An Introduction to the CCSF/PMA Graphics Facilities

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This document is an introductory guide to the effective use of the graphics hardware to be found in 215 Synchrotron. This equipment is owned and managed jointly by the CCSF (Caltech Concurrent Supercomputing Facilities) and the PMA (Physics, Mathematics and Astronomy) Division of Caltech.

In order to use any part of the system, you should have an account on the CCSF machines. Once you have an account on any of these, you have an account on all of them. To do this, talk to any of:

Heidi Lorenz-Wirzba, 818-395-2908, heidi@ccsf.caltech.edu
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The hardware facilities available are:

- Sun Sparc/10 with GS full color graphics board (`lux`)
- Stardent graphics machine with 2 processors and full-color screen (`uccello`)
- Tektronix dye-sublimation color printer,
- Panasonic optical disk recorder,
- 2 Panasonic SVHS video tape recorders with edit controller,

Connectivity

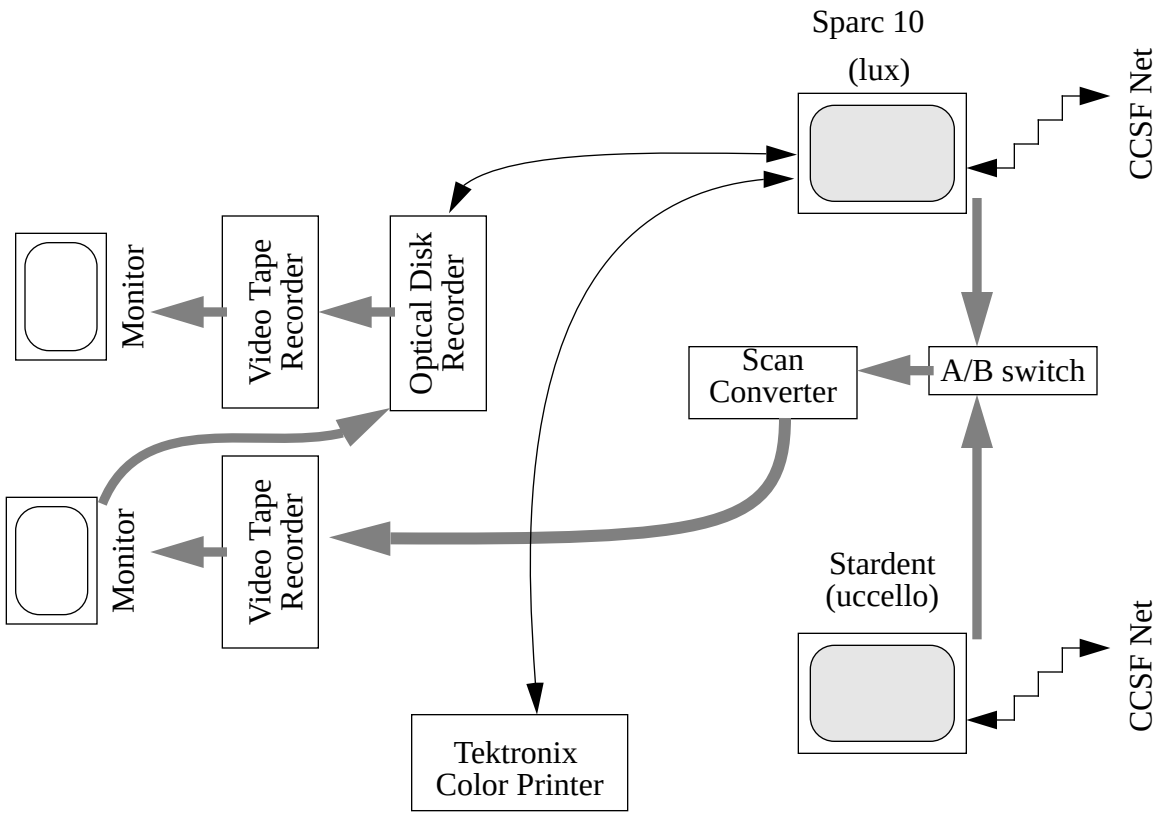
Figure 1 shows the connectivity of the system and its physical layout in 215 Synchrotron. Video feed comes into the A/B switches and is routed through various tape decks, monitors, etc, each of which may record, display or replace the feed before passing it on. The source of the video feed may be either `uccello` or `lux`, which may be toggled by flipping **all 3** of the A/B switches.

The high resolution signal sent from the computer to its monitor is intercepted by a scan converter, which converts it to a lower resolution suitable for the video system.

Once the video system has an appropriate feed, it should be displayed on the left-hand (upstream) monitor, and may be recorded with the left-hand tape deck. This would be appropriate for making a live recording of either screen, or a recording of what another machine is doing via X-windows (see below).

The video feed passes next to the Optical Disk Recorder (ODR), which can store and play back frames on a write-once cartridge, each of which holds 54000 frames. The recorder is controlled by `lux`. The server may initiate recording of a single frame, or be programmed to play back frames at different speeds.

There are also facilities for editing video tape to video tape, using the two tape decks, and the editing controller which is between them. The source tape (which is being read) should be to the left, and the edit tape (being written) on the right.



The Tektronix color printer can print PostScript level 2 pages, including full color (24-bit) or colormapped (8-bit) images.

The equipment will be described in more detail in the following sections, after a summary of some of the software available for visualization and graphics.

Graphics software available on CCSF machines may be summarized as follows:

Scientific Visualization: here we are creating a three-dimensional model representing the data, then rendering it on to the two-dimensional screen.

- **AVS** runs on `uccello`, `lux` and a Convex in 105 Booth called `hippo`. This is a flexible and modular system for visualizing multidimensional scientific data. It can be used via X11 from a remote machine, though it is much slower this way.

Images: here we have a two-dimensional grid of pixels, and we wish to modify the image by filtering or annotating it.

- **xv** can read and write many image file formats, including PostScript, and allows cropping and changing color maps. For details do "`man xv`".
- **pbm** image translation. In view of the large number of "universal file formats" for images, this set of translators is crucial to port images from one format to another. The filters are in `/usr/local/pbm`.
- **Plotix** from ParaSoft for two-dimensional graphics such as drawing lines and filled polygons. This library may be used for making graphics from either a sequential machine or a parallel program running the Express toolkit. The emphasis is on being easy to learn and on

simplicity of use.

There are also several programs for creating graphs and plots, adding titles and other graphics to images, or creation of high-resolution monochrome page descriptions for a laser printer. These include PostScript, AVS, FrameMaker, TIPS, Touchup, smongo and gnuplot.

Printing in Color

The Tektronix color printer can make prints on paper or on transparancies suitable for an overhead projector. It prints only from PostScript files, and is accessible only from `lux`. Usage of the printer is monitored by only allowing certain accounts to use the printer, so if you get a message about "Not member of restricted group", you should talk to one of the people listed at the beginning of this document.

To print PostScript from `lux`, use:

```
lux-> lpr -Pchroma <filename>
```

Video Recording, real time

Suppose we wish to make a tape which demonstrates the use of some software. First we need to bring up the software to be demonstrated on the screen of `uccello` or `lux`, either directly, or by running the software as an X client on a remote machine.

A copy of the screen should appear on the left-hand monitor of the video rack. If not, check that the video rack and monitor have power; if you see the screen of the machine you are not running on, flip all 3 of the A/B switches which are between `uccello` or `lux`.

Insert a tape in the left-hand tape deck and press "play" and "record" simultaneously, then go through the motions for the demonstration. You may selectively copy this tape to another tape with the editing controller, and/or add an audio track to the tape.

Using the Tape Decks

The video tape decks have Play, Record, Stop as do home video decks. In addition the black knob at the right of the deck allows very fine control of the tape position and speed. The knob has two modes which may be toggled by pushing in the knob. In one mode the angle by which the knob is turned controls the position of the tape being played, and in the other mode it controls the speed (rate of change of position) on the tape.

There are two switches to be aware of. One controls whether the tape is to be recorded in SVHS or the lower resolution VHS format. If you intend to edit the tape further, then SVHS is recommended for maximum resolution; if you intend to take the tape somewhere else and play it, VHS is recommended since your host is most likely not to have a SVHS video player.

Another switch "Local/Remote" controls whether the front panel or the pull-out edit controller is controlling the deck, and should be set appropriately.

Video Editing

The edit tape should be formatted in the same way that floppy disks need to be formatted before use: all that is required is that something be recorded on it, such as color bars. The scan converter under `lux` has a switch on the front labelled Test, which produces color bars. Thus the first step in

tape-to-tape editing is to record a color-bar signal over the part of the edit tape that you will be using.

The editing controller can record either in “assemble” mode or “insert” mode. The idea of assemble editing is that sections from the source are to be copied to the edit tape, appearing sequentially on the edit tape. Insert editing is the replacement of a section of the edit tape by a section of the source tape.

Video Recording, frame-by-frame

A frame-by-frame animation may be made with the following general scheme,

- Execute a program which draws the pictures you wish to record on the screen of either `uccello` or `lux`. The same picture should appear on the left-hand monitor of the video rack.
- Each time a single frame is rendered, a system call `ccsf_record` is made on `lux` which causes the server to request the optical disk recorder to record its feed. The frames should now record automatically without further intervention.
- When the recording is finished, the frames on the ODR may be played back interactively from the video server with the `gctl` tool, or there is a program `ccsf_playback` to play back groups of frames at various speeds.

These programs `ccsf_record` and `ccsf_record`, and also `gctl` (descibed below) are in `/usr/local/video/bin` on the CCSF machines, so your `PATH` should be set appropriately.

Thus your code (in C) might have the form

```
while(!finished){
   make_frame();
   if(video_recording)
      system(“ccsf_record”);
}
```

so that each time a frame is made on the screen, the system call causes the frame to be recorded. The running program may now be left until it has finished.

Recording from AVS

There are a number of AVS modules produced (or at least compiled) locally, which may be found in the AVS module library in `/usr/local/avs/Local`. One of these is `ccsf_recordavs`, which takes as input either a pixmap or an image, and causes a record on the optical disk recorder each time an input arrives.

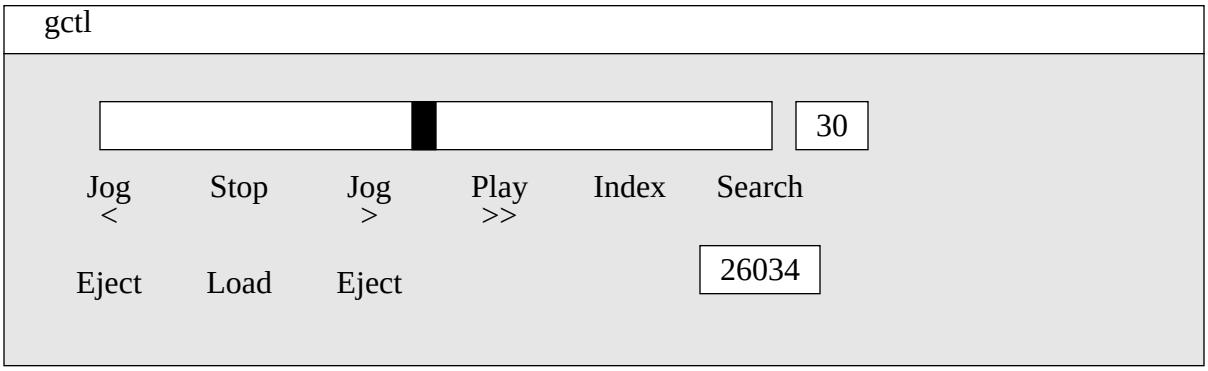
Another useful module is `xtoppm`, which takes in an image, and writes it to disk in the PPM format, which is understandable by both `xv` and the `pbm` toolkit.

Making a Video Tape

Having produced several such sequences of frames, perhaps with different inputs or data for the program, and perhaps having made and recorded some title stills on the optical disk recorder, you may examine the frames with `gctl`.

The tool `gctl` is in brings up a window something like this:

Jog moves the ODR forward or back by one frame, Play plays continuously at the speed in the top



left box (shown as 30 frames per second in the Figure above), Search changes the current frame to the number shown in the bottom right box (shown here as frame 26034 out of a possible 54000 frames. Moving the black bar to the left or right plays the frames at a continuously variable speed. The numbers in these boxex may be changed by typing there.

In addition to this interactive control of the optical disk player, it may be programmed to play sequences of frames. Suppose there is a file `playit` containing:

```
26038 26038 5
27382 28449 20    Everything after the 3 integers is a comment
28600 29002 -10
22300 22300 5
```

Each line of this file is a start frame number, end frame number, and a speed in frames per second. In the case that the start and end frames are the same, the third number is interpreted as the number of seconds to display the frame number. Notice that negative speeds are allowed to play backwards. The file can be played with `ccsf_playback`:

```
% ccsf_playback < playit
```

So we get frame 26038 for 5 seconds, frames 27382 - 28449 at 20 frames per second, etc.

Thus you may edit this file and play back the frame sequence until you are satisfied with the timing, then put a tape into the right-hand tape deck, press play and record together, and play back the frame sequence again, but this time with it being recorded on to the tape.

Files

In `/usr/local/video/bin` are

```
ccsf_record
ccsf_playback
gctl
```

In `/usr/local/video/galatea` is the source and include files for compiling with the Galatea controller for the Optical Disk Recorder. The library is in `/usr/local/video/lib/libG.a`

In `/usr/local/avs` is the module library `Local`, which contains pointers to the executables. Also in this directory is the source code for these modules.