

The Occultationist and the Mac

Bill Walsh, 2019 Jan 28

Executive Summary

While Windows-based PCs are better supported and more commonly used in the occultation community, Macintosh PCs may be used during some of the steps of planning, recording and reporting our observations. This report shares methods of using Macs during the record/digitize step.

The experimenters

Based on suggestions made (via email) by David Dunham and the late Brad Timerson, a small working group evolved to help create digital versions of my observations using a Mac. Alphabetically:

Tony George
Greg Lyzenga
Chuck McPartlin

While Bob Anderson was consulted a time or two, the four of us – Tony, Greg, Chuck and I – were the folks responsible for the experimental results shared in this report.

I owe every one of the folks above many, many thanks for their attention, time and expertise. I would never have figured this out on my own!

Caveats, denials ... and acceptance

One clear result of our experiment: No matter which Mac software we used, no matter which software settings we chose, no matter which codec we selected, we were never able to match the quality of recordings made via the IOTA-recommended Windows software suite. Never.

That said, we discovered many ways to record with “plenty good enough” quality. Over the years, IOTA's observers have used lots of different equipment. Our recording gear has transitioned from audio cassette-tape recorders through video camcorders to today's stick and laptop computers. But finding a better way doesn't invalidate the old ones.

While we all lean toward capturing the most complete and noise-free recordings possible, we should remember that any valid observation report is better than none! If an observer is uncomfortable using Windows machines, we can support and encourage their Mac-based observations ... while nudging them to consider a more standalone, more complete Windows-based solution in the future.

To you Mac fans out there

Two key steps of the planning-to-recording-to-reporting observational process are not fully supported

via the Mac OS. A brief table of the software hits and misses:

<u>Phase/Task</u>	<u>Windows software</u>	<u>Mac equivalent</u>
Planning:		
Find local events	Occult, OccultWatcher, etc	Steve Preston and Derek Breit websites
Share observing sites	OccultWatcher, email	<i>email only</i>
Recording/processing:		
Digital capture	IOTA_VideoCapture, etc	iMovie, MPEG Streamclip
Create light curves	Limovie, Tangra, etc	<i>NA (not available)</i>
Analyze light curves	R-OTE, PYOTE, etc	R-OTE, PYOTE only
Reporting:		
Submit to IOTA via:	email	email

There is no Mac equivalent for (a) creating light curves of our observations. And no Mac software can access OccultWatcher's centralized clearinghouse for (b) sharing/claiming our observing chords among other observers. However, we have several paths forward:

- 1) Run Windows software on a dual-boot Mac or via Windows-emulation software
- 2) Find a Windows-capable buddy to bridge over our missing tasks
- 3) Buy a cheap Windows laptop or stick computer

1) While Windows software can be run via a dual-boot Mac and/or Windows emulation software, experience shows that data frames will likely be dropped if we try this for the “digital capture” task. Emulation also appears to draw down laptop batteries much more quickly than usual, possibly limiting our recording time.

Handling digital-capture via Mac software – as discussed later in this report – avoids both of these issues. So read on!

2) Finding a local WinBuddy is nice, but not essential. A distant buddy can help almost as well. Our files are usually too big to pass back and forth via email, but we can use web/cloud file-storage sites such as Google Drive and Dropbox.

Always remember our buddy may have been up late observing. They may be tired, busy and overloaded. Make sure we don't become some kind of parasitic growth. Treat them well!

3) In the long term, Mac users should seriously consider buying a cheap Windows laptop or stick computer. The capabilities of IOTA's Windows-only software tools have grown markedly over the past few years ... and this trend is likely to continue.

Windows laptops capable of all our planning-recording-reporting tasks can be found for less than \$200 (US dollars). Several diehard Mac users have now purchased cheap Windows laptops for use with their observations ... including one member of our experimental team:

After installing [a 250 GB solid-state drive], life is good! I've got all the occultation software I need for observing/planning [and creating light curves] on the Windows notebook. Then I

use a flash drive to move the data over to my main Mac system for analysis using PYOTE or R-OTE. This seems to be a very stable and convenient environment, and frankly I feel no nostalgia at all for my old days of fussing with media and settings in iMovie. So for anyone that has the budget to invest a couple hundred dollars in a new notebook, I wouldn't hesitate to recommend this path.

By contrast, Apple continues to diminish, remove and disable our Mac-based software tools.

Apple versus the occultationist

As most Mac users know, we are no longer the apple of Apple's eye. Not only have development and testing resources been shifted from the Mac to the iPhone, Apple is working to make it easier to switch from one device to the other. One way they've reduced the user-interface differences between iPhone and Mac is by steadily removing non-essential, "power user" Mac abilities over time.

Unfortunately for occultationists, several of our tasks rely on these non-essentials – in particular, handling video clips stored via no- or low-loss compression. So while we applaud each advance in Mac hardware, we've come to dread each new release of its software.

In the very near future, new, off-the-shelf Macs may be useless to occultationists. Capturing and processing our video clips may require an old, legacy system.

Digital capture via Mac software

Finally, it's time to share the methods our experimental team used to successfully connect analog video cameras to our Macs, digitally capturing observations into data files of a format acceptable for the next step (creating light curves) of the planning-to-recording-to-reporting process.

Note: As the methods of avoiding (and detecting) dropped video frames are identical to those for Windows machines – and have been discussed at length elsewhere – they are not repeated here. Suffice it to say, each Mac user on our team can capture video without dropping frames.

Hardware used

1) Among us, we had several different versions of Mac hardware and software. While software differences were obvious and created issues (to be discussed later), we were able to ignore the differences in our hardware.

2) We used two different video-time-inserter designs and several different cameras. Again, we were able to ignore their differences.

3) We used two different analog-video-capture devices – the IOTA-recommended StarTech SVID2USB23 device and the Orion #52181 device. Both performed well – any image-quality differences between them were undetectable amidst the manifold software selections.

Although the Orion device is cheaper – \$15 versus \$45, in US dollars – the StarTech device is often

discounted on Amazon. (Mine cost \$33.51.) And of the two, only the StarTech is supported by the IOTA_VideoCapture Windows software, enabling a future “upgrade” to a cheap Windows machine.

While we recommend the StarTech due to this Mac/Windows flexibility, both devices will do the job.

Software used

The process of capturing video and creating a Limovie-ready data file requires acquiring, configuring and running three pieces of Mac software:

- 1) A codec (coder-decoder) to encode and decode digital data streams
- 2) A device driver to:
 - Communicate with the video-capture hardware
 - Create an MOV-format digital version of the observation in the Mac's file system
- 3) A video editor to:
 - Trim unnecessary video footage at the head and at the tail of the observation
 - Convert from MOV to Limovie's required type of AVI format

1) Both the device driver and the video editor rely on outside codecs, several of which are supplied by the Mac OS. Various releases of Mac OS supplied and supported certain codecs and not others. In general, the later the release the fewer codecs it supports. That is not a typo. Apple has removed and/or disabled certain codecs and video-processing libraries over the years.

Codecs may also be silently added to a given Mac's OS by non-standard software packages installed on that machine. We limited our testing to OS codecs supplied by Apple. We tested OS versions 10.6.8 (Snow Leopard), 10.7.5 (Lion), 10.11.6 (El Capitan) and 10.13.3 (High Sierra).

Note: We did not test any device drivers or video editors under macOS 10.14 (Mojave). Reportedly, Mojave not only tightens security on third-party software, it warns that support for non-64-bit-capable software will be removed in a future OS release. None of the device-driver or video-editor software described in this report is 64-bit capable. So we'd love for some volunteer testers (and their WinBuddies) to extend our testing to Mojave ... and beyond. :-)

2) Both video-capture devices recommend downloading the latest Mac driver from their respective websites. In addition, we also tried an earlier version of each driver, but the later versions produced files of equal quality and (typically) provided more options as to codec and file format.

No driver version could create a Limovie-ready AVI file; separate video-editing software is required.

3) Apple's iMovie video editor was present on each of our Macs when originally purchased. We tested two different versions: iMovie 8.0.6 and 9.0.9.

Unfortunately, Apple removed AVI-format exports with the iMovie 10.0 release, coincident with the jump to OS X 10.9 (Mavericks) in October 2013. Therefore, any iMovie that's version 10.0 or later is useless for our purposes.

One of us had access to an earlier version (9.0.9) of iMovie and runs it successfully on their OS X 10.11.6 (El Capitan; post-Mavericks) system, rather than the iMovie 10.1.6 which came with it. Another team member uses iMovie 8.0.6 on their macOS 10.13.3 (High Sierra) system.

We also tested version 1.9.3b8 of a simple freeware video editor named MPEG Streamclip, available from www.squared5.com. If you Google this software, you'll find a lot of negative reviews. However, almost all of the bad reviews were triggered by Apple's removal of a library Streamclip relied on for some of its high-compression-format (lossy) conversions.

As occultationists want no- or low-loss conversions, we don't care about this issue. Even the “crippled” Streamclip makes MOV files into low-loss Limovie-ready AVI files, no problem.

Driver configuration and codec selection

With both Orion and StarTech video-capture device drivers, we used the MOV format for output files.

Chuck and Tony tested the codecs available via the Orion-supplied device-driver, called EZCap. The best quality (and a relatively small file size) came via selecting “DV/DVC PRO – NTSC”. (From here on out, I'll abbreviate this codec choice as “DV/DVCPRO”.) EZCap can also capture video from the StarTech device.

Greg, Tony and I tested the codecs available via the IOTA-recommended StarTech device-driver. Two selections gave top-notch quality: YUV422 and DV/DVCPRO. While the YUV422 codec gave slightly better quality than DV/DVCPRO, DV/DVCPRO images were visually more appealing – with a darker background and more contrast – and its files were one-fifth the size.

Bottom line: With the StarTech driver, both YUV422 and DV/DVCPRO codecs give acceptable quality. Pick the codec you prefer.

Video-editor configuration and codec selection

After testing a wide variety of Apple's codecs in all of their various configurations within iMovie, we found selecting the DV/DVCPRO codec produced the best quality and relatively small file sizes – as we had found with the video-capture device drivers. Based on this common outcome, we checked a much smaller sampling of codecs and configurations within MPEG Streamclip ... and DV/DVCPRO was once again our codec of choice.

Strangely enough, within iMovie the (presumably) uncompressed “Apple None” codec supported by early versions of Mac OS X produced lower quality files than DV/DVCPRO. There is no need to jump through hoops re-enabling support for Apple None in later systems, as we did.

1) iMovie is a powerful, complex package. We don't want or need most of that power. It's sometimes difficult to force iMovie to act dumb, to do nothing. And dumbness isn't always possible. No matter what we tried, we could not turn off all of its “improvements”. MPEG Streamclip – a simple, freeware program – produces star-image videos of measurably better quality.

However, iMovie can produce “plenty good enough” results. So if you're uncomfortable downloading a

freeware package and/or if you're already familiar with iMovie – and have access to a version prior to the 10.0 release – by all means use it! After choosing “Export using QuickTime...” (enabling AVI-format output), the selections that worked best for us were:

Compression: DV/DVCPRO-NTSC
Quality: Best
Frame Rate: 29.97
Scan Mode: Interlaced
Aspect Ratio: 4:3

Note: iMovie may offer up an “Optimize: Full size” configuration checkbox; in our tests, iMovie behaved the same whether that box was checked or not.

2) With MPEG Streamclip, we suggest choosing “Export to AVI...”, then selecting:

Compression: Apple DV/DVCPRO – NTSC
Quality: Slide pointer to 100%
Sound: No Sound
Frame size: 640 x 480 (unscaled)

... with all other settings left at their default values.

Note: We're still fine-tuning Streamclip's recommended settings. Volunteer testers (and their WinBuddies) are welcome. :-)

Where's the data?

What follows is not a full listing of our test results. It's only provided to give a flavor of how some of the various configurations stack up against each other ... and as an example of our methodology.

Two test fields of a sky region near TYC 0755-02073-1 were captured in quick succession using the same telescope, camera and StarTech capture device – the first by a Windows PC and the second by a Mac. On the Windows machine, IOTA_VideoCapture was used to create a Limovie-ready AVI file.

The Mac captured its field in the MOV format using the YUV422 codec offered within StarTech's device driver. The resulting MOV file was then shared amongst us and run through iMovie and MPEG Streamclip under various versions of Mac OS and iMovie, using multiple codecs and codec options selected within iMovie and Streamclip. This yielded many Limovie-ready AVI files.

The one Windows AVI file and all of the Mac AVI files had three specific stars analyzed via Limovie. For simplicity, only data for the first star is listed below. Similarly, within iMovie and Streamclip, many different codecs and codec settings were tested ... but only results using DV/DVCPRO and the 256-color variant of Apple None are listed here:

<u>Software/Codec</u>	<u>Star #1</u>			<u>File size (Mbytes)</u>
	<u>B Value</u>	<u>B Sigma</u>	<u>SNR</u>	
IOTA_VideoCapture	343.61	114.7	2.995728	59.7
Streamclip/DVDVCPRO	320.38	118.29	2.708428	37.8
iMovie/DVDVCPRO a	290.68	107.14	2.713086	35.9
iMovie/DVDVCPRO b	286.42	108.65	2.636171	35.9
iMovie/DVDVCPRO c	286.17	109.01	2.625172	35.8
iMovie/DVDVCPRO d	287.48	109.2	2.632601	35.9
iMovie/None256c a	225.95	91.1	2.480241	91.5
iMovie/None256c b	227.68	94.47	2.410001	91.8
iMovie/None256c c	231.71	90.6	2.557534	91.5

Note: a, b, c and d refer to data runs made using different versions of Mac OS and iMovie

As Tony points out, IOTA_VideoCapture provides a “gold standard” of quality the various Mac methods can only aspire to.

Examining the iMovie results, we see the small variations due to different Mac OS and iMovie versions pale in comparison to the choice of codec.

Finally, MPEG Streamclip provides a noticeable increase in quality over iMovie, when both use the best (DV/DVCPRO) codec.

Conclusions and recommendations

While Windows-based software tools provide the “gold standard” in quality, Macs can capture and format video observations which are “plenty good enough”. Hundreds of occultation-observation reports have been submitted to IOTA over the years based on data captured with a Mac.

Two different, inexpensive analog-video-capture hardware devices have been used with Macs. We recommend the StarTech SVID2USB23 because it's also supported by the IOTA_VideoCapture software used by many Windows-based occultationists.

Both MPEG Streamclip (freeware: www.squared5.com) and old versions of Apple's iMovie (prior to iMovie 10.0) can clip the head and tail from captured videos and re-format them into the desired AVI format for analysis by other software. Unless you're already familiar with iMovie or are uncomfortable using freeware, give Streamclip a try – it's simpler to use and produces better-quality files.

As none of these software tools are 64-bit capable, older (pre-Mojave) versions of Mac OS are preferred ... if not required.

Good luck ... and may you have clear nights with dark skies!