Speckle Instrument GUI - Linux User Guide

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1. Introduction

The Speckle Instrument GUI has been developed by The Random Factory (Tucson, AZ) in collaboration with the Speckle Instrument PI (Steve Howell) and collaborators (Nic Scott, and Mark Everett - KPNO).

2. Installation

The GUI and accompanying packages are packaged using the **gzipped tar** archives. To install the package :

cd \$HOME tar xvzf speckle-control-x.y.z.tgz

where x.y.z is the appropriate version number.

This installation will place the files in the directory *\$HOME/speckle-control*. Although it is possible to install the software to a different location, this is not recommended as it will be necessary to manually change the location in some of the scripts included with the drivers.

Run the Andor drivers installation script

cd \$HOME/speckle-control/andor-driver sudo ./install_andor

Configure the USB devices for rw access

cd \$HOME/speckle-control ./setDevicePermissions

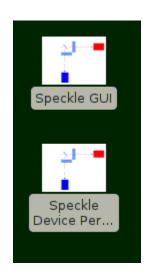
FOR GEMINI :

The Gemini computers are running a different version of Linux and need different links in the shared libraries. Unpack the prebuilt shared libraries by doing

cd \$HOME/speckle-control tar xzf untar-this-for-speckle-gemini-libs Once this setup has been completed, the interface can be started with the command

~/startspeckle2

These USB permissions can also be set using the desktop icon, and the program can also be launched with an icon double-click as well.



3. Graphical user interface.

The graphical user interface provides easy access to the major functions such as image acquisition, temperature control, and device setup and configuration.

The program will open a small main window, and then create a message window which shows the progress of the system startup operations.

Once the message window closes, the system is ready for use. The cameras are initialized, and temperature control has been switched on.

	Speckle	Control		↑ - □ ×
File Set ROI's Temperature Tools	Configura	ations		Help
Exposure 0.06 🖨 Binning 1 🖨	-52.9 degC	-54.3 degC	Comments : 🗖 Auto-clear	
Num. Frames 1 🗧 🗖 Display FFT	target	HR 7117		
Exp. Type Object 👻 🗆 Kinetic mode	ProgID	test		
Num. Seq. 1 🖨 Accum. 1 🖨	ra	+09:00:11.469		
File name : N20180706_000001 6	dec	+82:55:17.328		
	telescope	WIYN		
Observe Video Abort	instrument	speckle		
	DQ	- image		
Simulate : 🔽 Andors 🔽 Zabers	DQ	- cloud		
Telemetry V Filters	DQ	- water		
Configure data directory	D	Q - bg		
BLUE ARM		RED ARM	Frame Transfer	
Shutter=auto Temp Set -60 Autofit o	ls9 Sh	utter=auto Ter	np Set60	
Mode=wide Filter = clear	м	ode=wide F	ilter = clear	
🗆 EMCCD 🔹 High Gain 🛛 EM Gain 🔍 🗮 🗖	Auto Set 🛛 🗖	EMCCD 🗌 Hi	gh Gain 🛛 EM Gain 0 🚆 🗖 Auto Set	
Observation status : Idle		a 🚯 Q		

3.1 The main window

Most of the time the controls in this window will be the focus of observing activities.

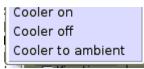
The following elements are provided :

3.1.1 Configurations menu

AcquireBright Standard SetupSingle SpeckleVideo SetupSeries AcquireFaint User selected Save current as

This menu provides quick setup for a range of commonly used observing or setup configurations. Each is a simple script (the sources can be found in \$HOME/speckle-control/config-scripts, and any new scripts which are added to this directory will be available as menu options after a GUI restart)

3.1.2 Temperature menu



This menu provides control over the camera cooler usage. Cooling may be switched on or off, and the "ramp to ambient" option may also be selected (this is applied when the camera is shutdown). The actual temperature setpoints are individually controlled using entry boxes in the main window.

3.1.3 Set ROI's menu

Acq-roi-128 Acq-roi-256 Acq-roi-512 Acq-full Adjust ROI Reset full-frame

This menu provides control over the data acquisition geometry. A range of "region of interest" sizes can be selected, or the geometry can be reset to include the full frame. If an ROI is chosen, then an image will be taken with each camera , and the best ROI of the requested size will be automatically generated centered on the brightest target in the image(s). If it is necessary to manually adjust the calculated ROI's, then selected that option and then use the ds9 controls to move them, and then click OK on the dialog.

3.1.4 Tools menu

This menu provides access to a set of commonly used option. There are two main types

Engineering Observing Filter Selection Camera status Plot timings HOME all stages zabers to wide mode zabers to speckle mode zaber red wide zaber red speckle zaber blue wide zaber blue speckle zaber input wide zaber input speckle

of item , GUI window visibility/mode, and Zaber stage motions.

The "Engineering" option resizes the main window to make visible an extra set of controls generally used for equipment characterization and setup.

				Speckle	Control		+ - = X
File	Set ROI's	Temperatur	e Tools	Configur	ations		Help
_				-52.9 degC	-54.3 degC		
Exposur		06 🖨 🛛 Binnin		BLUE ARM	RED ARM	Comments : Auto-clear	
Num. Fra		1 🚔 🔽 Displ	-	target ProgID	HR 7117 test		
Ехр. Тур			ic mode	ra	+09:00:11.469		
Num. Se		1 🖨 Accum.	1	dec	+82:55:17.328		
File nam	e: N201807	706_000001	6	telescope	WIYN		
Observe	e Video	Abort		instrument	speckle		
				DQ	- image		
Simulate	11 – 1	Andors	Zabers	DQ	- cloud		
		Telemetry	 Filters 	DQ	- water		
	Configure	data directory	1	D	Q - bg		
				_			
_	BLUE ARM		me Transfer		RED ARM	Frame Transfer	
Shutter	=auto Temp	Set -60	C Autofit d	s9 Sh	utter=auto Ter	np Set60 CAUtofit ds9	
Mode=	wide Filte	r = clear		м	lode=wide	ilter = clear	
	D 🗌 High	Gain EM Ga	in 0 🛢 🗆 4	Auto Set 🗌	EMCCD H	gh Gain 🛛 EM Gain 0 🍧 🗆 Auto Set	
		_					
Observa	tion status : Idle	9					
Vspeed		13			peed	1.13	
EMCCD H	IS 2	0		EM		20	
CCD HS	1 M	4Hz	INPUT	CC	D HS	1 MHz	
Move	to	0 Mo	veto	0	Move to	0	
Set	WIDE to current	: s	et WIDE to curr	ent	Set WIDE to cur	rent	
Set S	PECKLE to curre	nt Set	: SPECKLE to cu	rrent	Set SPECKLE to cu	irrent	
Set	HOME to curren	t S	et HOME to curr	rent	Set HOME to cur	rent	
	Load	Sa	ve Loa	d	Save Lo	ad	
	-744						

The detailed readout parameters of each camera can be manipulated, and the zaber station positions edited and loaded/saved. For Gemini, extra controls for the Focus and Pickoff stages, and the pico motors are also included.

The "Observing" option returns the main window geometry to the default , hiding the Engineering controls.

SPECKLE Filter Wheels control										
Red Position	Red Filter Name	Red Focus offse	et Blue Position	Blue Filter Name	Blue Focus off					
1	Red-I	0	1	Blue-U	0					
2	Red-Z	0	2	Blue-G	0					
3	Red-716	0	3	Blue-R	0					
4	Red-832	0	4	Blue-467	0					
5	clear	0	5	Blue-562	0					
6	clear	0	6	clear	0					
Load	d configuration	Save c	onfiguration	Clos	e					

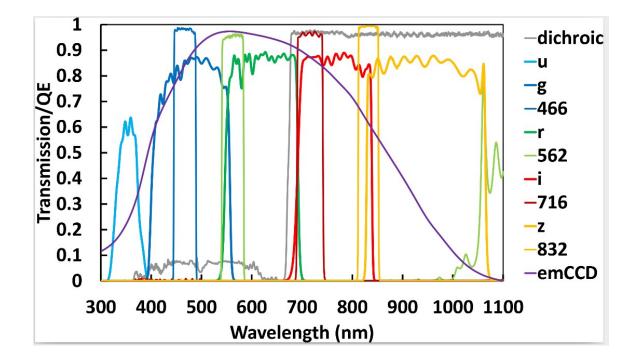
The "Filter Selection" option opens the Filter Wheel control window.

This provides options to rename filters and load/save the configurations. There is a placeholder for providing focus offset but this is not yet implemented.

Filter Transmission & Efficiency Curves

NESSI uses a dichroic beamsplitter to separate the incoming light (at 686nm) into blue and red channels before focusing on the two identical cameras, which operate simultaneously. The speckle filter choice will be one of 467nm or 562nm paired with one of 716nm or 832nm. NESSI's SDSS filters are also listed below (although not used for speckle imaging). Data are in nanometers and fractional efficiencies as quoted by the manufacturer.

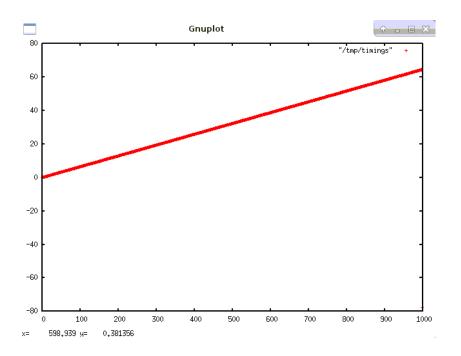
Name	c. wave	FWHM	diffraction limit	data
	(nm)	(nm)	(arcsec FWHM)	
467	467.1	44.0	0.034	nessi 467.dat
562	562.3	43.6	0.040	<u>nessi_562.dat</u>
716	716.0	51.5	0.051	<u>nessi_716.dat</u>
832	832.0	40.4	0.060	<u>nessi 832.dat</u>
u	354.3	32.7		<u>nessi u.dat</u>
g	480.0	151.1		<u>nessi g.dat</u>
r	620.0	143.5		<u>nessi r.dat</u>
i	765.4	146.4		<u>nessi_i.dat</u>
Z	943.3	242.7		<u>nessi z.dat</u>



The "Camera Status" option opens a window showing the current settings of the main camera configuration and readout parameters.

	figrations	Blue Arm	⊐ × Rei
			Rei
Shutter	0	0	
FrameTransferMode	1	1	
OutputAmplifier	0	0	
EMAdvanced	1	1	
EMCCDGain	2	2	
HSSpeed	1	1	
VSSpeed	1	1	
PreAmpGain	1	1	
ReadMode	4	4	
AcquisitionMode	1	1	
KineticCycleTime	0.0	0.0	
NumberAccumulations	1	1	
NumberKinetics	1	1	
AccumulationCycleTime	0.0	0.0	
TExposure	0.060000	0.060000	
TAccumulate	1.267853	1.267853	
TKinetics	1.267853	1.267853	
	Close		

The "Plot timings" option opens a file selection dialog. Selecting a data cube image-name will plot the time history of that cube's exposures (delta times with $0 = 1^{st}$ frame time).



The data can also be examined in the file /tmp/timings after a plot.

File Edit View Terminal Tabs Help nessi:more /tmp/timings 0 <th></th> <th>Terminal</th> <th></th>		Terminal	
0.0 0.0650005722045998 0.12899994850158691 0.1940000057220459 0.258c001542175293 0.32299995422362328 0.3880000114440918 0.451999027252197 0.5180000254249288 0.5810000894472656 0.5180000284472656 0.710000081 469727 0.7739992394842556 0.9303001163482666 0.9030001163482666 0.9030001163482666 0.9030001163482666 0.9030001355140445 1.032999923706055 1.032999923706055 1.610000135514404 1.228000075718944 1.289999616530273 1.385000190734863 1.488999672747803 1.6129999160766602 1.6370000457763672 1.7409999370574951 1.871000051498413 1.934999942779541 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.05959964277954 1.059599707 2.1280000596035 5.059596477954 1.059599707 2.1280000596035 5.0595964277954 1.05959964277954 1.059599707 2.1280000596035 5.059596777 2.1280000596035 5.059596777 2.1280000596035 5.059596777 2.1280000596035 5.059596777 5.0595977 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.059596777 5.0595977 5.0595777 5.0595777 5.0597777 5.059777 5.059777 5.059777 5.059777	File Edit View Terminal Tabs	Help	
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1.934999942779541 2.0 2.064000129699707 2.128000020960835	1.805999994277954		
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210000000000000000000000000000000000000	2.193000078201294		

The rest of the options command the motion of the relevant Zaber stages to the requested position(s). Feedback on the positions can be seen in the Mimic diagram, and in the debug log window.

3.2 Observations

The top left section of the main window contains a group of controls related to the sequencing and initiation of observations.

The exposure time can be specified (in seconds) using the spinbox , or a value can

be typed into the entry box area.

The number of frames to take can be specified using the spinbox, or a value can be typed into the entry box area. For Kinetic series, this specifies the number of exposures in each

datacube. For non-kinetic mode it specifies the number of individual exposures to be taken.

The Exp Type menu can be used to select common exposure types. Dark, Flat, etc.

This has little effect except over the shutter control, but the type is recorded in the image headers.

The Num Seq spinbox can be used to repeat a set of observations multiple times.

The Accum spinbox can be used to select the number of exposures to be accumulated before each camera readout. The exposures are thereby "co-added" by the camera.

This is normally used in conjunction with Kinetic series operations.

The File name entry box is used to specify the base name for the FITS files. It will be expanded to add Sequence and Frame number where appropriate as the files are stored.

The current frame number is shown to the right , and will auto-increment as data is taken.

The Observe button start a sequence of observations (could be just a singleton).

The Video button starts a display only sequence, it must be canceled using the

Abort button before data acquisition Observations can commence.

The binning spinbox controls the binning factor in both x and y dimensions.

The Display FFT option chooses whether to display the raw image data, or to display an

FFT of the data instead.

The Kinetic mode option selects the Kinetic Series mode where the data is assembled into a data cube where the third dimension is time. In this mode an array of (TAI) timing information about the exposures is also included in the FITS file as a Binary table Extension. Immediately below the Observing section is a set of options to switch on simulation mode for the various components. This is primarily intended for off-line testing, but could also be useful for operating in a degraded mode (eg. No filter control). Simulation options can also be set before starting the GUI (See the simulationMode file for an example).

The right side of the main window is focused on the meta data which will be included in the FITS headers. Some of this is automatically populated with data from the Telescope telemetry services. There are also menus for selecting a variety of Data Quality specifications, and a comments area (this area may be flagged to auto-clear after each exposure if required).

The current state of each camera (enabled, temperature) is prominently displayed topcenter of the main window.

The lower section of the window contains the major camera operating control. From here, the temperature setpoint, Filter, Shutter state, Frame Transfer mode, EM mode and gain can be changed. There are also options to enable EM gain advisory popups, and to Auto set the gain. Finally the display of the images in ds9 can be set to autofit or not (frame size)

Number of Image Sets to Acquire Per Target

The performance of speckle imaging is quite sensitive to conditions like seeing, so there are no strict rules to follow for determining the ideal number of image sets to acquire on a target of given brightness.

Observers targeting stars fainter than V=13 should plan on acquiring multiple image sets and those observing brighter stars may also benefit from taking multiple sets. This will depend on how they balance better contrast depth/image quality vs. number of targets visited. Multiple image sets per star can also help under less than optimal observing conditions and, given the several minutes needed to set up observing of each new target, many users may want to devote comparable time to exposures.

Each image set requires 1 minute of telescope time. Acquiring a target with a short slew requires 3 minutes and with a long slew, 5 minutes. Since a science target requires a point source observation, additional time is needed for that (about 4 minutes). Refer to the guide on estimating observing time for more information.

Note that we have found the signal-to-noise ratio for detecting secondary sources in speckle images does not grow as rapidly with exposure time as it would in traditional

CCD imaging (ie. with the square root of time). Proposers may not expect to achieve the same contrast limits on faint stars as bright ones (5 magnitudes may be achievable on 12th magnitude stars and 3 magnitudes on 14th magnitude stars.) The table below only suggests numbers of image sets to take for various magnitude stars:

V or R # image sets

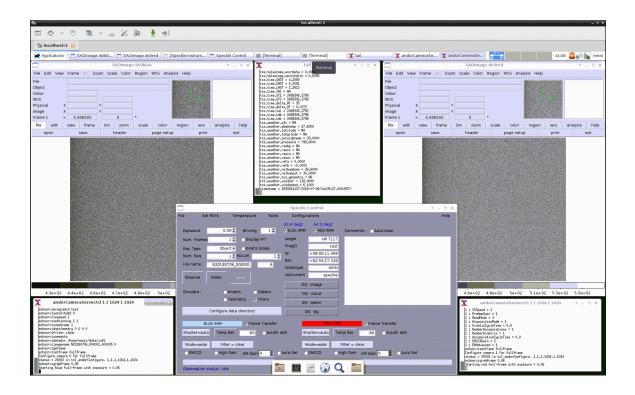
<12	1-3
12-12.5	3
12.5-13	5
13-13.5	7
>13.5	9

(Mark Everett (everett@noao.edu).

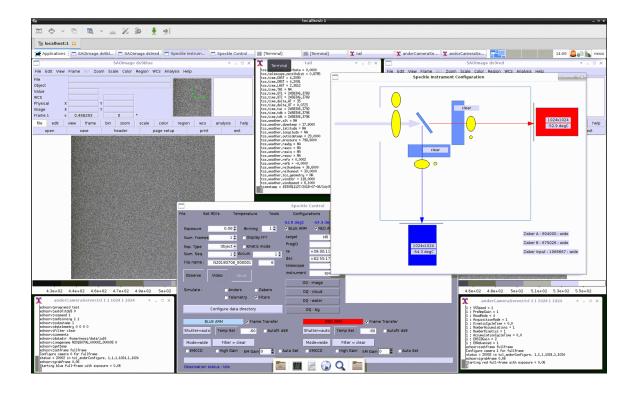
4. Desktop layout

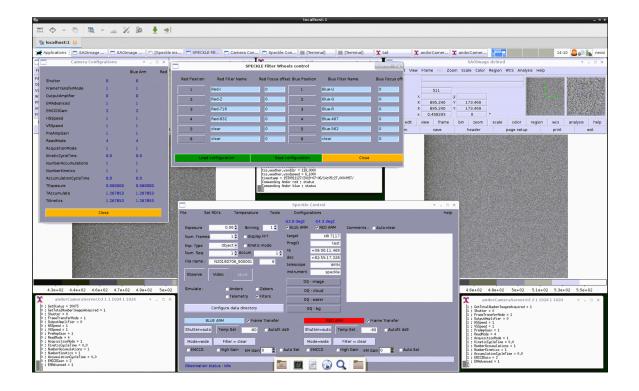
A recommend desktop layout is illustrated below. The main visible components are

ds9red image viewer for the Red arm camera images. ds9blue image viewer for the Blue arm camera images. Top-center xterm showing the debug log. Lower left xterm showing the Red camera server operations Lower right xterm showing the Blue camera server operations. Mid-screen main GUI window.



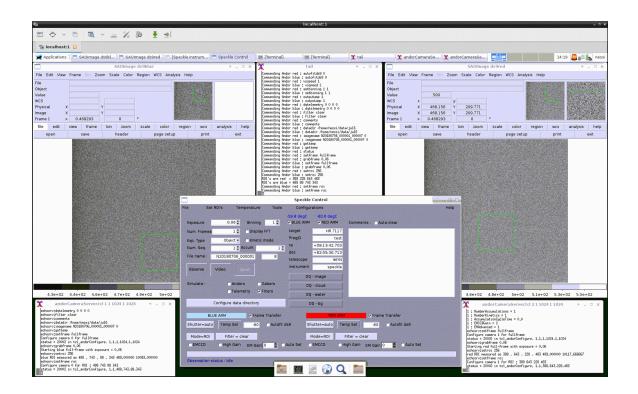
The following example also show typical popup windows for the Mimic diagram and Filter Wheels and Camera status windows.



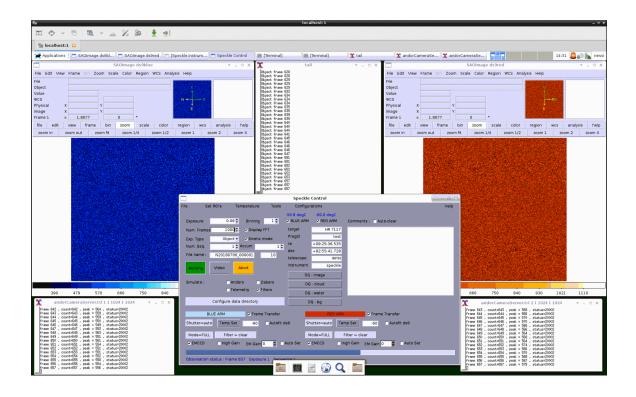


				Speckle	e Control			• • •
File S	Set ROI's Ter	nperature	Tools	Configu	urations			Help
Exposure	0.06 🖨	Binning		-52.9 degC	-54.3 degC		Auto-clear	
Num. Fram	es 1 🌩	🗆 Display F	FT	target	HR 711	17		
Ехр. Туре	Object 🔻	🗆 Kinetic m	node	ProgID		est		
Num. Seq.	1 🌲	Accum.	1 🖨	ra dec	+09:00:11.40			
File name :	N20180706_0	00001	6	telescope	+82:55:17.32			
Observe	Video	.bort		instrument	speck			
Simulate :	Ando	- 7	abers		Q - image			
simulate :	Telen			D	Q - cloud			
				D	Q - water			
	Configure data	directory			DQ - bg			
	BLUE ARM	🔽 Frame	Transfer		RED /	ARM	Frame Transfer	
Shutter=a	uto Temp Set	-60	∏Autofit d	s9 S	Shutter=auto	Temp Set	-60 🔽 Autofit ds9	
Mode=wid	de Filter = c	lear			Mode=wide	Filter = clear		
Mode=wid	de Filter = c	lear EM Gain 0	↓ ▼				I Gain 0 🚔 🗆 Auto	Set
							I Gain 0 🚆 🗆 Auto	Set
EMCCD) -				I Gain 0 🚆 🗖 Auto	Set
EMCCD	⊢ High Gain			Auto Set í			I Gain 0 🚆 🗖 Auto	Set
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C EMCCD Observatio	F High Gain n status : Idle 1.13	EM Gain 0		Auto Set 🤇	EMCCD	High Gain EN	I Gain 0 🚆 🗆 Auto	Set
Observatio	High Gain n status : Idle 1.13 20 1 MHz	EM Gain C	NPUT	Auto Set f V E C	Speed SmccD HS	High Gain EN	I Gain 0 🚆 🗖 Auto	Set
C EMCCD Observatio Vspeed EMCCD HS	High Gain n status : Idle 1.13 20 1 MHz	EM Gain 0	NPUT	Auto Set 🤇	Speed	High Gain _{EN}	l Gain 0 🚆 🗖 Auto	Set
CCD HS	High Gain n status : Idle 1.13 20 1 MHz	EM Gain 0	NPUT	Auto Set V E C 0	Speed SmccD HS	High Gain EM	I Gain 0 🚆 🗖 Auto	Set
CCD HS Move to Set Wi	High Gain n status : Idle 1.13 20 1 MHz	EM Gain C	NPUT	Auto Set V E C rent	Speed MCCD HS CD HS	High Gain EN 1.13 20 1 MHz 0 current	I Gain 0 🚆 🖍 Auto	Set
CCD HS Observation Vspeed EMCCD HS CCD HS Move to Set With Set SPE	High Gain n status : Idle 1.13 20 1 MHz DE to current	EM Gain C	NPUT o	Auto Set	Speed MCCD HS CD HS Move to Set WIDE to	1.13 1.13 20 1 MHz 0 current to current	I Gain 0 🚆 🗆 Auto	Set
CCD HS Observation Vspeed EMCCD HS CCD HS Move to Set With Set SPE	High Gain n status : Idle 1.13 20 1 MHz DE to current CKLE to current	EM Gain C	INPUT o VIDE to curr ECKLE to cu	Auto Set	Speed MCCD HS CD HS Move to Set WIDE to Set SPECKLE t	1.13 1.13 20 1 MHz 0 current to current	I Gain 0	Set

This desktop shows an example of the appearance after an ROI selection , each ds9 window shows the chosen region, and the numeric parameters can be seen in the camera server log windows.



This desktop shows a typical observing sequence in progress, the progress bar and associated status update as the series progresses. Note that in this instance we are displaying the FFT instead of the raw image data.



5 Log files

All GUI controlled operations are logged to disk. The files are named according to the cpu clock at the startup and stored in the /tmp directory.

nessi:ls /tmp/speckl*.log	
/tmp/speckleLog_1530322241.log	/tmp/speckleLog_1530502749.log
/tmp/speckleLog_1530322463.log	/tmp/speckleLog_1530502891.log
/tmp/speckleLog_1530322723.log	/tmp/speckleLog_1530503583.log
/tmp/speckleLog_1530323111.log	/tmp/speckleLog_1530504217.log
/tmp/speckleLog_1530323495.log	/tmp/speckleLog_1530504290.log
/tmp/speckleLog_1530323737.log	/tmp/speckleLog_1530504332.log
/tmp/speckleLog_1530324010.log	/tmp/speckleLog_1530504425.log
/tmp/speckleLog_1530324888.log	/tmp/speckleLog 1530504611.log
/tmp/speckleLog_1530325368.log	/tmp/speckleLog_1530504737.log
/tmp/speckleLog_1530325752.log	/tmp/speckleLog_1530504795.log
/tmp/speckleLog_1530326089.log	/tmp/speckleLog_1530505286.log
/tmp/speckleLog_1530327038.log	/tmp/speckleLog_1530505602.log
/tmp/speckleLog_1530327151.log	/tmp/speckleLog_1530506620.log
/tmp/speckleLog_1530332355.log	/tmp/speckleLog_1530508085.log
/tmp/speckleLog_1530335084.log	/tmp/speckleLog_1530508483.log
/tmp/speckleLog_1530335813.log	/tmp/speckleLog_1530511001.log
/tmp/speckleLog_1530336849.log	/tmp/speckleLog_1530511098.log
/tmp/speckleLog_1530398480.log	/tmp/speckleLog_1530511224.log
/tmp/speckleLog_1530398755.log	/tmp/speckleLog_1530546285.log
/tmp/speckleLog_1530398794.log	/tmp/speckleLog_1530546434.log
/tmp/speckleLog_1530398814.log	/tmp/speckleLog_1530548907.log
/tmp/speckleLog_1530399172.log	/tmp/speckleLog_1530553512.log
/tmp/speckleLog_1530399516.log	/tmp/speckleLog_1530553964.log
/tmp/speckleLog_1530403411.log	/tmp/speckleLog_1530554786.log
/tmp/speckleLog_1530403900.log	/tmp/speckleLog_1530556213.log
/tmp/speckleLog_1530404046.log	/tmp/speckleLog_1530556852.log
/tmp/speckleLog_1530405721.log	/tmp/speckleLog_1530557089.log
/tmp/speckleLog_1530407045.log	/tmp/speckleLog_1530557647.log
/tmp/speckleLog_1530410430.log	/tmp/speckleLog_1530560460.log
/tmp/speckleLog_1530410786.log	/tmp/speckleLog_1530561133.log
/tmp/speckleLog_1530410917.log	/tmp/speckleLog_1530561509.log
/tmp/speckleLog_1530411091.log	/tmp/speckleLog_1530562077.log

6. Command Line usage

There is a rich set of commands to allow interactive and scripted usage. To access the command line it is necessary to source the *startspeckle-cmds* script from the speckle-control directory and then type *source gui-scripts/gui2.tcl*

The following commands are available Filter Wheel :

loadFiltersConfig [filename]
saveFiltersConfig [filename]
echoFiltersConfig
selectfilter arm filter-number
findWheels
resetFilterWheel arm

Zaber stages :

loadZaberConfig [filename] saveZaberConfig [filename] echoZaberConfig zaberPrintProperties zaberConnect zaberDisconnect homeZabers zaberCheck zaberSetPos name position zabersStopAll zaberGoto name station

Pico Stages : Gemini only

loadPicosConfig [filename] savePicosConfig [filename] echoPicosConfig picosConnect picoCommand axis cmd picoSet axis parameter value

Andor Cameras :

Command may be issued from the GUI command line, scripted , or optionally by telnet to ports 2001, 2002. When using the command line the syntax is

commandAndor arm "command and parameters"

or commandAndors "command and parameters"

accumulationcycletime seconds index acquisition autofitds9 0/1 baseclamp 0/1 comments comment1|comment2|.... configure hbin vbin vstart vend hstart hend preamp vsspeed ccdhss emccdhss datadir data-directory dqtelemetry rawiq rawcc raqwv rawbg emadvanced index emccdgain 0/1 fastVideo exposure xs ys dim fitsbits data-format forceroi xs xe ys ye frametransfer index

gettemp grabcube exposure xs ys dim grabframe exposure grabroi exposure xs ys dim hsspeed amp index *imagename image-name* kineticcycletime seconds locatestar smooth dim numberaccumulations count numberkinetics count outputamp index positiontelem input-zaber field-zaber filter preampgain index programid program-id readmode index reset mode setexposure seconds setframe mode setroi mode settemperature degrees shutdown index shutter status version vsamplitude index vsspeed index whicharm

7. Recompiling the shared libraries

Low level functionality is provided in C/C++ for speed , and this code is wrapped using tcl and loaded into the interpreter at runtime. To move the code to a different version of Linux it may be necessary to recompile the libraries in the following directories. Each has either a Makefile or a set of build steps (e.g. andor/buildAndorWrap).

The Vips library may present more difficulty due to it's many dependencies. The package can be recompiled using the GNU standard incantations

./configure --prefix=some-installation-directory --without-python make install

If the configure step does not work , try

sudo apt install automake autogen m4 libtoolize aclocal automake --add-missing autoconf

then try the ./configure step again.

8. Changing hardware components

If it becomes necessary to change out either Filter Wheel or Camera components, the appropriate configuration files will be adjustment. The configuration files are in the

\$HOME/speckle-control directory

andorsConfiguration.[telescope] filtersConfiguration.[telescope]

In each case the serial number information will need to be updated.

The Filter Wheel serial numbers can be found using the lsusb command

nessi:lsusb Bus 001 Device 002: ID 8087:8001 Intel Corp. Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub Bus 003 Device 016: ID 05e3:0612 Genesys Logic, Inc. Hub Bus 003 Device 013. ID 03e3.0012 Genesys Logic, inc. Hub Bus 003 Device 017: ID 136e:0012 Andor Technology Ltd. Bus 003 Device 018: ID 136e:0012 Andor Technology Ltd. Bus 003 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub Bus 002 Device 003: ID 8087:0a2a Intel Corp. Bus 002 Device 044: ID 104d:1011 Newport Corporation Bus 002 Device 043: ID 104d:1011 Newport Corporation Bus 002 Device 042: ID 0403:6001 Future Technology Devices International, Ltd FT 232 Serial (UART) IC Bus 002 Device 041: ID 05e3:0610 Genesys Logic, Inc. 4-port hub Bus 002 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub nessi: nessi: nessi:lsusb -v -s 002:043 | grep iSerial iSerial 128 061D088E010F5400 nessi:lsusb -v -s 002:044 | grep iSerial iSerial 128 1B18177A01135400 nessi:

The Andor Serial numbers can be found by examining the "dmesg" log at system boot time.

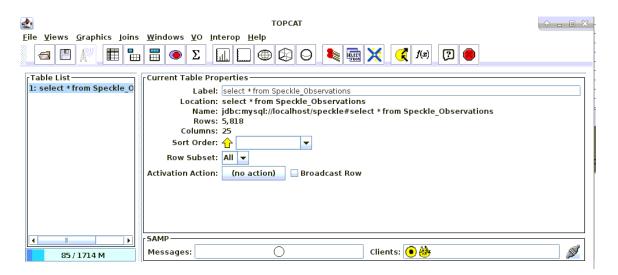
9.Database

The camera servers automatically log information about each image to the on-board database (Mysql). The database is named "speckle" and the table name is "Speckle_Observations". It can be viewed using the mysql command line program, or using the TOPCAT GUI.

e.g.

```
mysql -user=root speckle
select * from Speckle_Observations LIMIT 10;
```

Or using the TOPCAT gui



<u>&</u> <u>W</u>indow <u>S</u>ubsets <u>H</u>elp

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Table Browser for 1: select * from Speckle_Observations

	0wser101 1. se														
e	exposureStart	exposureEnd	Filter	amplifier	numex	numAc	window	colBin	rowBin	RA	Declination	dqimage	dqCloud	dqWater	dqBG
5800	1.530573E9	1.530573E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+20:53:02.780	+87:52:38.838	0	0	0	0 🔺
5801	1.530573E9	1.530573E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+20:54:14.16	+87:52:39.23	0	0	0	0
5802	1.530573E9	1.530573E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+20:54:14.16	+87:52:39.23	0	0	0	0
5803	1.530578E9	1.530578E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+21:44:54.319	+88:24:28.219	0	0	0	0
5804	1.530578E9	1.530578E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+21:44:54.319	+88:24:28.219	0	0	0	0
5805	1.530915E9	1.530915E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+10:13:13.532	+82:56:18.104	0	θ	0	0
5806	1.530915E9	1.530915E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+10:13:17.85	+82:56:18.141	Θ	0	0	0
5807	1.530917E9	1.530917E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+10:41:19.991	+82:56:33.363	Θ	0	0	0
5808	1.530917E9	1.530917E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+10:41:27.812	+82:56:33.423	0	0	0	0
5809	1.530918E9	1.530919E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+11:05:25.176	+82:56:42.548	0	0	0	0
5810	1.530918E9	1.530919E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+11:05:27.716	+82:56:42.561	0	0	0	0
5811	1.530919E9	1.530919E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+20:45:54.867	+88:27:46.997	0	0	0	0
5812	1.530919E9	1.530919E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+20:45:54.867	+88:27:46.997	0	0	0	0
5813	1.530919E9	1.530919E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+20:46:23.701	+88:27:47.28	Θ	0	0	0
5814	1.530919E9	1.530919E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+20:46:23.701	+88:27:47.28	Θ	0	0	Θ
5815	1.530920E9	1.530920E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+20:54:28.998	+88:27:47.687	0	0	0	0
5816	1.530920E9	1.530920E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+20:54:33.522	+88:27:47.694	0	0	0	0
5817	1.530920E9	1.530920E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+21:00:38.237	+88:27:48.277	0	0	0	0 =
5818	1.530920E9	1.530920E9	clear	ECMMD Amplifier	1	1	1,1024,1,1024	1	1	+21:00:43.47	+88:27:48.295	0	0	0	0 👻
•															•