Orbitscreen

Reference Manual

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Contents

Overview

Orbitscreen is a Motif[1] program to display arrays of process variables from the Advanced Photon Source control system. Although, in principal, any two arrays of process variables may be displayed, the most common use is to display the horizontal and vertical monitor readings.

There are three display areas in the interface, one for each of the arrays and a zoom area. In the zoom area both arrays can be displayed at once along with symbols for the major elements of the lattice.

There are a number of options to customize the way the values are displayed. It is also possible to:

- Store the current values internally
- Store the values from a snapshot file internally
- Display one of the stored sets of values along with the current values
- Display the difference of the current values with one of the stored sets of values
- Write the current values to a snapshot file

The program continuously updates and displays the standard deviation, average, and maximum absolute values for each array and will show the envelope of recent values if desired. (The standard defined with n rather than n-1 is used since the whole population is known.) The values are sent to the program anytime they change outside of their dead band. If the dead band is chosen appropriately, this should result in less traffic over the control network than if all of the values were polled at fixed intervals. When the display updates, the current values that have been received are displayed. It is possible to manually update all the variables via the Options/EPICS/Rescan menu.

A PV file determines which process variables are displayed in each array and other things such as units and scaling. A lattice file specifies the symbols and longitudinal lattice positions of the elements in the lattice. Sets of values can be saved and restored via snapshot files, and the difference with the

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[1]Motif is a standard graphical interface for X Windows systems. It is characterized by a three-dimensional look and feel.

values in these files or other saved sets of values can be displayed via options in the Options menu.

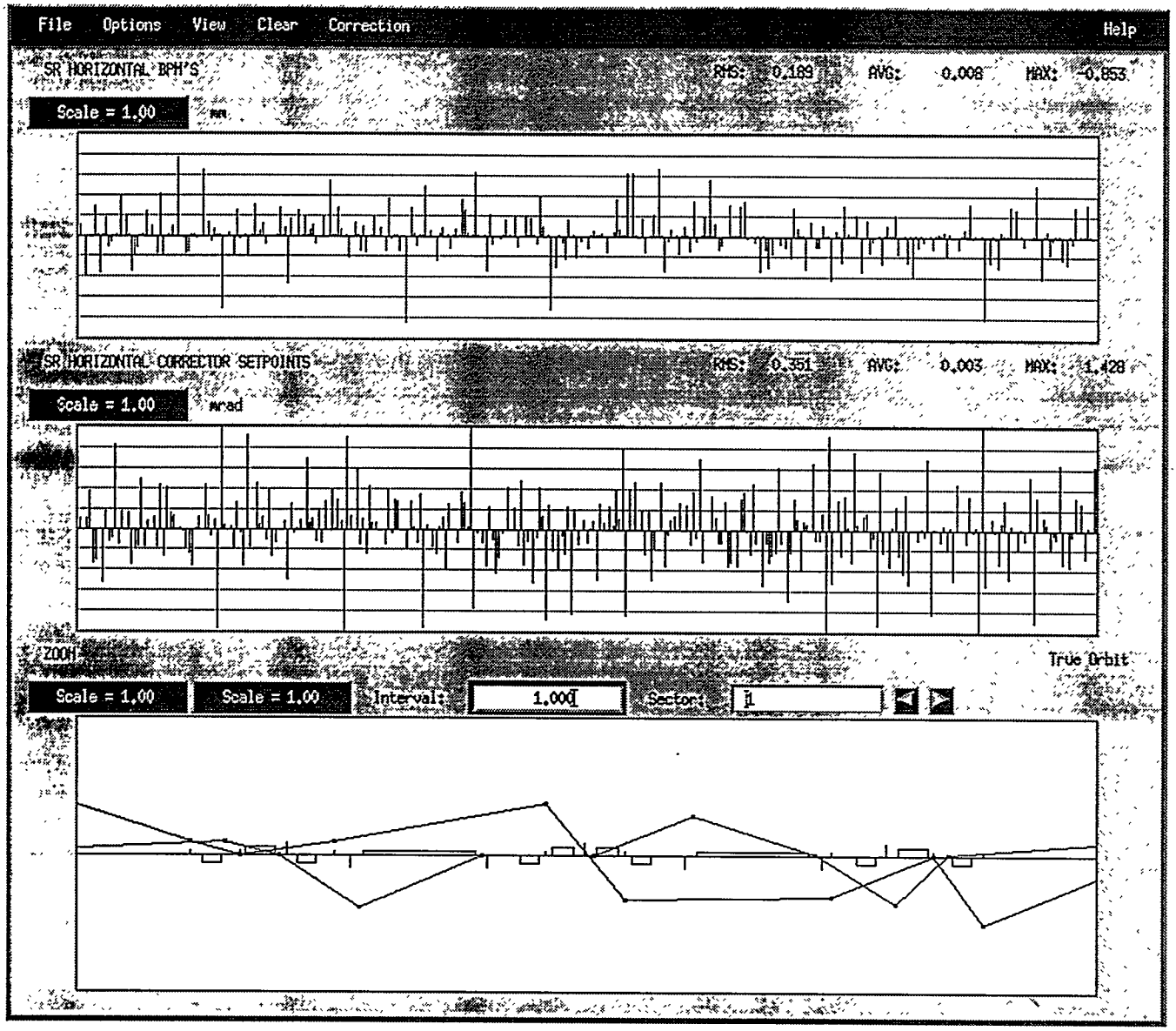

Fig. 1 The Orbitscreen Interface

Getting Started

In order for Orbitscreen to run properly, it needs to find the **orbitscreenrc** file. (It is possible to run Orbitscreen without the **orbitscreenrc** file, but it is not suggested.) This file contains the File/Load menu options and the locations of other files that Orbitscreen needs. There are three main ways to allow Orbitscreen to find the **orbitscreenrc** file.

- Put this file in your home directory, call it **.orbitscreenrc** (with a dot), and start Orbitscreen from anywhere. All of the directory and file locations should be specified (using full pathnames).
- Change to any directory where an **orbitscreenrc** (no dot) exists, and start Orbitscreen there.

- Set the environmental variable **$ORBITSCREENHOME** to the directory where **orbitscreenrc** (no dot) is located, and start Orbitscreen from anywhere.

The contents of **orbitscreenrc** are described under configuration.

The command line for Orbitscreen is of the form:

orbitscreen [Standard X Options] [-x]

It accepts any of the standard X-Window options, such as **-display machine:0**. The other option is:

-x Use Xorbit Simulation Mode.

Upper Two Display Areas

In the upper two display areas the values of the process variables are displayed in graphical form with uniform horizontal spacing between the points. Display options, such as whether the values are displayed as a line plot or as an impulse plot, are determined by settings that can be made in the View menu. There are mouse operations for displaying the numerical values of the three elements closest to the mouse cursor and moving the zoom window so the element closest to the mouse cursor is in the center. There are options in the View menu to show the region between the maximum and minimum values achieved for each process variable since the last reset. The Reset Max/Min switch is in the Options menu.

The scale of the window can be changed by a control above it. The displayed range extends from the negative of the value on the Scale button (at the bottom) to the positive of the value (at the top). The starting scale and a factor by which to multiply the raw data to get the desired units are set in the PV file, which also determines which process variables are displayed and the heading and units.

The standard deviation, average, and peak absolute values are shown and updated when the values are updated. (The standard defined with n rather than n-1 is used since the whole population is known.) The peak absolute value includes the sign of the value that was largest. The update time interval can be changed in the View/Timing menu.

Zoom Area

Both sets of values are shown together in their true relative lattice positions in the zoom window, along with symbols representing the lattice elements. The values from the upper display area are red by default and those from the middle display area are blue. There are mouse operations that scroll the window as well as controls above the window to change the size of the interval of the lattice displayed, the sector, and to scroll by a display interval one sector at a time. The zoom area can also be scrolled by clicking in the upper two display areas. The sector shown in the box labeled **Sector:** is the sector that is at the center of the display area. In addition, numbers designating the sectors and a mark identifying the center of the display area are displayed in the display area to help identify the sectors and the midpoint for mouse scrolling.

The scale of each of the curves in the zoom window can be changed by the controls above it. The left control corresponds to the upper display area and the right, to the middle. The scale corresponding to 1.0 is set in the PV file, which also determines which process variables are displayed and the heading and units displayed.

Other options controlling how and which curves are displayed are found in the Options/Zoom Options menu. The zoom area can be turned off entirely, and it does not appear if the process variables cannot be matched with the lattice elements in the lattice file.

Mouse Operations

In the upper two display areas:

Button 1: Pushing and holding Button 1 brings up a dialog box with the numerical values of the three elements closest to the mouse cursor. The dialog box goes away when you release the mouse button within the display area. If you want the box to stay up, drag the mouse cursor off the display area before releasing it.

Button 2: Pushing Button 2 moves the element closest to the mouse cursor to the center of the zoom area.

In the zoom area:

Button 2: Pushing Button 2 moves the point under the mouse cursor to the center of the zoom area. (Similarly to what Button 2 does in the upper two display areas.)

Button 3: Pushing and holding Button 3 scrolls the zoom area horizontally. The scroll speed is proportional to the distance of the mouse cursor from the center of the zoom area. You can scroll either direction, depending on which side of the center you hold the mouse cursor.

File Menu

Load

The Load button brings up a menu of predefined configurations that may be loaded into the display. Each configuration corresponds to a PV file and the associated lattice file. As soon as the configuration is loaded, monitoring starts. The configurations on the menu should be the most commonly used ones. If you wish to specify another configuration, you may pick the menu item labeled **Custom**. In that case, a file selection dialog box to pick the PV file will appear. The items that appear in the menu are specified in the configuration file.

Read

The Read button brings up a menu of possible slots in which to store data from a snapshot file. After choosing the slot from the menu, there will be a file selection dialog box to allow you to pick the snapshot file containing the data. The data stored in the slot can then be used for displaying or differencing with the current data.

Write

The Write button allows you to store either the current data or the data saved in one of the slots in a snapshot file. It brings up a menu which includes the current data and the possible slots. After choosing the current data or the desired slot, there will be a file selection dialog box to allow you to pick the snapshot file into which to write the data.

Plot

The Plot button brings up an SDDS plot of either the current data or the data saved in one of the slots.

Status

The Status button brings up a dialog box with information about the configuration and the data loaded into slots.

Quit

The Quit button closes any Channel Access connection and terminates Orbitscreen.

Options Menu

EPICS

Normally, using File/Load is sufficient to perform the required EPICS procedures. This item provides more control over EPICS. The **Start** button will initialize EPICS if it is not initialized and start it with the current PV file. If it is stopped, it will start it and rescan the process variables. Initialized means connections have been established with all the process variables. Started means it is initialized, is receiving messages whenever those values change outside of their dead bands, and is updating the display. When it is started, the **Start** button changes to a **Stop** button. Consequently, this button also tells you what state it is in. The **Stop** button leaves it initialized but not receiving messages and not updating the display. You can play with the existing data. The **Exit** button stops it and closes the connections, so it is no longer initialized. The **Reinitialize** button is equivalent to **Exit** followed by **Start**. The **Rescan** button causes it to explicitly update all the values whether they have changed out of the dead band or not. It insures the readings are current.

Store

The Store button allows you to store the current values in one of the available slots. The status of what is stored in the slots can be displayed with the File/Status button.

Display

The Display button allows you to display the current values from one of the available slots in addition to the current values. They will be a different color. This capability allows you to compare the current values, which are being updated, with some other set of values. **No Stored Values** turns off the display of these other values. The status of what is stored in the slots can be displayed with the File/Status button.

Difference

The Difference button allows you to display the difference of the current values and the values in one of the available slots. This capability allows you to see the changes in the current values from some other set of values. **Off** turns off the differencing. The status of what is stored in the slots can be displayed with the File/Status button.

Check Status

The Check Status button allows you to choose how much status information is displayed. The choices are **Off** (do not display status symbols), **Check InValid** (display symbols only for invalid readings), and **Check All** (display all status symbols). Orbitscreen still receives all status information regardless of these choices. The choices only determine how much of the information is displayed. The button is only operational if status process variables have been specified in the PV file.

Zoom Options

The Zoom Options button gives access to several controls that affect the zoom window. You can toggle on and off the display of lines or markers for the values in the upper (x1) or middle (x2) display areas and toggle the display of grid lines on and off. The zoom window display can also be turned entirely on and off with the **Active** toggle button. Turning it off will save processing time. It will be off in any event, regardless of the setting of this button, if the process variables cannot be matched with the lattice elements.

Reset Max/Min

The Reset Max/Min button resets the stored maximum and minimum values for each process variable to the current values. This effectively restarts the maximum/minimum history. The display of the history is controlled by the Max/Min and Filled Max/Min options in the View menu.

View Menu

Timing

The Timing button brings up a dialog box that lets you change the screen update interval. Recall that new values are received by Orbitscreen when the process variables go out of their dead band. These values are collected and are displayed only when the screen updates.

Markers

The Markers toggle button toggles whether markers are shown or not for the data points in the upper two display areas.

Lines

The Lines toggle button toggles whether lines are shown or not for the data points in the upper two display areas. If Bars are chosen, then Lines will not be, however.

Bars

The Bars toggle button toggles whether impulse lines are shown or not for the data points in the upper two display areas. Bars overrides Lines.

Grid

The Grid toggle button toggles whether grid lines are shown or not in the upper two display areas.

Max/Min

The Max/Min toggle button toggles whether the maximum and minimum values for each process variable since the last reset are shown or not in the upper two display areas. The maximum-minimum history is reset with the Options/Reset Max/Min button.

Filled Max/Min

The Filled Max/Min toggle button toggles whether or not the area between the maximum and minimum values is filled with gray. Filling the area makes it easier to see where the values have been during the history period. It does nothing if the Max/Min button is not set on.

Double Buffer

The Double Buffer toggle button toggles whether the updating of the display is double buffered or not. If it is double buffered, the screen is updated in the background and displayed all at once. This is the most pleasing option. Otherwise, you can see the lines being drawn as the screen is updated. You might use no double buffering to check that the updates are occurring, but usually there is no reason to change this setting.

Clear Menu

Clear

The Clear button clears all three display areas. Unless EPICS is stopped, they will be redrawn at the next scheduled update.

Redraw

The Redraw button redraws all three display areas with the last values used, not the current ones. Unless EPICS is stopped, they will be redrawn at the next scheduled update anyway.

Update

The Update button redraws all three display areas with the current values. Unless EPICS is stopped, they will be redrawn at the next scheduled update anyway.

Autoclear

The Autoclear button toggles whether new values erase old ones or not. Turning Autoclear off is another way to obtain a history of the values.

Correction Menu

The Correction Menu has not been implemented at this time and may not be.

Installation

In the typical, standard installation there should be a directory in which most of the Orbitscreen files are found. The files that should be in this directory are:

orbitscreenrc
orbitscreen.html
orbitscreen.gif
aps.icon

The last three are for the help package

There should be subdirectories **pv** for PV and lattice files and **snap** for snapshot files. There may be a similar set of subdirectories, **xorbit/pv** and **xorbit/snap**, for files used with Xorbit simulation.

All of these files may be located elsewhere if desired. See configuration.

The help package also refers to configuration files:

pv/par.bpm.pv
pv/par.lat
snap/par.bpm.ref.snap

that are assumed to be in subdirectories, **pv** and **snap**, relative to the location of **orbitscreen.html**. If they are not there, you will not be able to view them from Mosaic.

The executable file, **orbitscreen**, should be located in a directory somewhere in your **$PATH**.

The application defaults file, **ControlApp**, should be located as specified in the section on the application defaults file. You can specify personal modifications to the resources in this file in your **.Xdefaults** (or equivalent) file or in your own **ControlApp** file in your home directory. (See an X Windows manual for the involved search path that X uses to find resources.)

Configuration

Exactly what is displayed in Orbitscreen is defined via three types of files. There are PV files and lattice files, which are described below. There is also a configuration file that defines what appears in the File/Load menu as well as where the default PV files, lattice files, snapshot files, and the help files are located.

The program looks for the configuration file first in your home directory with the name **.orbitscreenrc** (with a dot). If one is not found, it next looks in the directory given in **$ORBITSCREENHOME** if it exists, otherwise in the current working directory, for a file named **orbitscreenrc** (with no dot). If it still has not found one, there will be no options in the File/Load menu except Custom; the PV and snapshot files will be assumed to be in subdirectories, **pv** and **snap**, to the current working directory; and the help files will be assumed to be in the current working directory.

This configuration file is an SDDS[2] file and has two parameters: **OSPVDirectory**, which specifies the directory for the PV and lattice files, and **OSSnapDirectory**, which specifies the suggested directory for the snapshot files. (Independently of these settings, Custom PV, custom lattice, and snapshot files may be read from or written to any directory by changing the filter in the file dialog box.) There are corresponding parameters, **OSXPVDirectory** and **OSXSnapDirectory**, which specify these directories if Xorbit simulation is used. If the first two parameters are not specified and **$ORBITSCREENHOME** exists, then they will default to **$ORBITSCREENHOME/pv** and **$ORBITSCREENHOME/snap**, respectively, and will default to **./pv** and **./snap**, respectively, otherwise. If the Xorbit parameters are not given, they will default to whatever is used for **OSPVDirectory** and **OSSnapDirectory**.

There is also a parameter, **OSHelpFile**, which specifies the location of the Mosaic[3] HTML help file. This file should be in **$ORBITSCREENHOME/orbitscreen.html**. It defaults to **$ORBITSCREENHOME/orbitscreen.html** if **$ORBITSCREENHOME** exists and to **./orbitscreen.html**, otherwise.

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[2]SSDS stands for Self-Describing Data Sets and is a format developed by Michael Borland to provide a flexible and standard, general purpose, file format. There are routines available for reading and writing SDDS files.

[3]This manual was designed to be printed and also viewed on-line in Mosaic. Mosaic is an information browser that connects to many information sites on the Internet and World Wide Web. It was developed at the National Center for Supercomputing Applications at the University of Illinois.

If any of these file locations are specified through the above parameters, it is suggested that the full pathnames be used.

There are two columns, **OSPVFile** and **OSPVMenuLabel**, which give the name of a PV file (without the path) and the label that will appear in the File/Load menu in order to use this file. These PV files will be expected to be in the **OSPVDirectory**. If these columns are not there, there will be no options in the File/Load menu except Custom.

An example configuration file should be located in **$ORBITSCREENHOME/orbitscreenrc**.

PV Files

The PV files specify what process variables are to be displayed in each of the display areas. They also specify the multiplier to be applied to the data, the headings, the default scale, and the units labels for each area as well as the lattice file to be used if the process variables correspond to lattice elements. The PV files are valid BURT[4] request files. You can make new PV files containing any process variable you wish to monitor, and you can save them in your own directories. These can then be read in from the File/Load/Custom menu. If you start with an existing PV file, it should be obvious where the changes are to be made. An example PV file should be located in **$ORBITSCREENHOME/pv/par.bpm.pv**.

The possible parameters that may be specified in a PV file are:

OSFileType: A required, fixed value of type string that should be "ORBITSCREENPV".

OSHeading1, OSHeading2: A fixed value of type string that specifies the description that appears above each of the upper display areas.

OSScaleFactor1, OSScaleFactor2: A fixed value of type double by which all the raw data will be multiplied before being displayed. The units label to be displayed to the right of the Scale button is obtained from the units field of these two parameters. For example, to convert raw data in millimeters to displayed values in meters, the fixed value would be 0.001, and the units would be "m". If this parameter is not supplied, it will be taken as 1.0.

OSScale1, OSScale2: A fixed value of type double that specifies the scaling on the Scale button (the number of units corresponding to full scale). If this number is not one of the available values, the next-higher available value will be used. If this parameter is not supplied, the former number on the Scale button will not be changed.

The PV file will have one more column for **StatusName** if status is implemented.

Lattice Files

The lattice files contain information about all the basic lattice elements, including their longitudinal coordinates. This information is used to draw the symbols for the magnets in the Zoom Window and to determine the longitudinal coordinates corresponding to the process variables, so that the values can be shown in their true relative locations in the Zoom Window. There should only be one lattice file for each ring so you should have little need to make one yourself. An example lattice file should be located in **$ORBITSCREENHOME/pv/par.lat**.

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[4]BURT is the backup and restore program for the APS control system.

The columns that must be specified in a lattice file are:

S: A required column of type double that is the position of the start of the element in meters.

Length: A required column of type double that is the length of the element in meters.

SymbolHeight: A required column of type short that is the relative height of the symbol for the element. Correctors should use 1, quadrupoles should use 2, and sextupoles should use 3. The sign of the number should indicate the sign of its strength.

Name: A required column of type string that is the name of the element. Orbitscreen will match elements to process variables by looking for this string as a substring of the process variable name.

The parameters that must be specified in a Lattice file are:

OSFileType: A required, fixed value of type string that should be "ORBITSCREENLATTICE".

Nsectors: A required, fixed value of type short that is the number of sectors into which to divide the lattice for the purposes of scrolling.

Stotal: A required, fixed value of type double that is total length of the lattice in meters.

Ring: A required, fixed value of type short that is 1 for a ring and 0 for a beamline.

There is a program, **xintolat**, that converts Xorbit input (*.xin*) files to lattice files. Its usage is:

xintolat [**-h**] [*file1.xin*] [*file2.lat*]

-h Help

If the filenames are not specified, the program will prompt for them.

Snapshot Files

Snapshot files may be saved via the File/Write menu. Depending on options in the menu, these files could contain the values of the displayed process variables at the current time, at the time the orbit was saved via the Options/Save menu, or at the time given in another snapshot file read via the File/Read menu. These snapshot files should be equivalent to the ones generated by BURT. They can be used to restore the process variables in them if these process variables are capable of being restored. (Monitor readings and corrector read backs cannot be restored, for example. Corrector set points can.) You can save snapshot files in your own directories. An example snapshot file should be located in **$ORBITSCREENHOME/snap/par.bpm.snap**.

The snapshot file will have two more columns, **StatusName** and **StatusValue**, if status is implemented.

Application-Defaults File

The application-defaults file for Orbitscreen is named **ControlApp**. It is needed in order to run Orbitscreen. The usual place for such files is in **/usr/lib/X11/app-defaults**. You may also have an additional application-defaults file named **ControlApp** in your home directory. You can put your own

resource customizations for Orbitscreen in this file or in your **.Xdefaults** file. If you do not understand about resources or application-default files, see your local administrator.

Status Indicators

Orbitscreen can be made to display the status of BPM readings. The status values must be available in a process variable which can have the enumerated values:

0 = InValid
1 = Valid
2 = OldData

In order to enable this capability there must be an additional string column in the PV file called **StatusName**. Each entry in this column should contain the name of the process variable that has the status information for the process variable that is to be displayed. If there is no status name or you don't want to use it, the entry should be a "-". If the column is not there, there will be no indication of status other than for process variables that are not connected.

When this has been done, the display should be the same as usual when the data is **Valid**. Otherwise there will be color-coded markers that indicate the status. Snapshot files will have two additional string columns, **StatusName** and **StatusValue**, to indicate the status. In addition to the three values above, **StatusValue** may also be **NotConnected** if Orbitscreen was unable to find either the process variable for the data or for the status.

Because of the asynchronous nature of EPICS, there is no guarantee the status displayed in Orbitscreen is exactly coordinated with the data, but it should be close.

Color Code

Red:	Data points in the upper display area
Blue:	Data points in the upper display area
Magenta:	Stored data points in the upper display area
Green4:	Stored data points in the lower display area
Black :	Data points that are not connected (large, square markers)
Grey30:	Data points that are Invalid (large, round markers)
Grey50:	Data points that are OldData (large, round markers)

Xorbit Simulation Mode

Xorbit can in principle be made to simulate the orbit for any of the lattices in the APS, although not all of them have been implemented at this time. To do this there is a special database of process variables in an IOC. These process variables closely resemble the real process variables for monitors and power supplies and have the same names with "**Xorbit:**" attached. When set points for magnet power supplies are changed via the control system, Xorbit is notified and calculates the appropriate orbit. It then supplies the new readings to the read backs for the power supplies and monitors. This process takes about 4 seconds for the over 3000 process variables for the storage ring, but is essentially instantaneous for the PAR.

The simulation includes the effects of random magnet displacements and monitor offsets and includes nonlinear effects from the sextupoles. This simulation capability allows physics application codes to be tested and debugged on something resembling a real system without disturbing the real system or before the real system is operational.

Orbitscreen may be run in Xorbit simulation mode by specifying -x on the command line. In this mode it attaches "**Xorbit:**" to the front of all process variable names. Consequently, configuration files may be tested with Xorbit with no change to the files for a lattice that has been implemented in Xorbit (provided the actual names and the names in the Xorbit database follow the same naming conventions).

Xorbit calculates magnet strengths in theoretical units (e.g. radians for corrector magnets) whereas the real process variables correspond to power supply currents (Amperes). The relationship between the current and the strength depends on the magnet hardware and the energy of the beam. The Xorbit database has been designed to convert between theoretical units and Amperes, taking these relationships into account. The relationship between magnet strength and current is taken to be linear in this databaset. This is a good approximation for correctors, but may be inaccurate for the larger magnets away from their reference values.