Chapter 2

Using CM/AVS Modules

This chapter tells how to execute the CM/AVS modules from a workstation and from a CM-5 partition manager. The following topics are discussed:

- The CM/AVS Modules
- Using CM/AVS Modules in a Network
- Preparing to Run Remote CM/AVS Modules
- Running a Remote CM/AVS Module — Tutorial
- An Important Note about Performance
- Running CM/AVS Modules Locally
- Cleaning Up

For a more thorough discussion of remote module execution, please refer to the *AVS User's Guide*.

2.1 The CM/AVS Modules

CM/AVS provides the following modules. Most are CM-5 versions of AVS modules. A detailed description of each module appears in Appendix B.

```
antialias cm
clamp cm
color range cm
colorizer cm
combine scalars cm
```

```
compare field cm
compute gradient cm
contrast cm
downsize cm
extract scalar cm
fft cm
field math cm
field to byte cm
field to double cm
field to float cm
field to int cm
luminance cm
orthogonal slicer cm
threshold cm
```

The following modules are unsupported. Detailed descriptions of these modules appear in Appendix C.

```
field to polygons
field to spheres
```

2.2 Using CM/AVS Modules in a Network

AVS supports distributed computation over a heterogeneous network of computers. While you run the AVS kernel on a local graphics workstation, you can execute modules locally or on other workstations or systems. Using CM/AVS, you can also execute CM/AVS modules on a CM-5.

You use CM/AVS modules in exactly the same manner as AVS modules. When you build a network, you may interconnect AVS modules and CM/AVS modules.

If you run AVS on a CM-5 partition manager, you can run CM/AVS modules locally. (We do not recommend this as a good use of partition manager resources.)

2.3 Preparing to Run Remote CM/AVS Modules

It is likely that you will run AVS on a local workstation and run the CM/AVS modules on the CM-5. The remote use of any modules, including CM/AVS, requires some preparation.

AVS uses a “hosts file” to find remote modules. The file identifies remote hosts and the directories on those hosts that contain modules. The hosts file format is described under Remote Module Execution in the Advanced Network Editor chapter in the *AVS User’s Guide*.

You may choose to rely on the system administrator to maintain the file **`/usr/avs/runtime/hosts`**. Alternatively, you may choose to create and maintain a private hosts file. In either case, your **`.avsrc`** initialization file must point to a legitimate hosts file.

To create and use a **`.avsrc`** file, follow these steps:

1. Create a **`.avsrc`** file. AVS looks for this file first in the current directory, and then in your home directory. We recommend putting it in your home directory.

   A minimal **`.avsrc`** file might look like this:

   ```
   # Point to a file containing remote hosts
   Hosts /home/yourname/.avs-hosts
   ```

   where the specified hosts file is **`/home/yourname/.avs-hosts`**.

2. Check the hosts file:

   - It must reside at the pathname specified in the **`.avsrc`** file. The pathname must be valid on the system where AVS is invoked.

   - It must contain one line of information for every remote host/directory combination where you want AVS to look for modules.

   Each information line in a hosts file contains four fields, in this order:

   (1) A logical name that identifies a particular combination of a remote host and a module directory. This logical name will appear in the Remote Host Browser. (Just the host name may be used for this purpose, unless more than one module directory on the host is of interest. In that case, each of the directories requires its own line in the hosts file.)

(2) Both the name of the remote shell program (the path to **rsh**) and the actual host name of the remote machine. (For CM/AVS modules, the host name should be a CM-5 partition manager.) You may add options to **rsh**. The entire field is enclosed in double quotes.

(3) The directory on the remote host that should be searched for modules.

(4) The default data directory on the remote host.

To make the remote CM/AVS modules available, the hosts file must contain a line that specifies a CM/AVS modules directory on a partition manager. The line might look like this:

```
pep.think.com "/usr/ucb/rsh pep.think.com -n"
              /usr/lib/cmavs_library
              /usr/avs/data
```

pep.think.com is the logical name of the CM-5 partition manager (**pep.think.com**) and the module directory **/usr/lib/cmavs_library**. (Field 1)

/usr/ucb/rsh is the command to run a command shell on the remote machine, whose real name is **pep.think.com**; **-n** is an **rsh** option that prevents input conflicts with the caller. (Field 2)

/usr/lib/cmavs_library is the directory that contains CM/AVS modules. (Field 3)

/usr/avs/data is the data directory. (Field 4)

2.4 Running a Remote CM/AVS Module — Tutorial

In this section, we build a simple network to turn an RGB image into a greyscale image. We use a CM/AVS module, **luminance cm**, in the network. The module is the CM-5 version of the AVS **luminance** module.

First, make the preparations described in Section 2.3. Then, follow these steps:

1. Start AVS and bring up the AVS network editor. From the menu in the upper left of the network editor menu, select **Module Tools**, as shown in Figure 1.

2. *Optional:* If you want the CM/AVS module icons to appear under a **`CM Modules`** Library header instead of being incorporated in the AVS module lists, do the following:

   Select **Edit Module Library**, then select **Create Empty Library** on the resulting pop-up window. Enter **`CM Modules`** in the pop-up prompt for a name, then select **OK**. Close the **Edit Module Library** pop-up window. **`CM Modules`** appears as the selected AVS Module Library header in the AVS Module Palette.

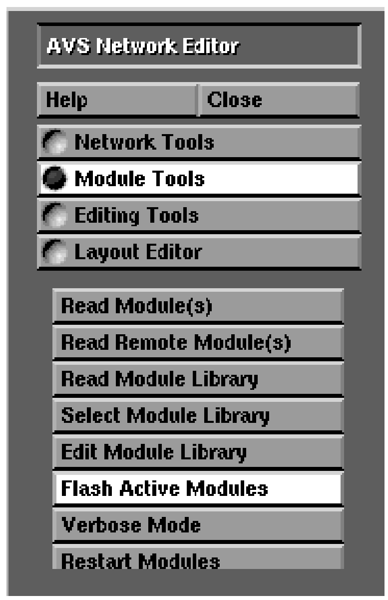

Figure 1. Module Tools menu.

3. Select **Read Remote Module(s)** from the **Module Tools** menu. This brings up a Remote Host Browser containing a list of available hosts. Select a CM-5 partition manager (one that is named in **`.avs-hosts`**) from this list. In this example, we use **`pep`**, as shown in Figure 2.

   The selection causes the display of the contents of the current directory on the host. If the binary file **`cmavs-modules`** is not in the contents list, change to the directory that contains it (**`/usr/lib/cmavs_library`**). Select **`cmavs-modules`** from the list and close the module selection window.

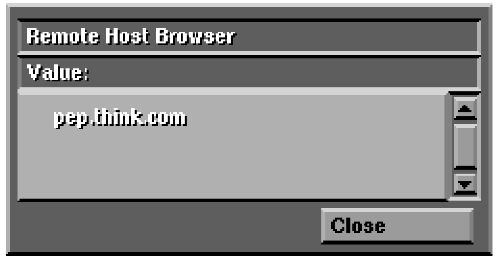

Figure 2. Remote Host Browser.

When the read of the binary file is complete, an icon representing each of its modules appears under the appropriate Library header. Each icon has a button on the right side. On a remote module, this button is colored pink.

4. Drag one instance each of the following modules into the network editor workspace. Place them as shown in Figure 3. The appearance of colored badges designating input and output ports indicates that the AVS modules are active and ready to accept connections. *Wait for the ports to appear* on one module before you drag in the next one. (Section 2.5 explains the benefit of waiting.)

    `read image` (**Data Input** list)

    `luminance cm` (**Filter** list)

    `colorizer cm` (**Filter** list)

    `display image` (**Data Output** list)

    When **`display image`** becomes active, the image display window comes up. Reposition it, if you like. (It will expand to about four times its initial size to accomodate the result.)

5. When all four modules are active, connect the output of **`read image`** to the input of **`luminance cm`**: position the cursor over the **`read image`** output port, press the middle mouse button, move the cursor to the **`luminance cm`** input port, and release. Similarly, connect the output of **`luminance cm`** to the input to **`colorizer cm`**, and the output of **`colorizer cm`** to the input to **`display image`**. See Figure 3.

6. Select **`read image`** on the Network Control Panel and read the image **`/usr/avs/data/image/mandrill.x`**. (This image file is included with AVS.) The modules in the network change color when they are active, so you can watch as the image data progresses through the network. During processing, it is actually transferred to the CM-5 for luminance and colorizer calculations, then back to the local workstation to be displayed. See Figure 3 and Figure 4.

Figure 3. The complete network and display.

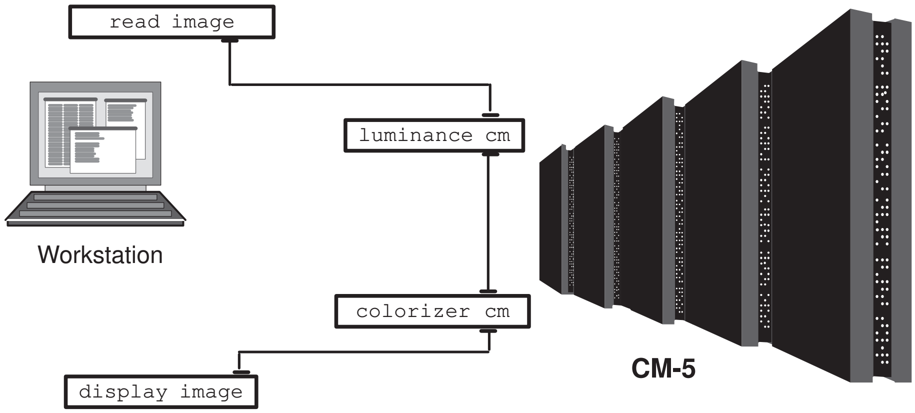

Figure 4. Example network: processing locations.

2.5 An Important Note about Performance

To realize the best performance for your application, you must take a bit of care when you add modules to a network. After you drag a module into the workspace, *wait for its ports to appear* before you drag in another module.

This can have an effect on performance because multiple CM/AVS or AVS modules may be linked into a single binary, enabling multiple modules in a network to run in a single process. Field transfers between modules in a single process consist of a simple pointer copy. By contrast, field transfers between processes must use sockets. If you add new modules to your network too quickly, AVS may not have time to ascertain whether or not it can fulfill the module requests with a single process.

2.6 Running CM/AVS Modules Locally

Running AVS on a CM-5 partition manager does not make the best use of the partition manager resources. However, it can be done, provided you follow these steps to make the CM/AVS modules accessible to the AVS Network Editor:

1. Start AVS and bring up the AVS Network Editor. From the menu in the upper left of the Network Editor menu, select **Module Tools**, as shown in Figure 5.

2. *Optional:* If you want the CM/AVS module icons to appear under a `CM Modules` Library header instead of being incorporated in the AVS module lists, do the following:

   Select **Edit Module Library**, then select **Create Empty Library** on the resulting pop-up window. Enter `CM Modules` in the pop-up prompt for a name, then select **OK**. Close the **Edit Module Library** pop-up window. `CM Modules` appears as the selected AVS Module Library header in the AVS Module Palette.

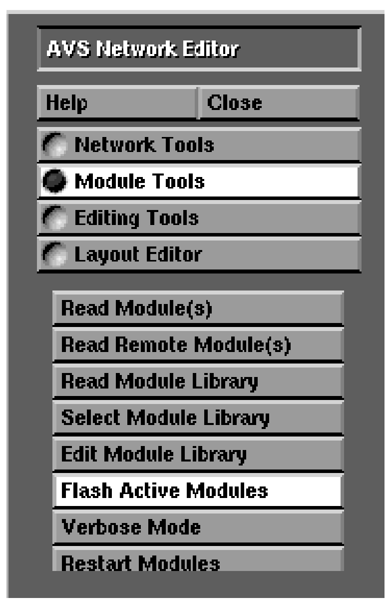

Figure 5. Module Tools menu

3. Select **Read Module(s)** from the Network Editor list. A display shows the contents of the current directory. If the binary file `cmavs-modules`

is not in the contents list, change to the directory that contains it (**`/usr/lib/cmavs_library`**). Select **`cmavs-modules`** from the list, then close the module selection window. (From this point, you may pick up with Step 4 in the tutorial, Section 2.4, if you like.)

2.7 Cleaning Up

If AVS terminates abnormally (if the kernel crashes or if there are network problems, for example), CM/AVS modules may be left running on the CM-5. Therefore, it is a good idea to use **`cmps`** and check the partition manager process status after AVS terminates. Be sure that no stray modules continue to run and waste system resources.