

Area detector

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What is areaDetector?

- areaDetector supports a wide range of 2-D detectors and cameras
- easy integration of new detectors in framework
- includes many plugins for image processing
- <https://github.com/areaDetector>
- <http://cars9.uchicago.edu/software/epics/areaDetector.html>
- <http://cars9.uchicago.edu/software/epics/areaDetectorDoc.html>

What devices are supported?

- CCD detectors
- Pixel array detectors
- Cameras
- URLs

Starting IOC

- `$ cd ~/build-epics`
- `$ cd iocs/simDetectorIOC/iocBoot/iocSimDetector`
- `$./start_epics`

Plugins

- color conversion
 - FFT
 - file writing
 - overlay
 - ROI (region of interest)
 - statistics
 - PVAccess
 - and others...
-
- <http://cars9.uchicago.edu/software/epics/pluginDoc.html>

Enabling plugins

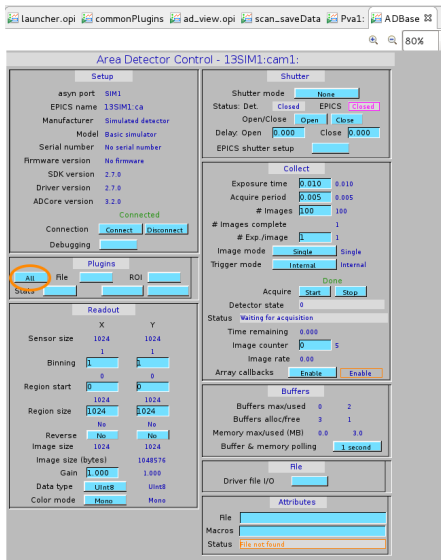


Figure 1: Accessing plugins control

Enabling plugins

launcher.opi commonPlugins 3 ad_view.opi scan_saveData Pva1:

13SIM1: Common Plugins

Plugin name	Plugin type	Port	Enable	Blocking	Dropped	Free	Rate		
Image1	NDPluginStdArrays	SIM1	Enable	Enable	No	0	20	0.00	More
Disconnected	Disconnected	Disconn	Disconnect	Disconnect	Disconnect	Disconnect	Disconnect	Disconnect	More
PROC1	NDPluginProcess	SIM1	Disable	Disable	No	0	20	0.00	More
TRANS1	NDPluginTransform	SIM1	Disable	Disable	No	0	20	0.00	More
CC1	NDPluginColorConvert	SIM1	Disable	Disable	No	0	20	0.00	More
CC2	NDPluginColorConvert	SIM1	Disable	Disable	No	0	20	0.00	More
OVER1	NDPluginOverlay	SIM1	Disable	Disable	No	0	20	0.00	More
ROI1	NDPluginROI	SIM1	Disable	Disable	No	0	20	0.00	More
ROI2	NDPluginROI	SIM1	Disable	Disable	No	0	20	0.00	More
ROI3	NDPluginROI	SIM1	Disable	Disable	No	0	20	0.00	More
ROI4	NDPluginROI	SIM1	Disable	Disable	No	0	20	0.00	More
STATS1	NDPluginStats	SIM1	Enable	Enable	No	0	20	0.00	More
STATS2	NDPluginStats	SIM1	Disable	Disable	No	0	20	0.00	More
STATS3	NDPluginStats	SIM1	Disable	Disable	No	0	20	0.00	More
STATS4	NDPluginStats	SIM1	Disable	Disable	No	0	20	0.00	More
STATS5	NDPluginStats	SIM1	Disable	Disable	No	0	20	0.00	More
SCATTER1	NDPluginScatter	SIM1	Disable	Disable	No	0	20	0.00	More
GATHER1	NDPluginGather	SIM1	Disable	Disable	No	0	20	0.00	More
ROISTAT1	NDPluginROIStat	SIM1	Disable	Disable	No	0	20	0.00	More
CB1	NDPluginCircularBuff	SIM1	Disable	Disable	No	0	20	0.00	More
ATTR1	NDPluginAttribute	SIM1	Disable	Disable	No	0	20	0.00	More
FFT1	NDPluginFFT	SIM1	Disable	Disable	No	0	3	0.00	More
FileNetCDF1	NDFileNetCDF	SIM1	Disable	Disable	No	0	1	0.00	More
FileTIFF1	NDFileTIFF	SIM1	Disable	Disable	No	0	20	0.00	More
FileJPEG1	NDFileJPEG	SIM1	Disable	Disable	No	0	20	0.00	More
FileNexus1	NDPluginFile	SIM1	Disable	Disable	No	0	1	0.00	More
Disconnected	Disconnected	Disconn	Disconnect	Disconnect	Disconnect	Disconnect	Disconnect	Disconnect	More
FileHDF1	NDFileHDF5 ver1.10.1	SIM1	Disable	Disable	No	0	20	0.00	More

Figure 2: Enabled plugins (without NDPluginPva loaded)

Adding NDPluginPva plugin to IOC

<http://cars9.uchicago.edu/software/epics/NDPluginPva.html>

Plugin is included in default build, but not enabled in startup script

Plugins are started by the `commonPlugins.cmd` file in the `ADCore/iocBoot` directory.

If necessary, copy from `EXAMPLE_commonPlugins.cmd` file.

Adding NDPluginPva plugin to startup

- Stop IOC (if running)
- `$ cd ~/build-epics`
- `$ cd areaDetector/ADCore/iocBoot`
- Edit `commonPlugins.cmd` and remove comment character (`#`) from three highlighted lines:

`commonPlugins.cmd`

```
...  
# Optional:  load NDPluginPva plugin  
NDPvaConfigure("PVA1", $(QSIZE), 0, "$(PORT)", 0,  
$(PREFIX)Pva1:Image, 0, 0, 0)  
dbLoadRecords("NDPva.template", "P=$(PREFIX),R=Pva1:,  
PORT=PVA1,ADDR=0,TIMEOUT=1,NDARRAY_PORT=$(PORT)")  
# Must start PVA server if this is enabled  
startPVAServer
```

Starting IOC with NDPluginPva plugin

Exactly the same as starting IOC earlier. Changes in `commonPlugins.cmd` will add in PVAccess support.

- `$ cd ~/build-epics`
- `$ cd iocs/simDetectorIOC/iocBoot/iocSimDetector`
- `$./start_epics`

Enabling NDPluginPva plugin

launcher.opi commonPlugins 33 ad_view.opi scan_saveData Pva1: ADBase

135SIM1: Common Plugins

Plugin name	Plugin type	Port	Enable	Blocking	Dropped	Free	Rate
Image1	NDPluginStdArrays	\$IM1	Enable	No	0	20	0.00
PVA1	NDPluginPva	\$IM1	Enable	No	0	20	0.00
PROC1	NDPluginProcess	\$IM1	Disable	No	0	20	0.00
TRANS1	NDPluginTransform	\$IM1	Disable	No	0	20	0.00
CC1	NDPluginColorConvert	\$IM1	Disable	No	0	20	0.00
CC2	NDPluginColorConvert	\$IM1	Disable	No	0	20	0.00
OVER1	NDPluginOverlay	\$IM1	Disable	No	0	20	0.00
ROI1	NDPluginROI	\$IM1	Disable	No	0	20	0.00
ROI2	NDPluginROI	\$IM1	Disable	No	0	20	0.00
ROI3	NDPluginROI	\$IM1	Disable	No	0	20	0.00
ROI4	NDPluginROI	\$IM1	Disable	No	0	20	0.00
STATS1	NDPluginStats	\$IM1	Enable	No	0	20	0.00
STATS2	NDPluginStats	\$IM1	Disable	No	0	20	0.00
STATS3	NDPluginStats	\$IM1	Disable	No	0	20	0.00
STATS4	NDPluginStats	\$IM1	Disable	No	0	20	0.00
STATS5	NDPluginStats	\$IM1	Disable	No	0	20	0.00
SCATTER1	NDPluginScatter	\$IM1	Disable	No	0	20	0.00
GATHER1	NDPluginGather	\$IM1	Disable	No	0	20	0.00
ROI1STAT1	NDPluginROIStat	\$IM1	Disable	No	0	20	0.00
CB1	NDPluginCircularBuff	\$IM1	Disable	No	0	20	0.00
ATTR1	NDPluginAttribute	\$IM1	Disable	No	0	20	0.00
FFT1	NDPluginFFT	\$IM1	Disable	No	0	4	0.00
FileNetCDF1	NDFileNetCDF	\$IM1	Disable	No	0	1	0.00
FileTIFF1	NDFileTIFF	\$IM1	Disable	No	0	20	0.00
FilePEG1	NDFilePEG	\$IM1	Disable	No	0	20	0.00
FileNexus1	NDPluginFile	\$IM1	Disable	No	0	1	0.00
Disconnected	Disconnected	Disconnect	Disconnect	Disconnect	Disconnect	Disconnect	Disconnect
FileHDF1	NDFileHDF5 ver1.10.1	\$IM1	Disable	No	0	20	0.00

Figure 3: NDPluginPva plugin enabled

Testing PVAccess link to image

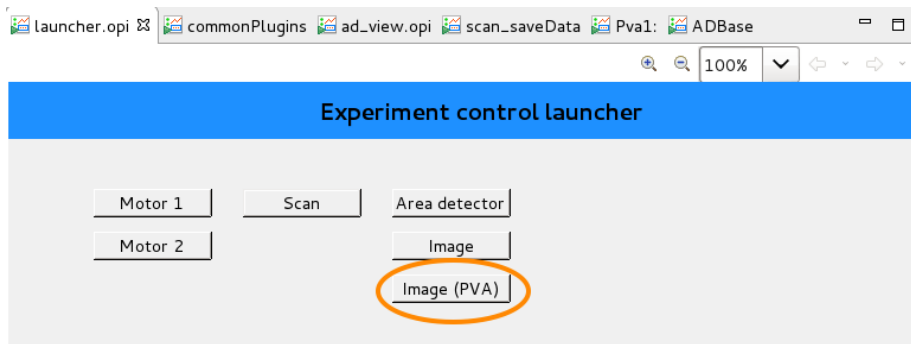


Figure 4: Link to PVAccess display of image

VImage widget

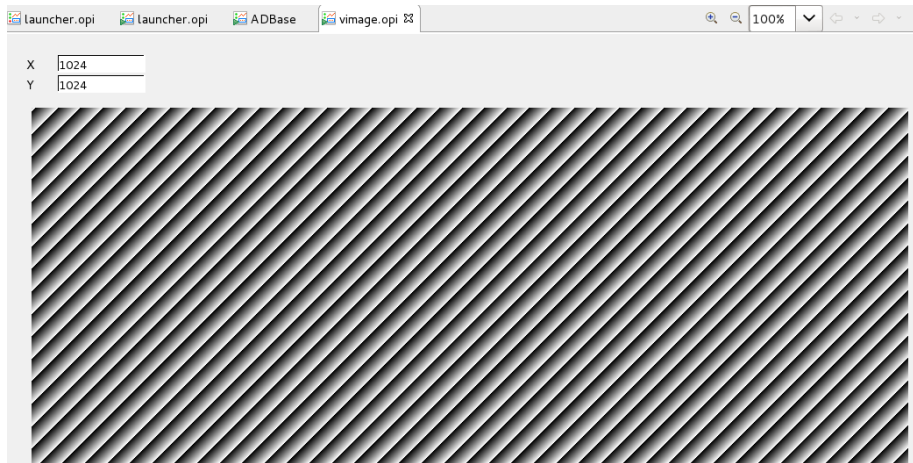


Figure 5: VImage widget display of AD image

Controlling PVAccess server

From IOC shell:

```
epics> stopPVAServer
```

```
epics> pvasr
```

PVA server not running

```
epics>
```

Controlling PVAccess server

```
epics> startPVAServer
```

```
2018-03-02T16:56:55.542 Using dynamically assigned TCP port  
34289.
```

```
epics> pvasr
```

```
VERSION : pvAccess Server v6.0.1-SNAPSHOT
```

```
PROVIDER_NAMES : local,
```

```
BEACON_ADDR_LIST :
```

```
AUTO_BEACON_ADDR_LIST : 1
```

```
BEACON_PERIOD : 15
```

```
BROADCAST_PORT : 5076
```

```
SERVER_PORT : 34289
```

```
RCV_BUFFER_SIZE : 16384
```

```
IGNORE_ADDR_LIST:
```

```
INTF_ADDR_LIST : 0.0.0.0
```

```
epics>
```

Command line access to image

```
$ pvget 13SIM1:Pva1:Image
13SIM1:Pva1:Image
structure
union value
ubyte[]
[0,10,20,30,40,50,60,70,80,90 ...]
```

```
$ caget 13SIM1:Pva1:Image
Channel connect timed out:  '13SIM1:Pva1:Image' not found.
```

```
$ caget -# 10 13SIM1:image1:ArrayData
13SIM1:image1:ArrayData 10 0 10 20 30 40 50 60 70 80 90 ...
```


Demonstrations

- Detector triggering
- Single/multiple/continuous acquisition
- Exposure time vs acquire period
- Trigger modes
- Readout control - binning, region start, region size, reverse
- Gain, data type, color mode
- Shutter control
- Plugins

Plugin control

- Enabling
- Connecting
- Configuring

Plugin demonstration

- Process - background subtraction, flat field correction, scaling, clipping, filtering
- Transform - rotate and/or flip
- Overlay
- Region of interest
- Statistics

Other plugins

- Scatter/gather
- File writing
- FFT

Exercises

- Using plugins, rotate image and add rectangle from (700,700) to (800,800)
- Reverse the order of the above plugins and observe the difference
- Test pvget monitor of PVAccess image data (13SIM1:Pva1:Image)
- Use caput to set number of frames to acquire to and image mode to Multiple
- Use caput with put-callback to trigger detector and wait for completion (`caput -c -w 1000 <pv_name> <pv_value>`)
- Test whether pvput can be used for above two operations
- Use an ROI plugin to generate, and display in the CA display, the area from (0,0) to (200,200)