Astronomical Adventures

An Occasional Series on Building, Outfitting and Operating a Remote Observatory

By Manny Leinz

The first three parts of this series detailed the initial steps to realizing my dream of building a remotely operable astronomical observatory, from planning through building, first light and initial outfitting of the observatory at our vacation home in Mariposa, Ca. Episodes 1 - 3 were featured in last year's March, June and October editions of Prime Focus, respectively.

Episode 4 – Autonomy by Baby Steps

From the beginning of my observatory adventure, my goal has been to be able to perform all operations: from opening the roof, slewing to and imaging multiple targets, to downloading data and shutting everything down all autonomously from over 300 miles away from our home in Southern California. As a former aerospace engineer who developed avionics for spacecraft, I've never had any illusions that this would be easy. If something goes wrong with your satellite after launch there isn't a ladder tall enough to fix it, so all critical systems are at a minimum dual or even triple redundant, meaning that no single failure – or possibly two – can result in the loss of the mission.

Unlike satellites, however, there are almost certain to be 'single points of failure' in even the most well thought out remote observatory: if your roll-off roof jams in a rainstorm, you are getting in your car to make that long drive, but not before your precious equipment gets soaked!

These single points of failure worry me – a lot – but autonomy is not an all-or-nothing proposition. I will be approaching automation incrementally, increasing capability each step along the way and not moving on to remote autonomy until I am confident that all critical systems are as robust and reliable as possible.

The Steps on the Autonomy Ladder

The fact that the observatory is located over five hours away certainly presents significant challenges. However, having a vacation home on the same property as the observatory provides the opportunity to test all systems across the internet and work out the bugs prior to any long distance operations. With this thought in mind, I've outlined a plan to achieve autonomy in a number of phases, outlined below:

Phase 1- Manual operation from within the observatory. With power, mount, telescope, camera and computer available at the observatory, imaging can be accomplished locally and downloaded onto removable media for later post-processing. For many amateurs, this represents the 'end state' and is perfectly fine as long as you are willing to spend your nights in the observatory proper.

Phase 2 – Semi-automated operation from the vacation home. This capability requires some additional infrastructure, including an internet connection, and remote control software (we will discuss these shortly). I have further divided Phase 2 into parts "a" and "b". Phase 2a relies on manual start-up and shutdown – opening/closing the roof, turning power on/off and focusing – but enables all other operations to be conducted from the home over the internet. Phase 2b adds remote roof and power control, automated focusing and situational awareness cameras for safety.

Phase 3 – Autonomous Operation from Southern California - or Almost Anywhere. This capability requires remote control of subsystem power, added redundant systems for communication, and battery backup in the event of power outages. I've divided Phase 3 into parts "a" and "b" as well. Phase 3a requires opening and closing of the roof to be performed remotely by an operator – me – but allows all imaging operations to proceed automatically. Phase 3b adds autonomous startup and shutdown and therefore requires safety systems to ensure there are no obstructions during roof opening and closing. Also weather – particularly clouds and rain – needs to be continuously

monitored so that the roof may be closed automatically to protect sensitive equipment.

Moving Up the Ladder

Just as in climbing a ladder, each higher rung brings one closer to the ultimate goal, but also increases the consequences in the event of a slip and potential painful fall. I'm therefore making my climb slowly and deliberately, and hopefully enjoying the experience along the way.

As I've described in the first three episode of this series, at present the observatory structure is complete, the telescope is mounted and computer is operational. Phase 1 is solidly in place and I am moving toward Phase 2a.

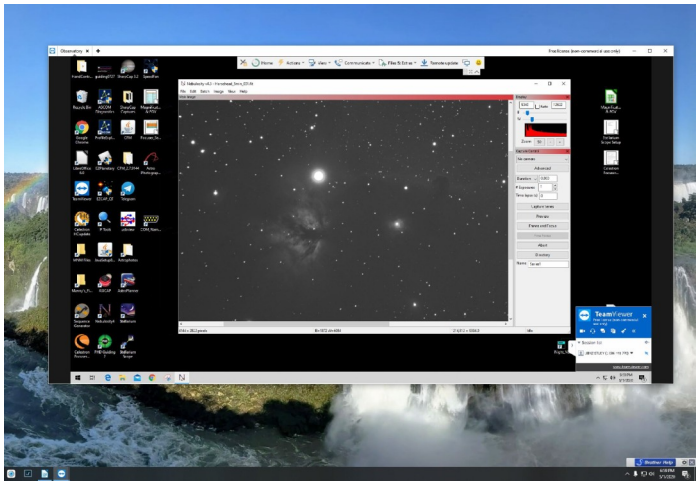
Remote Control

The obvious first step to controlling an observatory remotely, is to connect it to the internet. Since our home is about 200 feet from the observatory, I initially considered wireless options – wifi using directional antennas – to avoid trenching. Ultimately, though, considering the criticality of this interface, I decided to run a dedicated Ethernet cable. Thankfully, with the help of a local friend with a backhoe, we were able to complete the trenching in one long day on June 11, 2018. We ran a Cat 6e cable, rated for direct burial and enclosed in ¾ inch conduit for extra safety, with a second conduit providing a spare.

Ethernet Trenching Nearly Done - Those Rocks Were Terrible!

With the addition of a wireless router in the observatory – an Asus RT-12 – I was soon connected to the internet, and even had a wifi hotspot for better connectivity to my phone!

Better yet, the internet connection enabled remote control of the observatory computer from our vacation home. I looked at various options for remote control software, but quickly settled on Teamviewer (www.teamviewer.com). Teamviewer enables secure, password protected access, remote control and file sharing from a remote computer anywhere. Best of all, it is free for personal non-commercial use. Once I had downloaded Teamviewer and set it up, I was able to log into the observatory computer from our vacation home and control imaging sessions from there. The climb up the ladder has begun; Phase 2a here we come!



A Teamviewer Remote Connection to the Observatory Computer

As remote control becomes a reality, I have begun to seriously think about the limitations of my imaging setup. My observatory currently houses a vintage 2005 Celestron CGEM-1100, including an 11" OTA and mount. It has served me well over the years, but in the pursuit of a robust remote imaging capability, I've decided that I will need a more precise and reliable mount. That will be the subject of the next episode of this series.

Next Episode: Pausing for an Upgrade

P. S. If you'd like to hear more about my observatory build and plans for the future, tune in Sunday, May 17 at 6:30 PM, to hear my talk on the Astro Imaging Channel (www.theastroimagingchannel.org).