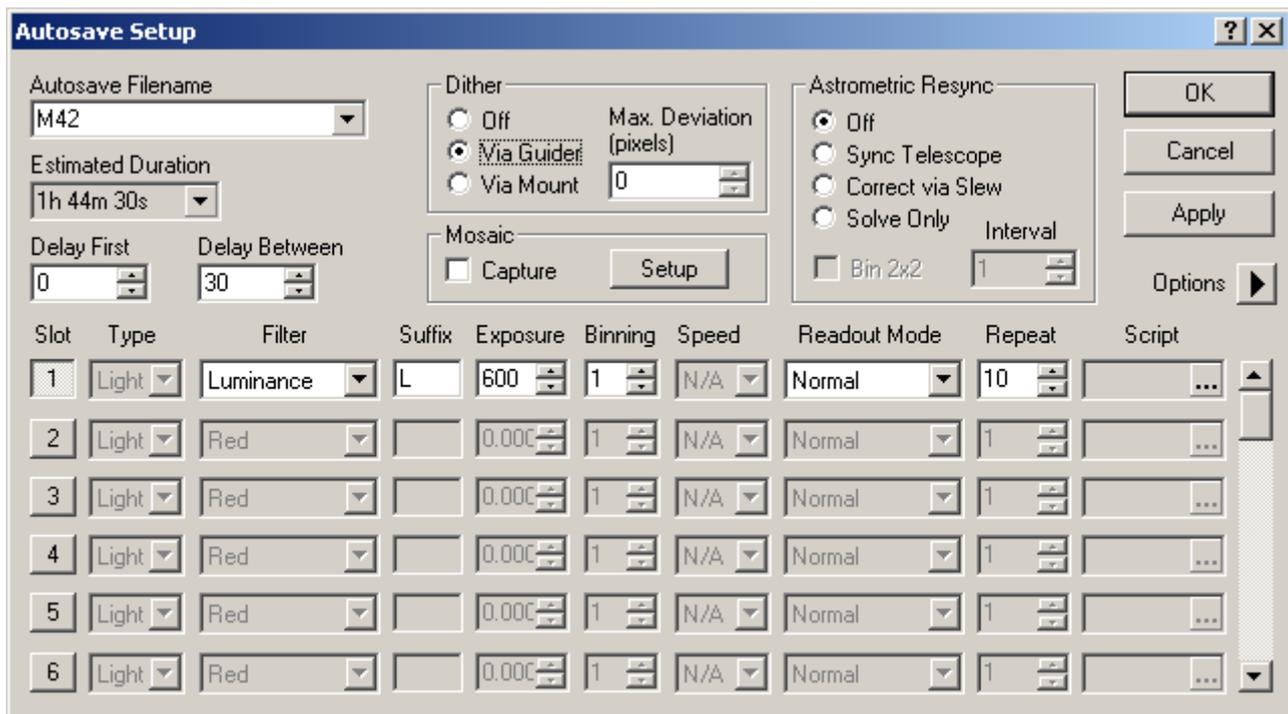
OK the autosave setup window. Repeat this SEQ setup on the second slave if applicable.

This seq file must now be specified in the slave software on the same computer as below. The browse button will allow you to select the SEQ file.



### Configuring the software: Setting up the master sequence

The autosave sequence on the MASTER computer must be setup for the full number of required subs instead of the single sub on the slave. You must also enter a generous delay between each exposure to allow for performance and download differences on the master and slaves, e.g. 30 seconds .



Dither will be turned on in your normal fashion.

OK the autosave sequence window.

### Running: Start the master program

Maxim should be running on the master computer and the autosave sequence setup as required. The cameras must be connected and the autoguiding calibrated and running.

Press the START button on the master program. It will now wait for Maxim to start a sub exposure. My single slave is called “tom-pcn”.



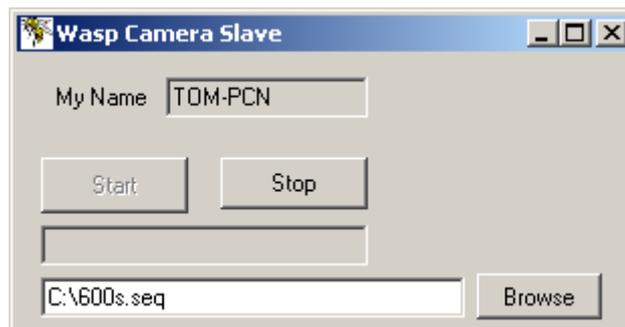
If the master software is unable to connect to Maxim dl it will give an error. The likely causes are an improper installation of Maxim, or the wrong product level of Maxim. It may also be required that you run Camera Sync Master as administrator. It is also possible that you have multiple copies of the software running. Either inspect task manager and kill them or restart your computer.

You may also have a block in your firewall program – add all our software as exceptions.

When pressing start, the master software will check that it resolve the IP addresses of the named slave computers and complain if this is not possible.

### Running: Start the slave

Maxim should be running on the slave with the camera connected and the sequence file setup as above. Press the start button on the slave and it will connect to Maxim, if this fails see reasons above.



### Running: Start the exposures

Everything is now ready to start the multiple exposure sequence on the master computer in Maxim as normal. You do not need to start anything in Maxim in the slave.

When the Maxim on the master computer starts the exposure you will automatically see an exposure triggered on the slave. Both exposures should end at roughly the same time and

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Maxim will download and save the images as normal. The master Maxim should then wait 30 seconds for the post exposure delay and then dither and then start the next exposure.

## **The Curdridge Observatory**

Our aim is to produce hardware and software solutions to maximise your astrophotography.

This document describes some standard software. If you require further modifications or assistance please contact me on [tomh@tomhow.me.uk](mailto:tomh@tomhow.me.uk)

### **Licensing note:**

This software is not produced by Diffraction Limited, the correct licensing of Diffraction Limited products is the responsibility of the user.