

OAG Tools for General Users

A Contribution to the "Getting Started with EPICS" Lecture Series

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August 24, 2004

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Brief Introduction to OAG

- Group of accelerator physicists and programmers formed in 1995 to "apply the lessons of commissioning to accelerator operation."
- We write high-level applications for physicists, engineers, and operators, e.g.,
 - Automated startup and shutdown
 - Orbit correction and steering
 - Accelerator experiments
- We manage the accelerator data logging systems and configuration control systems.
- Much of the software we write is generic and can be used in any EPICS context.

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Outline

- Brief introduction to Operations Analysis Group
- Intended audience
- What you'll learn
- How to access the software
- General features of OAG applications
- Accessing the accelerator data logs
- Performing data analysis
- Controlling things through EPICS
- Summary

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Intended Audience

- We cater to a range of users
 - Programmers in a variety of languages
 - Those who want commandline tools
 - Those who want an easy-to-use graphical user interface (GUI)
- Today, we'll concentrate the last type.
- Underlying software is the same.
- Two later talks will concentrate on the details.

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A Few Details

- We build our applications out of two components
 - Tcl/Tk: a scripting language that allows easily making graphical user interfaces (GUIs).
 - SDDS: a type of general data file and a toolkit of C programs that work with such files.
- Almost all the screen-shots in this presentation are Tcl/Tk GUIs.
- The data processing is done by SDDS tools hidden under the Tcl/Tk layer
 - SDDS Toolkit for data processing and display
 - SDDS/EPICS Toolkit for EPICS-specific functions

What You Can Learn from this Talk

- Types of applications that are available from OAG
- Features and usage of specific applications
 - Detailed click-by-click guidance,
 - Review of the interface, or
 - Listing of major features.
- Important concepts for using OAG applications
 - SDDS files and “meta-applications”
 - Reusing data and programs
- How you can do even more with SDDS Toolkits
- How OAG software differs from similar EPICS clients

Accessing the Software

- For AOD, ASD, and XFD staff with access to a Sun workstation, access is via your workspace menu

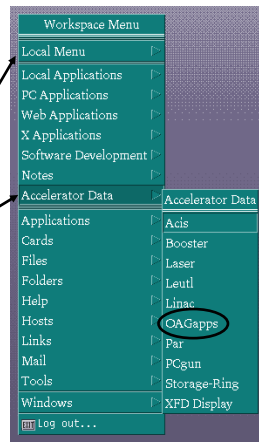
Right-click on the background to bring up the workspace menu

Click on “Accelerator Data”

Click on “OAGapps”

- Others can download from our website:

<http://www.aps.anl.gov/asd/oag/oaghome.shtml>



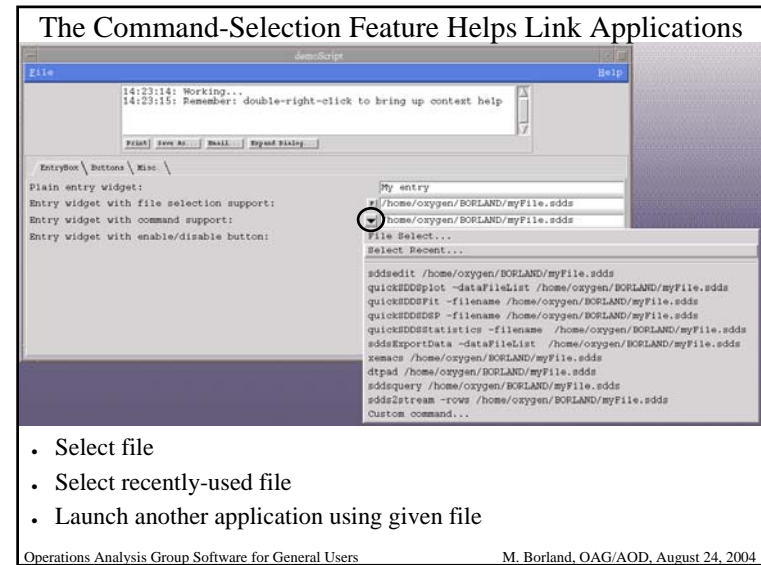
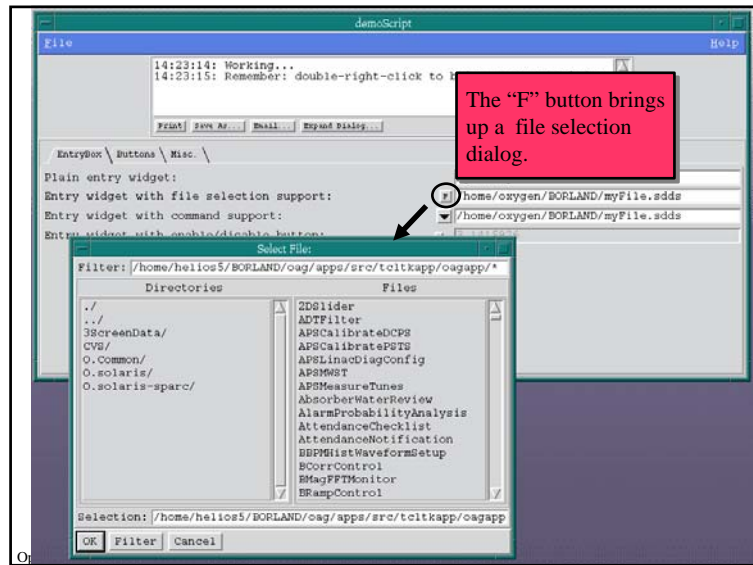
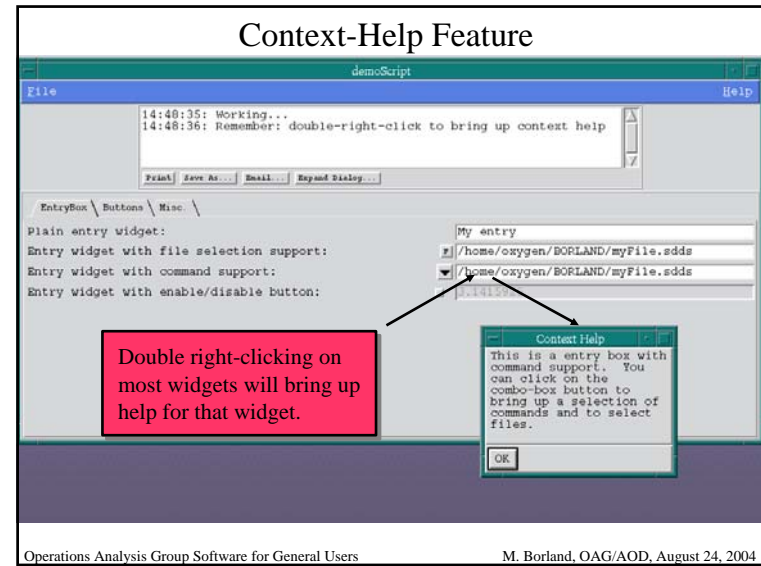
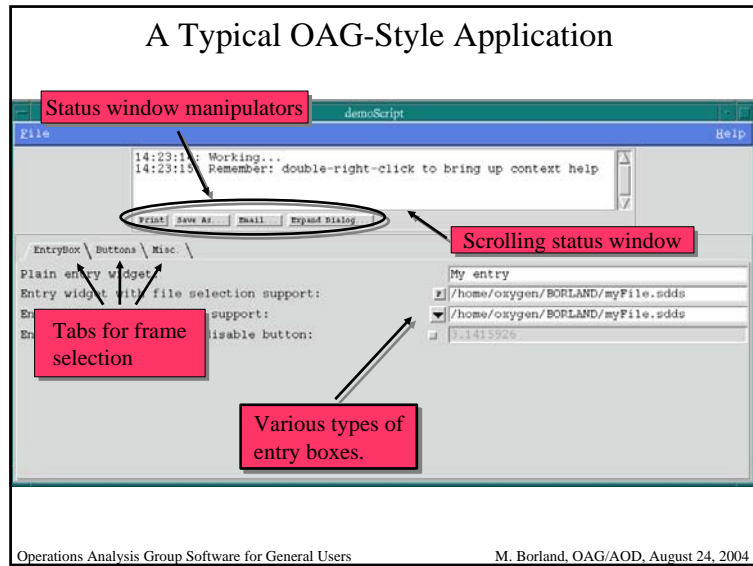
OAGapps Main Menu

Generic applications for controlling things in EPICS

Applications for accessing the accelerator data logs

Data collection, review, and analysis utilities






Why All the Files?

- OAG applications require input and output filenames as part of data processing
- Some feel this is inconvenient or even bad software design
- However, using files
 - Lets user name and identify data and results
 - Creates open-ended “meta-applications” out of many small, simple applications
 - Lets anyone add to the application suite
 - Avoids getting trapped by software that doesn't do what you want

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The screenshot shows a menu structure with 'Data logger review' highlighted in red. A secondary window titled 'Data Logger Review SubMenu' is open, listing various review options such as 'Alarm logger review...', 'Monitor data review...', 'PV Change Logger...', 'Glitch data review...', 'Review PFM Error and Activity Log...', 'Alarm probability analysis...', 'Search alarm review...', 'Extended monitor data review...', 'Data log comparison...', 'Search data review...', 'OPI data review...', 'Injector Beam Time Review...', and 'Check data loggers...'. A red box in the top right corner of the slide contains the text 'Data Logger Review SubMenu'.

Data Logger Review SubMenu

- Access archives of accelerator-related data
- Review alarm history
- Review signal values
- Review history of setpoint changes
- Review glitches
- Find process variables in the data loggers

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Alarm Logger Review

- The alarm logger review utility allows
 - Reviewing alarms by subsystem and time period
 - Finding alarm times, severity, and status
 - Viewing related information (e.g., status bits)
 - Histogramming alarm density
 - Look for overlapping alarms
- We monitor alarms on 14k process variables
- Private alarm logs also supported

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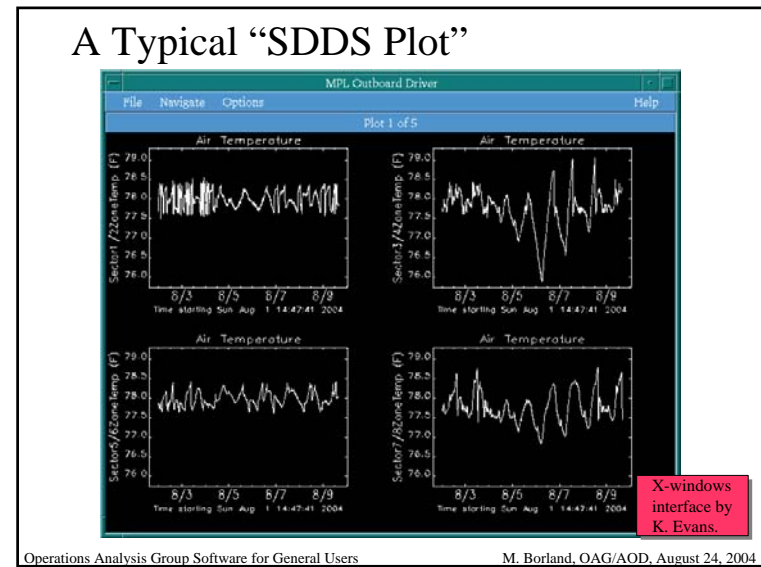
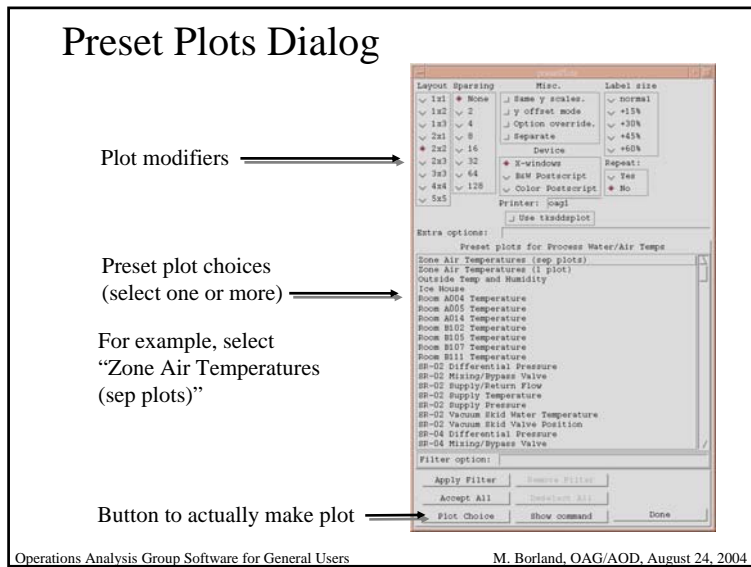
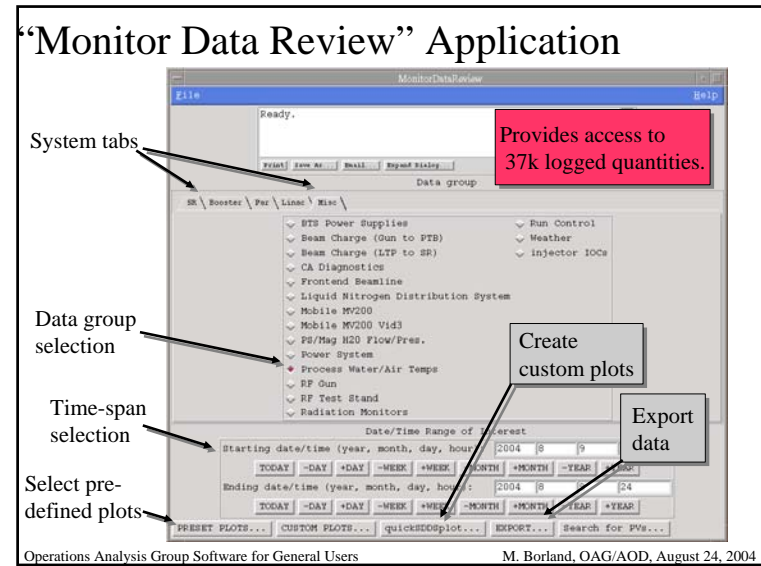
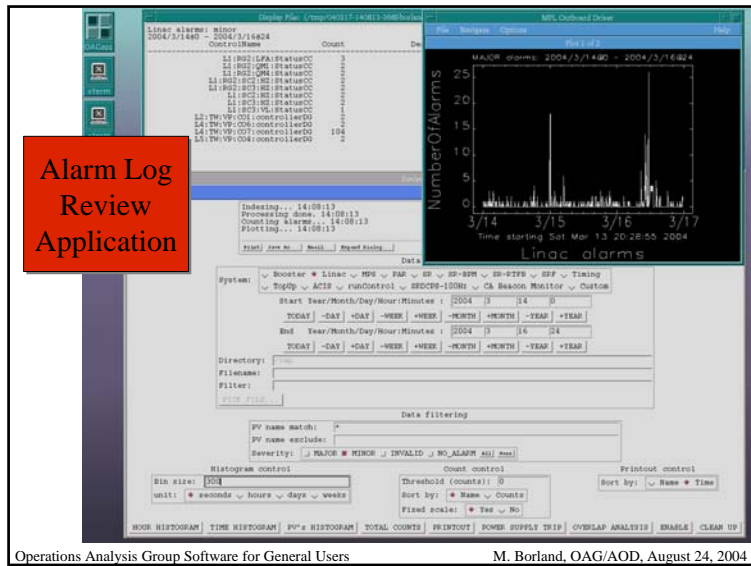
Alarm Logging or ALH?

- ALH (ALarm Handler) is a GUI for alerting operators to alarms
- ALH logs data, but
 - Must have GUI open
 - Not space efficient
 - No analysis tools
- sddsalarmlog provides
 - Background logging
 - Space-efficient format
 - Sophisticated analysis and review tools

You need both!

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Web Access to Accelerator Data Logs

Operations Analysis Group
Accelerator Operations Division---Argonne National Laboratory

Mission Statement

The mission of OAG is to apply integrated capabilities and experience in accelerator physics, accelerator operation, accelerator simulation, and high-level software to the operation, understanding, and enhancement of the Advanced Photon Source.

1. Development, maintenance, and application of software for highly-automated, highly-reliable accelerator operation, data collection, diagnosis, and experimentation.
2. Development, maintenance, and application of software for accurate, timely simulation of APS accelerator systems.
3. Development and exploration through simulation and experiment of innovative ideas for accelerator enhancements to improve the quality and reliability of beam delivered to users.
4. Integration of knowledge and understanding of the interplay of accelerator subsystems to provide reliable advice and decisions on accelerator operations and modifications.

Graphics Gallery

- Photos of the APS bunch compressor.
- First 8-day top-up run.
- Current APS SDDS plots. (Link moved to Operations tab)
- Storage ring current and lifetime. (Link moved to Operations tab)
- APS RF Gun Beam and Electromagnetic Field Simulation

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Data Review

Data groups available on the OAG web site:

SR RF	Run Control	Beam Charge (Gun to P1B)	Link: RF Top Up
SR Absorber HCG	SR BPMs	BTS Power Supplies	Link: Modulators
SR Vacuum	SR Ave. BPMs	Booster Pulsed Power Supplies	Link: Modulators Top Up
SR chamber temps	SR BPLD	Booster Vacuum	Link: Diag
SR DCPS_construction@psds	SR Synch. Light Mon.	Booster RF	Link: SDDS Top Up
SR DCPS_construction@psds (extensive)	SR Hydraulic Level	Booster Ramp Phase	Link: Switch Gear
SR DCPS_construction@psds (100 Hz state)	SR Switchgear	Booster Injection	Link: Test Stand
SR DCPS_quadrupole	SR Injection	PARLET Vacuum	Link: Water
SR DCPS_quadrupole (extensive)	SR Feedback Status	PARLET DC Power Supplies	RF Gun
SR DCPS_quadrupole (100 Hz state)	SR Feedback Control Errors	PAF Pulsed Power Supplies	RF Test Stand
SR Pulsed Power Supplies	SR Thermocouples	PAF RF 1	Inspector (DC)
(Position Monitor)	SR Source Parameters	PAF RF 2	SR (DC)
Process Water / Air Temp	ID Data	Link: Vacuum	Mobile M/200
Process System	RM Data	Link: Power Supplies	Mobile M/200 V302
PSMag HDD Flow/Press	Frontend & PSS	Link: Power Supplies Top Up	CA Diagnostics
	Beam Charge (LTP to SR)	Link: RF	Weather

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Data Group

Process Water / Air Temp	Control Name / Readback Name
Zone Air Temperature (exp 000)	0 AME B0042conTemp4
Zone Air Temperature (1 000)	0 AME B0052conTemp4
Outside Temp and Humidity	0 AME B0142conTemp4
Ice House	0 AME B0102conTemp4
Room A004 Temperature	0 AME B1102conTemp4
Room A005 Temperature	0 AME B008107Temp
Room A014 Temperature	0 AME B0081117Temp
Room B102 Temperature	0 AME FF1053A4
Room B108 Temperature	0 AME FF1053A4
Room B109 Temperature	0 AME FF1053A4
Room B110 Temperature	0 AME FF1053A4
Room B111 Temperature	0 AME FF1053A4
SR-CD Differential Pressure	0 AME FF1053A4
SR-CD Mixing@y-axis Valve	0 AME FF1053A4
SR-CD Supply/Return Flow	0 AME FF1053A4
SR-CD Supply Temperature	0 AME FF1053A4
SR-CD Supply Pressure	0 AME FF1053A4
SR-CD Vacuum Bld Water Temperature	0 AME FF1053A4
SR-CD Vacuum Bld Valve Position	0 AME FF1053A4
SR-CD Differential Pressure	0 AME FF1053A4
SR-CD Mixing@y-axis Valve	0 AME FF1053A4

Plot

Starting date/time: 2004 8 1 0 0
Ending date/time: 2004 8 7 14 00

Plot Options

Size: Normal
Background Color: White
Layout: List
Label font: Normal
Spacing: None

Miscellaneous

Same Y scales
Y-axis mode
Separate
Option override

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Sample output from web-based data review

75.5
75.0
74.5
74.0
73.5
73.0
72.5
72.0
71.5

8/2 8/4 8/6 8/8

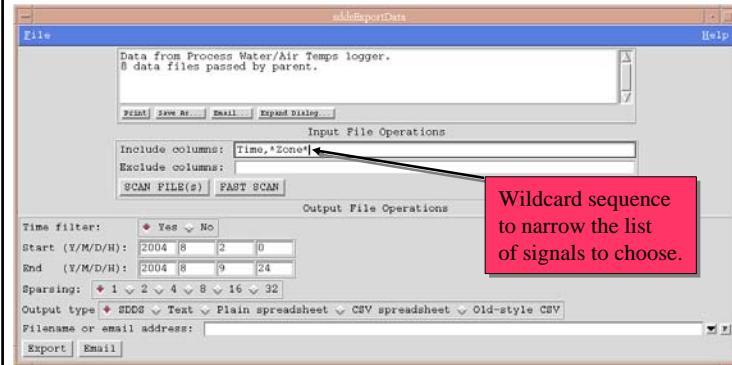
Time starting Sat Jul 31 15:36:18 2004

Tue Aug 24 10:07:12 CDT 2004

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Exporting Data

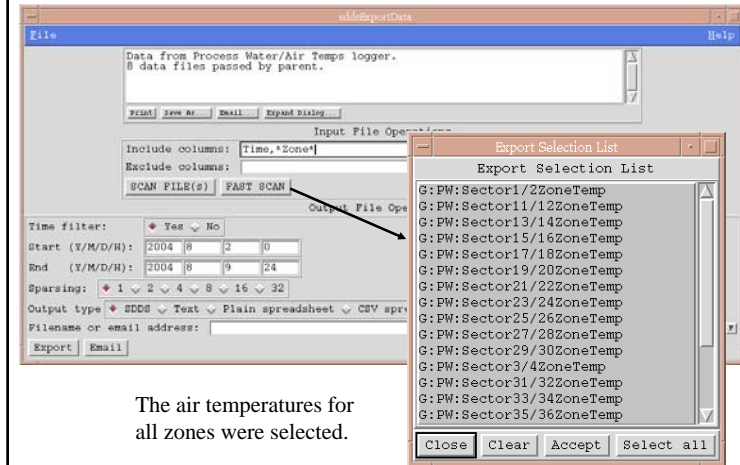
In this case, "sddsExportData" is launched from the data review application to allow exporting the selected data.



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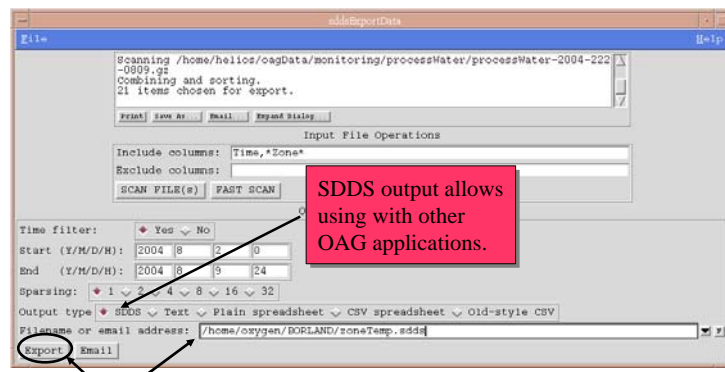
Exporting Data



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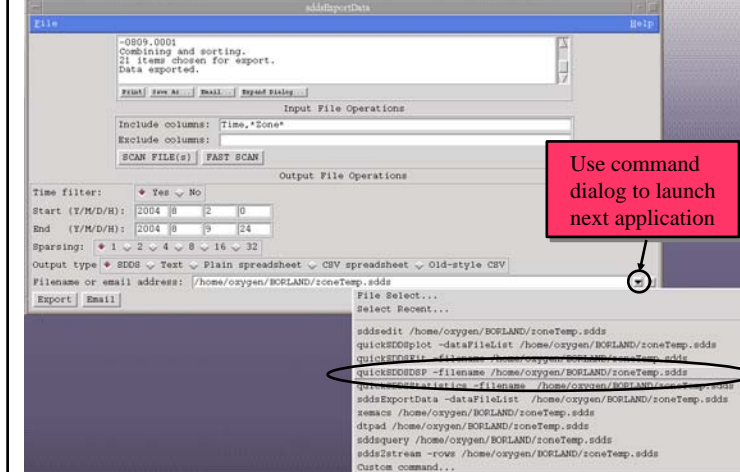
Exporting Data



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Working with Exported Data



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SDDS Utilities SubMenu

“Quick” interfaces to basic SDDS capabilities

- Graphics
- Fitting
- Digital signal processing
- Statistical analyses
- Edit
- Export/import

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“quick SDDS DSP”: Digital Signal Processing

Fast Fourier Transforms

Input file preset by export application

Select independent and dependent variables

Specify output file and processing parameters

Do the analysis and display results

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Example of FFT Results

FFT shows 1 and 0.5 day components to temperature variation

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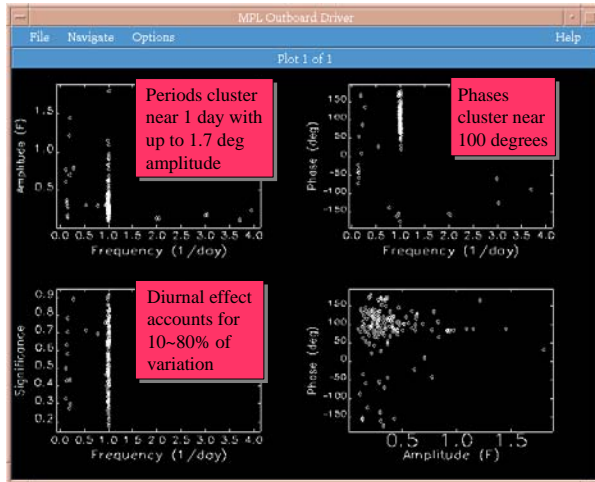
More DSP: NAFF

Numerical Analysis of Fundamental Frequencies

To make it more interesting, look at all 172 AHU temperatures for the experimental hall.

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NAFF Reveals a Wealth of Information



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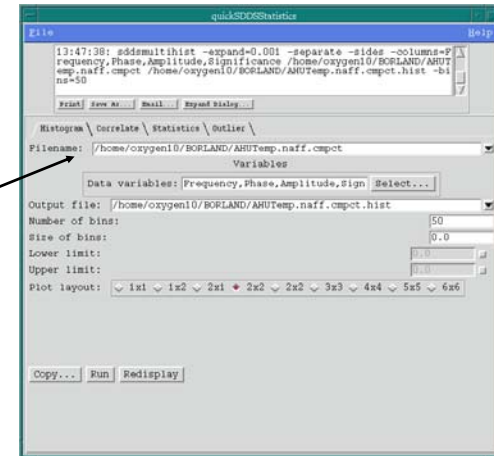
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“quick SDDS Statistics”

- Histograms
- Statistics computation
- Outlier analysis
- Correlation analysis

Input for histogram is the output from NAFF analysis.

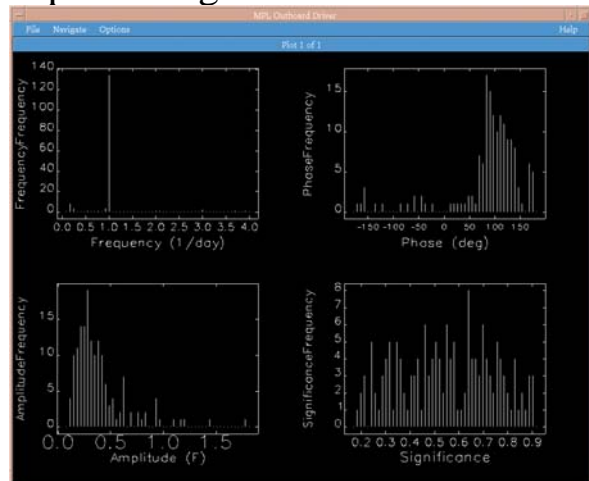
The idea of using one program's output as another program's input is central to SDDS.



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Sample Histogram Results

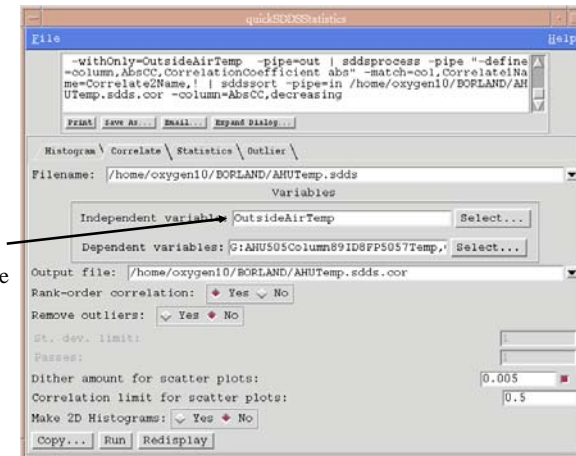


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Searching for Correlations

Search for correlations with outside air temperature



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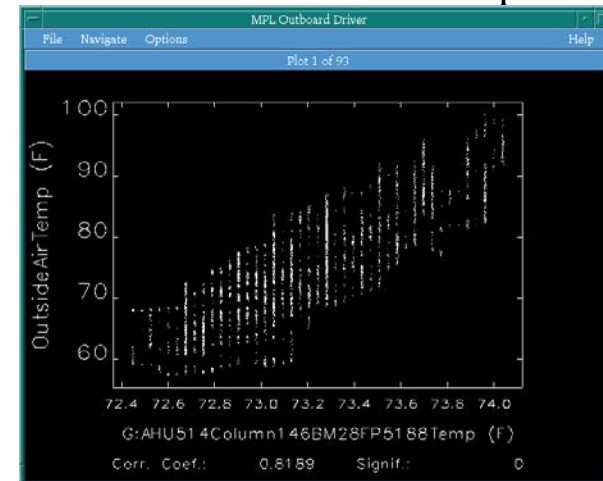
Correlation Analysis: Experimental Hall Temps. with Outside Air Temp.

Corr.Coeff.	Corr.Signtf.	CorrelatePair
0.819	0.000	G:AHU514Column146BM28FP5188Temp_OutsideAirTemp
0.805	0.000	G:AHU517Column160ID32FP5234Temp_OutsideAirTemp
0.805	0.000	G:AHU513Column139BM26FP5174Temp_OutsideAirTemp
0.795	0.000	G:AHU507Column102ID13FP5093Temp_OutsideAirTemp
0.791	0.000	G:AHU514Column142ID26FP5192Temp_OutsideAirTemp
0.777	0.000	G:AHU509Column116ID18FP5117Temp_OutsideAirTemp
0.761	0.000	G:AHU508Column110BM16FP5104Temp_OutsideAirTemp
0.761	0.000	G:AHU513Column141ID25FP5180Temp_OutsideAirTemp
0.754	0.000	G:AHU511Column128ID22FP5146Temp_OutsideAirTemp
0.752	0.000	G:AHU508Column110BM16FP5103Temp_OutsideAirTemp
0.750	0.000	G:AHU515Column152BM30FP5202Temp_OutsideAirTemp
0.745	0.000	G:AHU516Column156ID31FP5219Temp_OutsideAirTemp
0.737	0.000	G:AHU513Column140ID25FP5172Temp_OutsideAirTemp
0.735	0.000	G:AHU513Column139ID25FP5175Temp_OutsideAirTemp
0.719	0.000	G:AHU513Column140ID25FP5171Temp_OutsideAirTemp
0.717	0.000	G:AHU513Column138ID25FP5176Temp_OutsideAirTemp
0.716	0.000	G:AHU515Column152BM30FP5201Temp_OutsideAirTemp
0.714	0.000	G:AHU514Column143BM27FP5196Temp_OutsideAirTemp
0.709	0.000	G:AHU517Column160BM33FP5233Temp_OutsideAirTemp
0.705	0.000	G:AHU513Column140ID26FP5173Temp_OutsideAirTemp
0.702	0.000	G:AHU510Column119BM19FP5135Temp_OutsideAirTemp
0.702	0.000	G:AHU511Column125BM21FP5154Temp_OutsideAirTemp
0.701	0.000	G:AHU508Column106ID14FP5108Temp_OutsideAirTemp
0.693	0.000	G:AHU514Column144ID27FP5190Temp_OutsideAirTemp
0.693	0.000	G:AHU509Column113BM17FP5121Temp_OutsideAirTemp
0.691	0.000	G:AHU514Column143ID27FP5184Temp_OutsideAirTemp
0.691	0.000	G:AHU514Column144ID26FP5193Temp_OutsideAirTemp
0.687	0.000	G:AHU513Column139ID25FP5181Temp_OutsideAirTemp
0.684	0.000	G:AHU506Column94BM12FP5074Temp_OutsideAirTemp
0.682	0.000	G:AHU509Column113BM17FP5126Temp_OutsideAirTemp
0.680	0.000	G:AHU515Column150ID29FP5203Temp_OutsideAirTemp
0.676	0.000	G:AHU514Column145ID27FP5195Temp_OutsideAirTemp
0.673	0.000	G:AHU511Column128ID21FP5143Temp_OutsideAirTemp
0.659	0.000	G:AHU516Column156ID31FP5217Temp_OutsideAirTemp
0.657	0.000	G:AHU506Column96ID11FP5077Temp_OutsideAirTemp

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Correlation Scatter Plot Example



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Statistics Computation

Example of computing a variety of statistics for AHU temperatures

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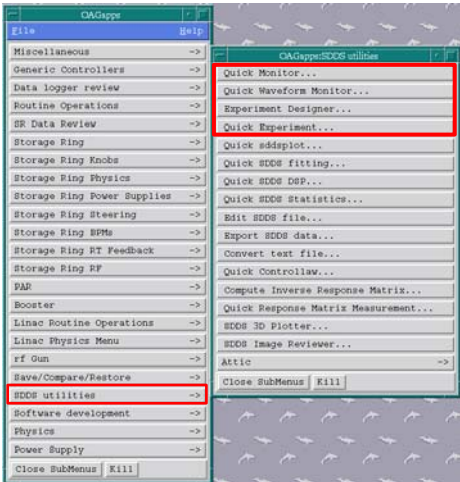
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Statistics Results

Data	Mean	Median	StDev	QRange	Units
OutsideAirTemp	74.6002	73.6877	0.66182	12.3464	F
G:AHU513Column138ID24FP5170Temp	149.361	149.083	3.15517	2.45618	F
G:AHU513Column138ID24FP516Temp	136.968	137.142	1.87958	1.92712	F
G:AHU511Column128ID22FP514Temp	81.1791	80.9895	1.12983	1.62488	F
G:AHU513Column140ID25FP5171Temp	71.118	71.0896	1.10392	0.642395	F
G:AHU510Column119BM19FP513Temp	76.0424	76.3799	0.994822	1.66266	F
G:AHU510Column122ID19FP5130Temp	77.2784	77.3624	0.956028	0.869141	F
G:AHU506Column94BM12FP507Temp	72.0692	72.6389	0.843221	1.20923	F
G:AHU508Column102ID13FP509Temp	71.3853	71.5431	0.837135	0.982463	F
G:AHU506Column96ID10FP508Temp	72.9772	72.7523	0.799526	1.54932	F
G:AHU505Column90ID0FP504Temp	72.7389	72.5255	0.766343	1.03798	F
G:AHU508Column95BM11FP507Temp	72.7368	73.6011	0.760342	1.20911	F
G:AHU505Column90ID0FP504Temp	73.4221	73.2057	0.760193	1.05583	F
G:AHU505Column92BM10FP506Temp	72.6179	72.4878	0.755631	1.11333	F
G:AHU505Column88BM9FP506Temp	72.5121	72.2988	0.724488	1.02026	F
G:AHU513Column139BM26FP517Temp	73.3495	73.3569	0.720899	1.03804	F
G:AHU507Column104BM4FP508Temp	72.8949	72.8279	0.720211	1.02032	F
G:AHU508Column110ID13FP510Temp	73.4295	73.2812	0.709764	1.03804	F
G:AHU505Column92BM10FP506Temp	73.719	73.5450	0.70514	1.05811	F
G:AHU513Column140ID26FP517Temp	72.3504	72.3744	0.704499	0.75379	F
G:AHU511Column128ID22FP514Temp	71.4532	71.203	0.702095	0.944701	F
G:AHU511Column126ID20FP514Temp	73.2692	73.2057	0.693935	1.20923	F
G:AHU511Column126ID20FP514Temp	72.6155	72.5255	0.678965	0.944441	F
G:AHU514Column142ID26FP519Temp	72.7267	72.6767	0.615339	1.13361	F
G:AHU506Column94BM12FP507Temp	73.7232	73.5836	0.613883	0.982344	F
G:AHU509Column115BM17FP512Temp	73.5204	73.4325	0.601155	0.982344	F
G:AHU505Column90ID0FP504Temp	72.3857	72.2988	0.580747	0.75379	F
G:AHU513Column139BM26FP517Temp	73.7623	73.5836	0.570005	0.75379	F
G:AHU513Column138ID25FP517Temp	72.2851	72.2988	0.56553	0.75379	F
G:AHU513Column139ID25FP517Temp	73.0856	73.1501	0.563497	0.75379	F
G:AHU511Column124BM21FP515Temp	71.9982	71.8454	0.559164	0.75379	F
G:AHU506Column96ID11FP507Temp	72.7235	72.6389	0.558715	0.75379	F
G:AHU513Column140ID26FP517Temp	71.8758	71.8075	0.534919	0.75379	F
G:AHU513Column137BM25FP517Temp	72.8068	72.79	0.530951	0.75379	F
G:AHU505Column90ID0FP504Temp	73.2372	73.1679	0.534436	0.75379	F
G:AHU508Column108ID13FP510Temp	72.4288	72.2988	0.52788	0.75379	F
G:AHU513Column139ID25FP517Temp	71.7383	71.6923	0.525887	0.75379	F
G:AHU507Column102ID13FP509Temp	72.9825	73.0546	0.526466	0.75379	F
G:AHU509Column114ID17FP512Temp	72.4345	72.3744	0.523983	0.75379	F
G:AHU507Column102ID13FP509Temp	71.803	71.7493	0.521031	0.75379	F
G:AHU508Column108BM16FP510Temp	72.9612	72.979	0.510259	0.793457	F

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SDDS Utilities SubMenu (again)

“Quick” interfaces to basic SDDS capabilities

- Data collection
- Experiment execution

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Data Collection

- quickMonitor
 - Interface to basic features of the program sddsmonitor
 - Time-interval-based data collection
- quickWaveformMonitor
 - Interface to basic features of the program sddswmonitor
 - Time-interval-based collection of waveforms and scalar values
- For more sophisticated applications, one can use commandline SDDS tools...

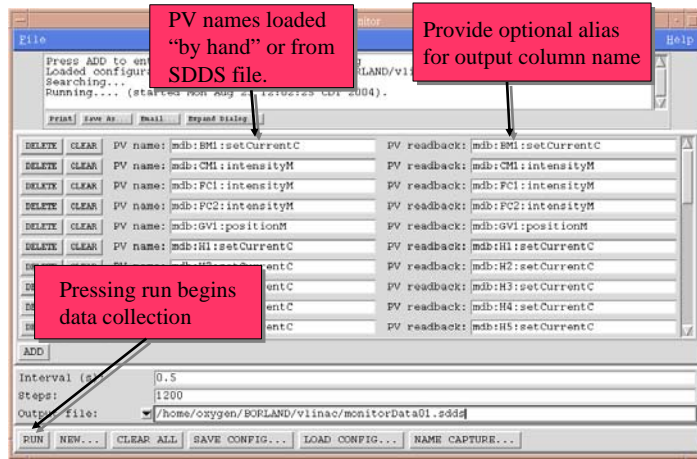
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SDDS Data Collection Capabilities

- Capabilities include
 - Time series logging of values and statistics
 - Glitch-, alarm-, or trigger-initiated logging with pre- and post-event samples
 - Synchronous and quasi-synchronous logging
 - Logging of changes to values
 - Alarm logging with related data capture
- Input files for these programs are largely identical
- All APS accelerator data logging uses these tools
- See our web site or later talks for more...

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quickMonitor



PV names loaded “by hand” or from SDDS file.

Provide optional alias for output column name

Pressing run begins data collection

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MEDM Allows Dragging and Dropping PV names

Click on PV widget with middle mouse button

Click in entry box with middle mouse button

K. Evans' NameCapture application makes SDDS file directly

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quickMonitor Run Dialog

sddsmonitor command is visible (educational!)

Basic plot features (use command dialog for more)

Stop sddsmonitor but keep window open

Stop sddsmonitor and close window

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quickMonitor or StripTool?

- StripTool is a popular EPICS client for time-series sampling
 - Convenient interface
 - Scrolling plots of the data
- Use StripTool when
 - ~5 channels or less
 - Primary interest is *seeing* the data
 - Note: StripTool can dump SDDS data
- Use quickMonitor when
 - More than ~5 channels
 - Primary interest is *analyzing* the data
 - quickSDDSplot can perform "movie" plots of updating

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Homework: Analyze the Vlinac* Simulation

- Use quickMonitor to collect data on all PVs.
- Use quickSDDSplot to review signals: *Final current (FC1) varies with time.*
- Use quickSDDSstatistics to look for correlations with FC1: *Cathode temperature is highly correlated.*
- Use quickSDDSdsp to look for frequencies: *Clear 60s oscillations!*

*N. Arnold, ASD

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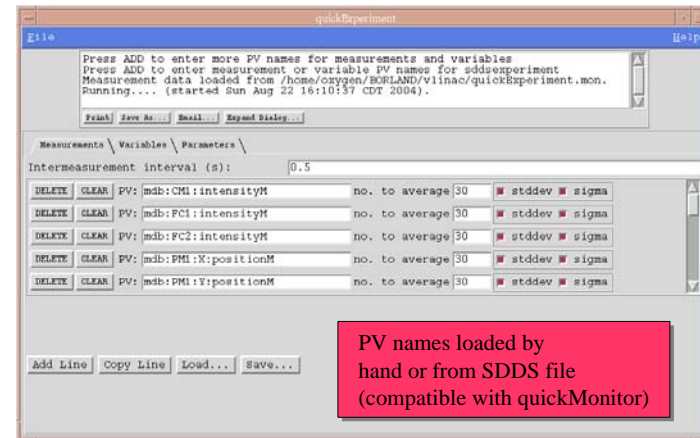
Experiment Execution: quickExperiment

- Limited interface to sddsexperiment
- Perform 1-D experiments with several (ganged) variables
- Measure any number of readbacks, with averaging and statistics
- sddsexperiment offers more
 - N-dimensional experiments
 - Verification of response of variables
 - Test limits to ensure data quality
 - Script execution

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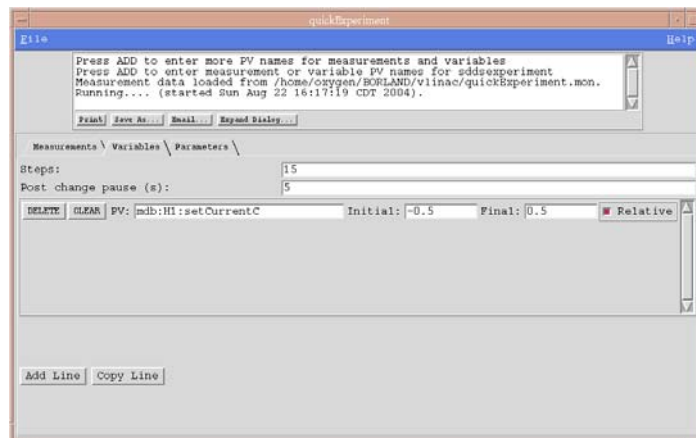
Example with Vlinac



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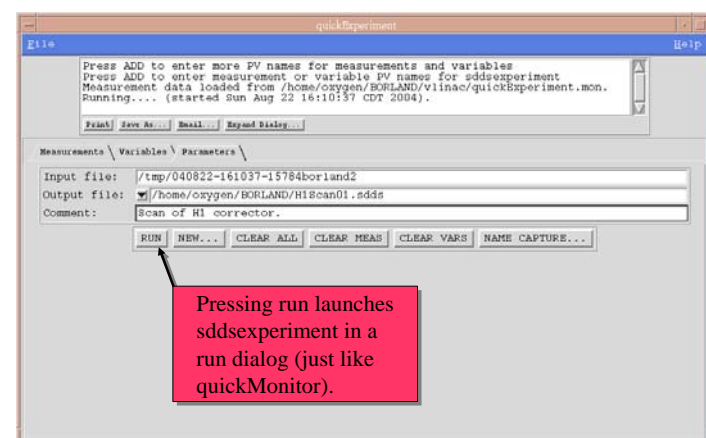
Variables Tab



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Parameters Tab

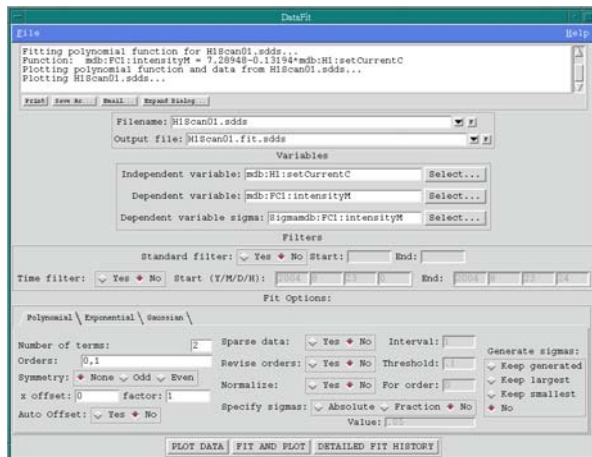


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Use quickSDDSFit to Look at Results

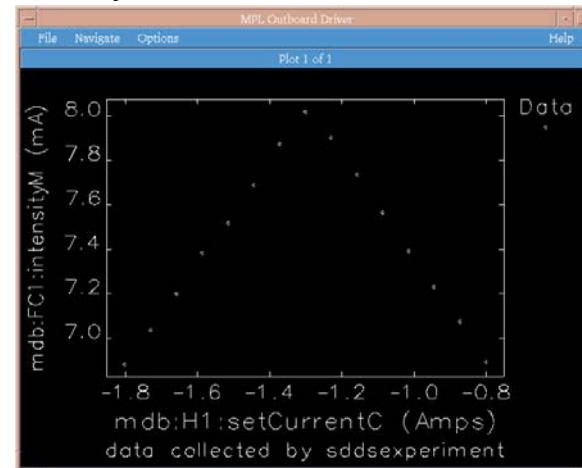
Provides polynomial, exponential, and gaussian fitting and display.



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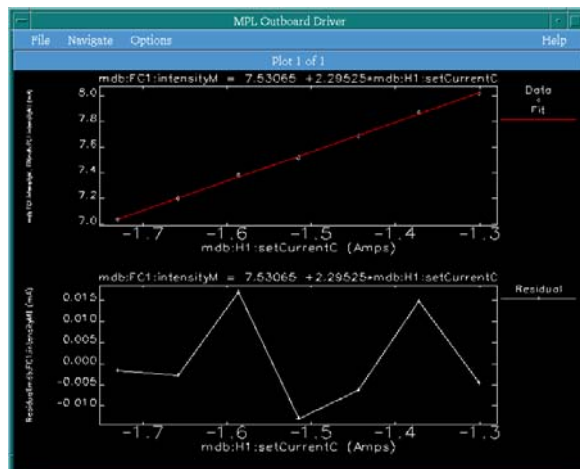
Intensity Data Is Bi-Linear



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Linear Fit to One Side



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Experiment Execution: ExperimentDesigner

- Allows designing complex experiments that involve
 - Initialization
 - Execution sequence
 - User interaction
 - Coordination of external programs and scripts
 - Finalization
 - Postprocessing
- Configurations can be saved and executed as a script with no interface
 - Allows N-dimensional experiments

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ExperimentDesigner: PV Panel

Configuration loaded from file /home/oxygen/BORLAND/vlinac/ED01/monitorLines
 Completely loaded from /home/oxygen/BORLAND/vlinac/execution
 Completely loaded from /home/oxygen/BORLAND/vlinac/ED01/execution
 Completely loaded from /home/oxygen/BORLAND/vlinac/ED01/changeControl.

Loaded configuration from file menu.

Declared PVs directly visible to the script: controls and readbacks

Defined equation to compute a new quantity from PVs.

PV / Equation	Minimum	Maximum	PVtype
mdb:HI:setCurrentC	-5.00000000	5.00000000	Control
mdb:cathodeTemp	159.82661216176	0.00000000	Readback
Equation	CathodeTemperat	60.2955210	-degC

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Experiment Designer: Initialization Design

17:33:17 Done.
 17:33:18 Configuration loaded from file /home/oxygen/BORLAND/vlinac/ED01/monitorLines
 17:33:18 Completely loaded from /home/oxygen/BORLAND/vlinac/execution
 17:33:18 Completely loaded from /home/oxygen/BORLAND/vlinac/ED01/changeControl.

Press "Add Init Entry" to add the initialization steps.

PV name	Readback name	set_value	orig_value	tolerance
mdb:cathodeCurrentC	mdb:cathodeCurrentC	12	12	1.0
mdb:gunonC	mdb:gunonC	1	1	0.0
mdb:GVI:positionC	mdb:GVI:positionC	1	1	0.0

Script: exec sddsosr -restore /home/oxygen/BORLAND/vlinac/config.snap
 Script: exec maintainReadback -configFile /home/oxygen/BORLAND/vlinac/maintain
 Script: exec sleep 5

- Set cathode current, check response
- Turn gun on, check response
- Open valve, check response
- Restore setpoints from SDDS file
- Launch cathode temperature regulator (more later)

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Experiment Designer: Execution Design

17:33:17 Done.
 17:33:18 Configuration loaded from file /home/oxygen/BORLAND/vlinac/ED01/monitorLines
 17:33:18 Completely loaded from /home/oxygen/BORLAND/vlinac/execution
 17:33:18 Completely loaded from /home/oxygen/BORLAND/vlinac/ED01/changeControl.

Steps [5] Interval (s) [1] Run Postprocess after experiment? [Yes] No

Output Directory: /home/oxygen/BORLAND/vlinac/
 Output rootname: edRun01
 Experiment Description: Experiment designer demo

Press "Add Exec Entry" button to add the execution steps in order

Type	SET/VIEW Arguments	INSERT	DELETE
ChangeControl			
WaitTime			
ReadValue			
RunProgram			

For each experiment step:

- Change control values
- Wait a specified time
- Read declared PVs
- Run program

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Experiment Designer: Run Program Dialog

Program: sddsstatmon sddsmonitor sddslogger sddswmonitor sddsstatmon

Input File: /home/oxygen/BORLAND/vlinac/sddsmonitor.in
 Output File suffix: stat
 steps: 30 interval (s): 0.5 append appendToPage
 User custom options:

Output Directory: /home/oxygen/BORLAND/vlinac/
 Output rootname: edRun01
 Experiment Description: Experiment designer demo

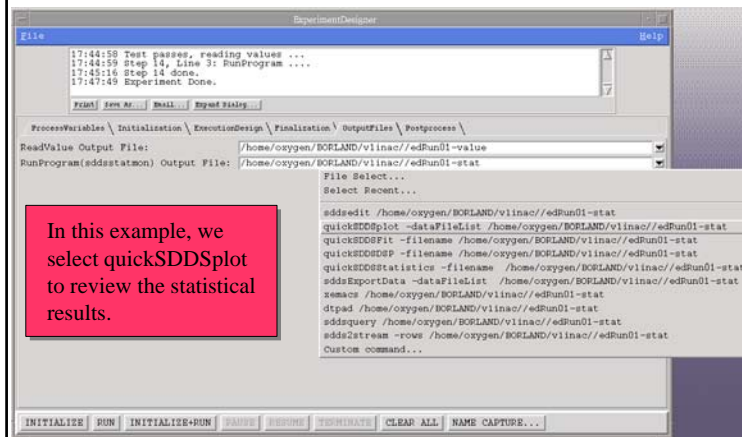
Press "Add Exec Entry" button to add the execution steps in order

Type	SET/VIEW Arguments	INSERT	DELETE
ChangeControl			
WaitTime			
ReadValue			
RunProgram			

Run Script action (not shown) used for general programs.

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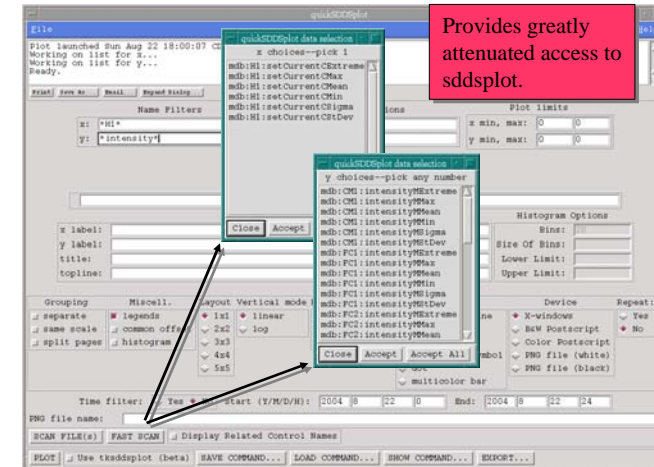
Experiment Designer: Output Files Tab



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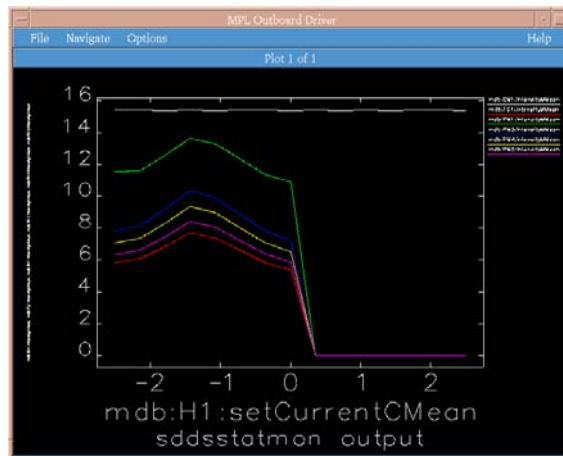
quickSDDSplot Interface



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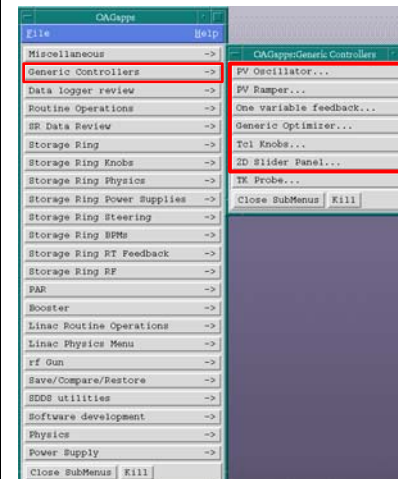
quickSDDSplot Output Example



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Generic Controllers SubMenu



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- Set up a one-readback, one-actuator feedback loop
- Set up and perform optimizations
- Change PVs in oscillatory or ramped fashion
- Set up knobs and 2D sliders

Can use the script "maintainReadback" to regulate Vlinac cathode temperature

The "readback" is the thing to be stabilized (cathode temperature)

The "actuator" is the control used to stabilize the readback

Use "GetGain" button to measure response coefficient

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Sample for 60s and use midpoint of readings to deal with the oscillation.

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Graph of the response

"Gain" value automatically entered in dialog

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Effectiveness of Feedback

Feedback turned on

Reduction in oscillation limited by update rate of the PVs

Time starting Thu Aug 19 20:01:02 2004

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Generic Optimizer*

- A common requirement in control systems is optimization of some quantity
- Feedback requires quasi-linear responses measured around the desired point
- Automated optimization is useful when none of these conditions apply
 - Explores new territory
 - Has advantages over manual tweaking
 - It is relatively slow

*Inspired by J. Lewellen's "amoeba" script.

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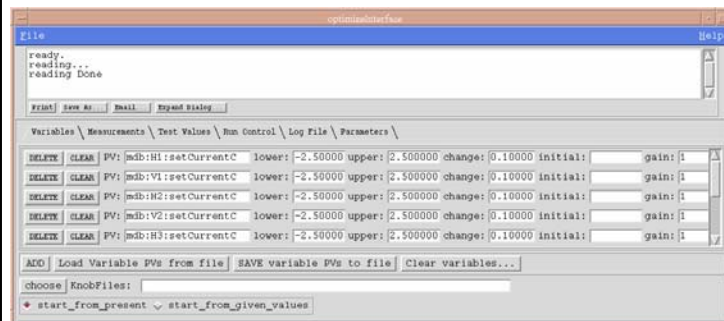
Example: Optimization of the Vlinac

- Deliberately mis-set all the correctors in the Vlinac simulation
- Set up optimizer with
 - 10 variables: the setpoints for all the correctors
 - 1 readback: the final beam current
- Use Simplex method without initial 1D scans
- To reduce current ripple and noise effects:
 - Use maintainReadback to regulate cathode temperature
 - Average for 60 seconds

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Optimizer Interface: Variables Tab

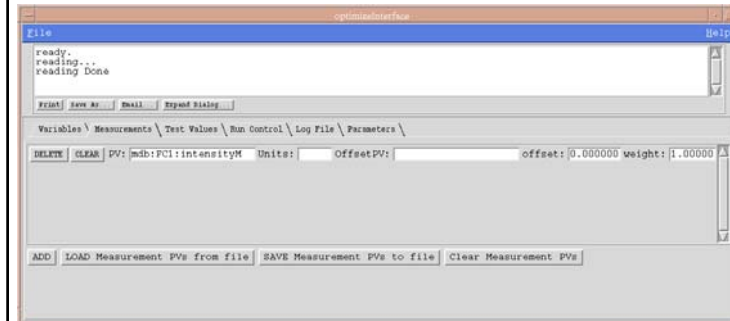


- Any number of actuators ("variables")
- Enter limits and initial step sizes
- Provide composite knob definition files

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Optimizer Interface: Measurement Tab

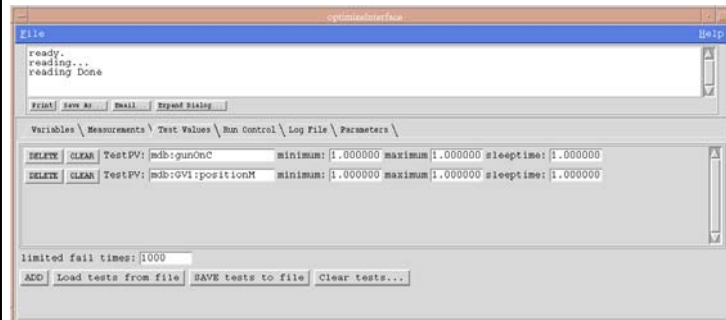


- Optimizes the mean-absolute-value (MAV) or RMS of any number of readbacks with optional offsets and weighting

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Optimizer Interface: Tests Tab

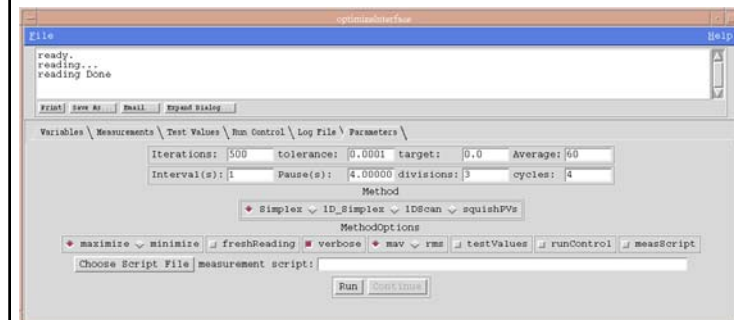


- Optional “test values” to prevent optimizer from running when conditions are not right (e.g., no beam)

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Optimizer Interface: Parameters Tab

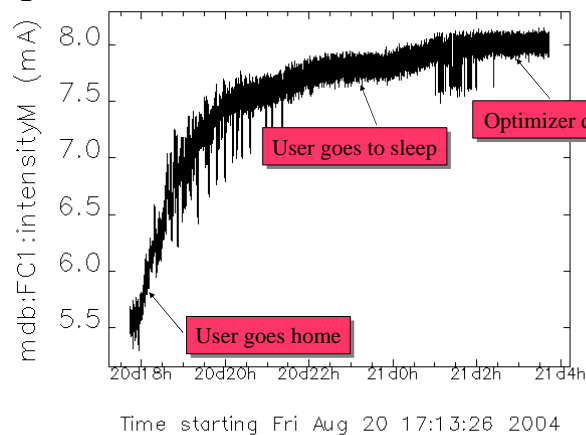


- Simplex or successive 1-D scan methods
- User-specified averaging and post-change pause
- Can optimize with user script to compute penalty function

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Optimizer Result



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Summary

- OAG provides a number of tools for the general EPICS user
 - Access to accelerator data logs
 - Perform data collection
 - Plot and analyze data
 - Design and execute experiments
 - Feedback and optimization
- These tools are interlinked by SDDS files
- Don't miss follow-up lectures
 - OAG Tcl/Tk (R. Soliday)
 - SDDS (M. Borland)

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OAG Group Members

- Present:
M. Borland, L. Emery, N. Sereno,
H. Shang, R. Soliday
- Emeritus:
D. Blachowicz, B. Dolin, K. Evans, C. Saunders