Trouble Shooting Agile from the Observing Specialist's Point of View

This document describes relatively simple things to do or check if Agile becomes inoperable, or if you face software problems. If Agile is mounted on the telescope and you have wasted fifteen minutes of 3.5 m telescope time figuring out the problem, then perhaps it is time to wake me up. My residential number is 503-648-6337 and my cell phone number is 503-809-9121. I offer a lifetime of support for Agile, the instrument lifetime of course, not mine. :-) If you have any other additions or suggestions on how to improve this document, I would really appreciate the feedback.

–Anjum Mukadam

1 Lost Communication with the Camera

If you are logged in to nimble, and attempting to run the camera results in an error message that communication to the camera is lost, then here are a few simple things to do. Also read through this section if you just tried to run the command "pvparam" and it resulted in a set of error codes (see the last step required to mount Agile at the NA2 port in the documentation). This section is also relevant if the observer typed cntl-c at a point when he/she was warned not to do so.

1. If the camera is not connected to the controller or if the controller is not connected to the computer (see section 2 for both these connections), then that would result in this error message. You will also see this error message if everything is connected, but the controller is not powered on.

2. If the driver for the CCD camera is not loaded or not loaded properly, then that would also produce this error message. Try executing the command "rmrsp" as user ccd on nimble. This should unload the driver, if it was previously loaded. If not, you will get an error message that you can ignore. Then please load the driver again using the command "inrsp" as user ccd on nimble. Check that the driver is loaded with the command "chkrsp", which should now result in the output "rspiusb 17292 0". Please note that none of these commands require a root or any other password anymore.

3. Sometimes the CCD camera crashes (and takes nimble down with it as well at times), and wipes off or corrupts the device /dev/rspiusb0 necessary to communicate to the camera. Please execute the command "rmdevrsp" as user ccd on nimble to remove the device /dev/rspiusb0. Then to regenerate the device again, please type the command "mkdevrsp" as user ccd. Please note that none of these commands require a root or any other password anymore. If all was well a moment before, and you suddenly lost communication to the camera, this is the first step to check.

4. If the observer typed cntl-c at a point when he/she was explicitly warned not to do so, then you will have to carry out steps 2 and 3 just above before the observer can acquire data again.

2 Integrity of Cable Connections

I will describe all of the hardware connections here, in case an incorrect connection may be the source of your problem.

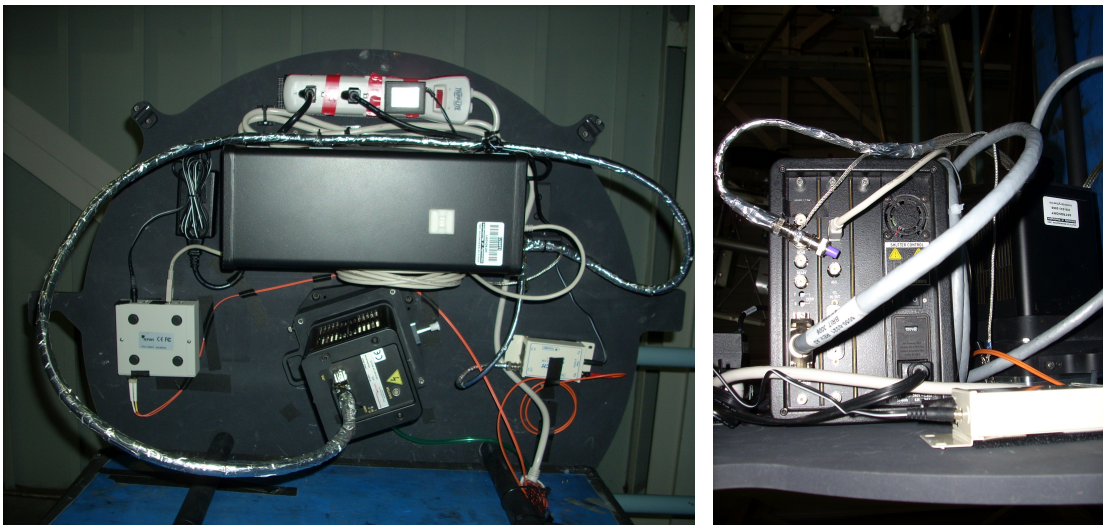

Figure 1: The triple-shielded analog cable covered with aluminium tape connects the camera to the electronics controller. Digital CCD images travel via a USB 2.0 cable into a media converter (visible to the left of the camera), that transmits these images through the orange duplex fiber-optic cable to the computer nimble. Exposures are controlled directly by GPS-synchronized pulses that travel through a separate fiber-optic cable into another media converter (visible to the right of the camera). These pulses then traverse via a foot long co-axial cable (also covered with aluminium tape) into the BNC connector marked as “Ext Sync” on the electronics controller after suitable termination by a 50 ohm resistance.

1. The CCD camera is connected via a 6-foot long triple shielded analog cable to the electronics controller (thick silver cable in the left panel of Figure 1). ACCIDENTALLY DISCONNECTING THE CAMERA WHEN IT IS POWERED ON CAN FRY THE CCD; this is not covered by warranty. If you ever manage to do this, it may not be the end of the world. The probability of frying the CCD is small. In either case, please report the circumstances and we will all work together in eliminating them, so that this may not happen again.

2. The digitization of the pixel values takes place in the electronics controller. The digital signal then travels via a USB 2.0 cable to an ICRON media converter, and then via a 75 ft duplex fiber-optic cable to the intermediate level. This cable is connected to a second 330 ft duplex fiber-optic cable using a LC-LC adaptor; the long fiber-optic cable is laid from the intermediate level up to the computer room. In the computer room, another ICRON media converter changes the optical signal to digital CCD images, which are transported to the data acquisition computer nimble via a USB 2.0 cable. To check that this connection is established, simply look for a lit LED on either of the media converters right next to the point, where the USB cable feeds into the media converter.

Suppose the LED is not lit, then you could try swapping the 75 ft fiber-optic cable between the intermediate level and the instrument with an equivalent spare cable kept in the Agile cabinet. This step may also need to be carried out if the cable got damaged from getting run over by another instrument cart for example. Thanks to Dave Woods and Nick MacDonald, the fiber-optic cables are now enclosed in a hard plastic braid that should protect them in case someone steps on the cable braid.

Spares and other un-utilized components of Agile have a new home in a filing cabinet that you will arrive at if you simply turn left after exiting the 3.5m control room and walk straight. On the left hand side, you will find cardboard boxes, one of which contains fiber-optic cables. Within this box, you will find a bubble FEDEX pack with two 75 ft long fiber-optic cables. To replace the CCD imaging cable, please use the duplex fiber-optic cable that has two strands of fiber.

3. Agile does not have a mechanical shutter; we use the frame transfer operation to end an exposure and initiate the subsequent new image. The frame transfer operation for non-zero exposures is triggered by a pulse carried via a co-axial cable to the controller. We connect this pulse to a suitable T-connector, terminate it with a 50 ohm resistor, and then connect it to external sync on the controller (see Figure 1). It is a common mistake to connect the co-axial cable to the topmost BNC instead of external sync. In such a case, in the absence of a triggering pulse, the exposure would never end and no new images would come into the memory. If you are not receiving images for non-zero exposures from the camera and are able to acquire bias images successfully, then it necessarily implies that the timing pulses are not reaching the electronics controller. Also it is important to terminate the co-axial cable with a 50 ohm resistance.

4. The data acquisition computer nimble houses a Brandywine PCI timing card that receives IRIGB pulses from the new GPS clock for synchronization. When the observer sets an exposure time of n seconds in the software, a command is sent to the timing card to generate a pulse every n seconds. This pulse is synchronized within a microsecond of GPS time in principle, and triggers the frame transfer operation in the CCD camera. These pulses start out from a custom-built little aluminium unit from a BNC connector marked “OUT”, and are converted into an optical signal. The pulses travel through a fiber-optic cable and are converted back into an electrical signal and are then connected to the controller as above. To check that this connection is intact, simply ascertain that the LED marked as “Receive” on the SI Tech media converter mounted to the right of the CCD camera is lit.

   If this LED is not lit, then please enter the computer room and check that the LED marked ”Transmit” on the SI Tech media converter near Nimble is lit. If it is, then you could try swapping out the short 75 ft cable between the intermediate level and the instrument with the spare cable kept in the Agile cabinet. As in step 2 above, please retrieve the FEDEX bubble pack with the spare fiber-optic cables and choose the single-strand fiber-optic cable meant for the timing pulse for the swap.

3 Recovering Nimble

Passing incorrect parameters to the camera can cause a system crash, that may also freeze Nimble. Our software needs to be more rugged in detecting such mistakes and preventing resultant crashes. Since the exposure control is dictated by the sync pulses, the hardware keeps on acquiring data even though the software quits. This is an unhappy state for the system, and to prevent a computer crash, you mush uninstall and re-install the driver rspiusb.ko. To do so, please type “rmrsp” and then type “inrsp” as user ccd.

If Nimble has indeed crashed, you will have to reboot the computer in the brutal fashion. Here are the steps needed to recover after nimble has been rebooted. You also have to carry out these steps to prepare nimble for observations even if you simply rebooted the computer.

1. The driver for the CCD camera auto-loads when it is connected to the computer and powered on. We have already setup scripts to auto-load the driver for the timer card every time that nimble is rebooted.

2. Please also delete the device /dev/rspiusb0 with the command “rmdevrsp” and then recreate a new device with the command “mkdevrsp”. You no longer require the root or any other password for either of these commands.

3. Type the command “pvparam”; you do not have to be root to execute this command. This should initiate the cooling of the CCD. Any attempt to run the camera will initiate CCD cooling, and should be followed by a distinct increase in sound from the camera.

4. Please check that the filesystem /export/images is mounted on nimble. The observer acquiring images with exposure times longer than 10 seconds can safely hope to write the data to this remote NFS mounted disk. On average it takes about a quarter of a second for nimble to write the data to /export/images, but this number easily varies under different conditions. Writing images to /export/images will also imply easy access to the data for the observing specialists to focus the telescope or otherwise.

4 Problems related to instrument timing

1. We have never experienced a crash related to the Brandywine PCI timer card, but for the sake of completeness, I will include instructions on how to load the driver that runs the timer card. Try executing the command “lsmod | grep Pci9030”; you do not have to be root to execute this command. If the computer response is “Pci9030 23432 0”, then all is well. If not, as root execute the command “/usr/src/redhat/BUILD/PlxLinux/bin/modload 9030” on nimble.

2. Devoid of an antenna, the timer card determines the current time to an integral second value using Network Time Protocol (NTP), and uses the GPS IRIGB pulses to fine-tune its value of time. Hence it is of primary importance that the ntpd daemon should be running on nimble at the time of data acquisition. The data acquisition program quits if the system is not running ntpd. Should you encounter this predicament, execute the command “service ntpd start” as root.

3. The data acquisition program issues a warning if the PC clock is not synchronized to NTP. If you choose to observe under these circumstances, please do check the status of the synchronization every 10 minutes. Typing “ntpq” followed by the command “pe” on the prompt should allow you to view the servers included in the configuration file /etc/ntp.conf and the results from polling them. A suitable server chosen by NTP shows up with an asterisk next to it, and this implies that the clock is synchronized.

4. If you observe timing problems, please ensure that the sync pulse co-ax connection on the electronics controller has been suitably terminated.

5. Uneven exposures may result from a noise pickup in the co-axial cable; please report the incidence of any uneven exposures along with the configuration of the instrument at the time to Anjum or Russell. We have found it necessary to ground the instrument to the mounting plate and shield the foot-long co-axial cable. You will notice a grounding wire attached to one of the clamping grooves, so that the shielding will attain the same ground potential as the telescope structure when Agile is mounted at the NA2 port, eliminating any potential ground loop problems. These arrangements should drastically reduce or eliminate any noise pick up in the co-axial cable that carries the sync pulses to the controller. Please do not attempt to fix the problem yourself in the middle of the night, but the short term solution would be to restart the program and cross your fingers that the noise pulses do not occur again.

5 Other Hardware Problems

1. Any noise visible in CCD images is likely to have been picked up by the cable between the camera and the controller because the signal is still in analog form. We have now covered this cable with aluminium tape, and grounded this third layer of shielding similar to the co-axial cable above. Should you observe intermittent noise in the CCD images, please be aware that it is a minor effect smaller than the inevitable read noise. Please report it to Anjum, and do not attempt to fix the problem.

2. In conditions of high humidity, if you are observing without a filter, you may get condensation on the CCD window. Simply remove the filter slide, and use a hair dryer or heat gun on low to shoot warm air through the filter slot for a few minutes or till the condensation is no longer visible. Please ensure that the hair dryer is not plugged into an orange plug (connected to UPS units) or you may end up with more problems than you started with. Ideally you should not see any condensation on the CCD window as we are now constantly passing a thin stream of dry air across it, but if you do, please send an email to Anjum, Nick, and Mark along with the humidity and dew point values at the time.