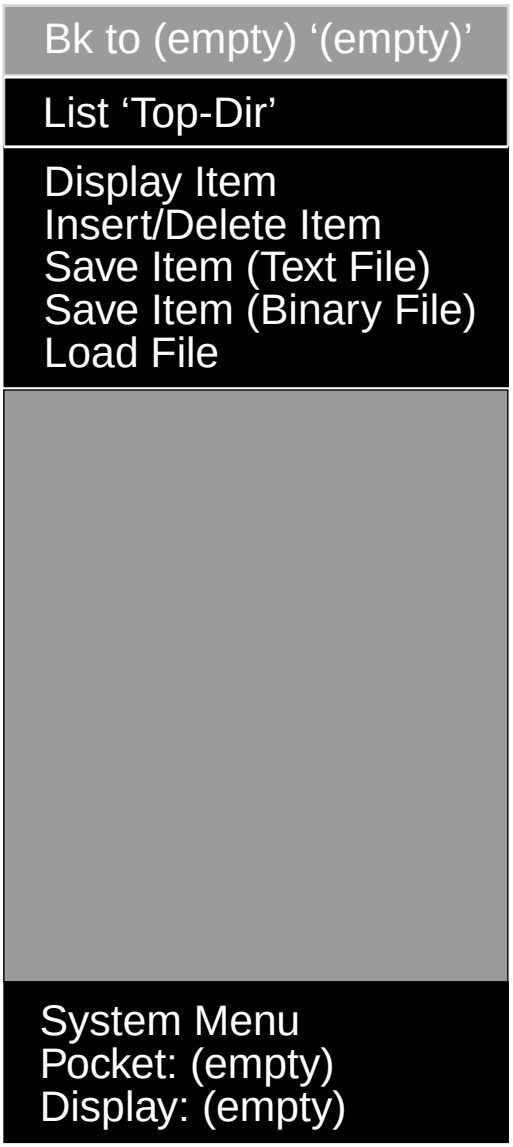
DRAFT

SKANDHA

Tutorial

With **Skandha** you can build complex objects, color and light each piece separately and edit individual contours to accurately recreate your object in three dimensions. To learn the basics of **Skandha** you will work with a sample file called **pisces**, which is a stylized image of a fish. When you have completed the tutorial you should have a better understanding of the file tree and how to manipulate it, know what filters do and how to use them and understand the basic operations used for editing individual contours. **Skandha** can also be used for video animation but that is not included as part of this document.



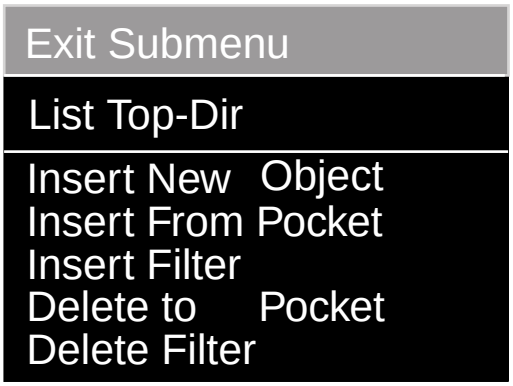
If you have not already done so, make a directory called **fish** under your home directory and using **tar** extract the **pisces** file from the distribution tape. Change directory to **fish** and start **Skandha** by typing **skandha** and then **return**. After a short pause, a window will be created and you should see the **Main Menu** which resembles the one in the right-hand column. At this point, **Skandha** is running but no files are loaded into it.

The mouse is used to move around in **Skandha's** menus. There are two menu "areas", the **System Menu** "area" and the **Operational Menu** "area". The **System Menu** resides at the bottom of the **Main Menu** and is used for system-wide parameters such as color definition, defining the drawing area, setting the orientation of the default light, real-time rotations, etc. The **Operational Menu** occupies the remaining portion of the **Main Menu** and is used for manipulating files, constructing the file tree, and modifying contours. The

operation of entries in the **System Menu** is covered under that heading in the reference portion of this manual so this tutorial will deal with the **Operational Menu** and techniques used in editing with **Skandha**.

Before loading an image data file into **Skandha** it is good practice to insert a *list*. The *list* will be the top of the file tree and all other objects will be "hung" from it. The arrangement permits the user to store, display and manipulate multiple objects at one time.

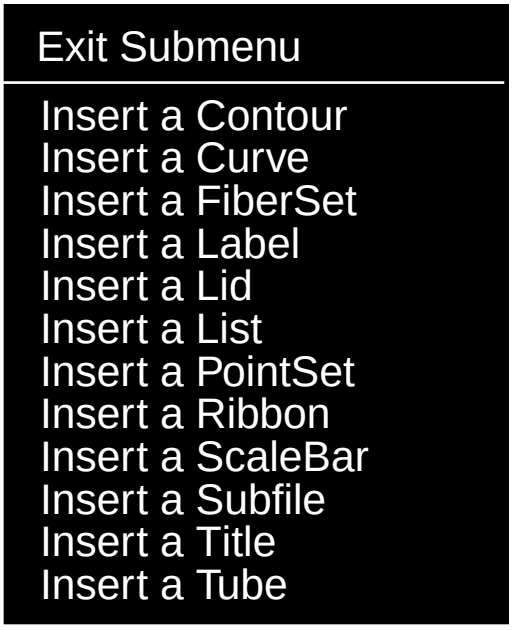
To insert a *list*, click with the cursor arrow on **Insert/Delete Item** in the **Main Menu** and the **Insert/Delete Menu** will appear.



A *list* is an object.

Select **Insert New Object**.

You will descend one more step into the menu morass and be confronted with the entire list of objects used by **Skandha**.



Select **Insert a List**.

Nothing appears to happen but don't dismay. Click on **Exit Submenu** to move back up the file tree.

You will now see the menu shown to the right. The addition of the **Child Menu** (at the bottom) indicates you have been successful in inserting a *list* into the file tree.

At this point, there are two items to note that should make life easier when traversing the wilds of the **Skandha** menu system. First of all, an asterisk opposite a menu option, such as that next to **On to List '()'** indicates which object was last accessed by the user. Where there is only one object such an indicator is unnecessary but there usually is an extensive list of objects and the marker is quite useful. Secondly, the menu is color coded. The default colors are red, blue and green (you can set your own colors by using the **Edit Special Color** entry in the **System Menu** - see page 10). Selecting the red portion of the menu moves you to the **Parent Menu** or one level up the file tree. Select **Bk to (empty) '(empty)'** and you will see the **Exit Menu** (page 20). You are at the top of the file tree and you can leave the program. Since we don't want to exit yet, select **Continue Program** and you will be returned to Skandha.

Blue indicates your current level, the **Normal Menu**. This menu allows you to manipulate the file tree by adding files from the disk or deleting files into the pocket, inserting new objects (such as lists or tubes) and modifying the file tree through the use of filters.

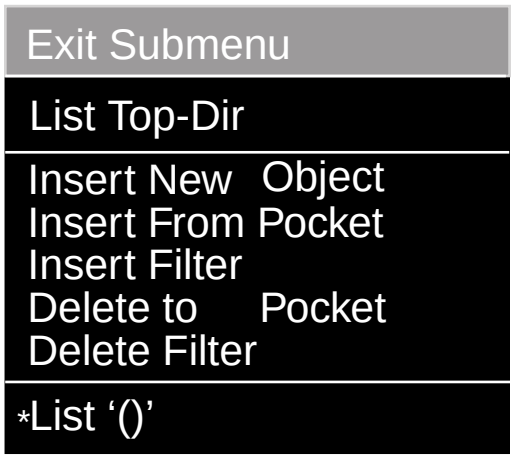
Selecting the green portion of the menu moves you to the **Child Menu** or one level down the file tree. Currently, the **Child Menu** consists of an empty, un-named list but it could be any of the objects defined by Skandha.

Before loading the demonstration file from disk you will modify the list you inserted by adding a color filter and a rotor. Then you will give the list a name.

Inserting a filter is a three step process. From the **Normal Menu** select **Insert/Delete Item** and a menu showing the class of objects that can be inserted or deleted will appear.

Give the command to insert a filter.

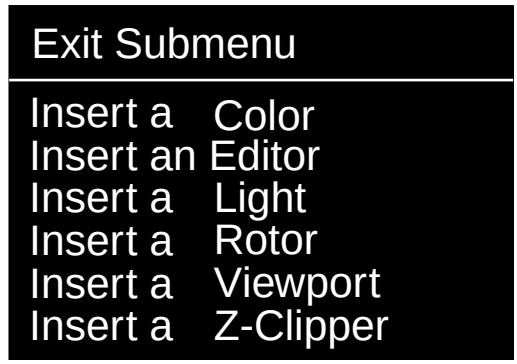
Select **Insert Filter**.



The menu showing the list of filters available will be drawn.

Select the type of filter to be inserted.

Select **Insert a Color**.

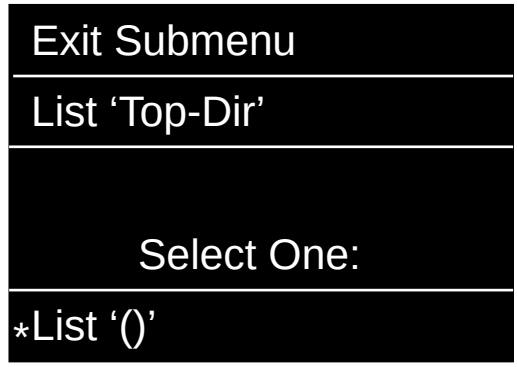


A menu listing the objects at the current level of the file tree will appear.

*Select the target for the filte*r.

The **Select Menu** appears which, for this example, has only one place to insert a filter, the **List'()'**.

Click on **List'()'**.



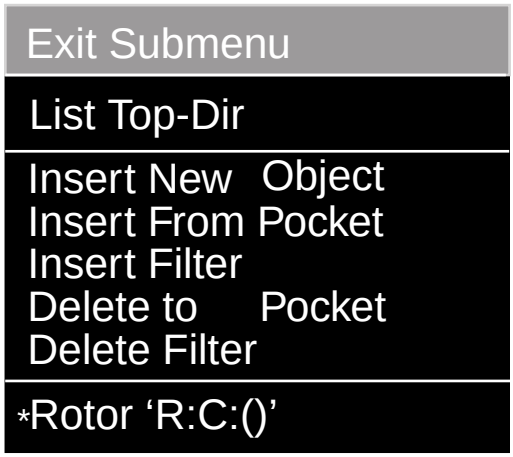
List '()' will be replaced by **Color 'C:()'**.

To add a Rotor, exit the submenu by clicking on the top line. You will be returned to the menu showing the list of filters. Select **Insert a Rotor**. Again the **Select Menu** with its single choice appears. Click on **Color 'C:()'** and it will change to **Rotor 'R:C:()'**, indicating the rotor has been added. Thus to insert a filter, the user must 1) give the command to insert a filter by selecting **Insert Filter** from the **Insert/Delete Menu**, 2) select from the list of filters the type to be inserted and 3) select the target for the filter.

The last filter inserted is the first to be deleted. In the above example, you cannot delete the color filter until you have deleted the rotor. Deleting a filter is a two step process. First, return two levels up the file tree to the normal menu. Select **Insert/Delete** Item and you will be confronted with the menu on the right.

Give the command to delete the filter.

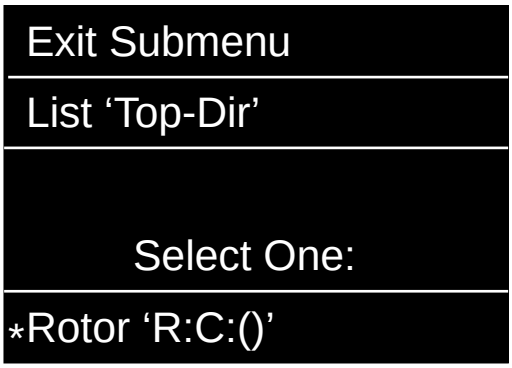
Select **Delete Filter** from the **Insert/Delete Menu**.



The **Select Menu** will appear.

Select the target for removing a filter.

Click on **Rotor 'R:C:()'**.



Rotor 'R:C:()' will be replaced by **Color 'C:()'** indicating the rotor was deleted. To delete the color filter click again and **Color 'C:()'** will be replaced by **List '()'**.

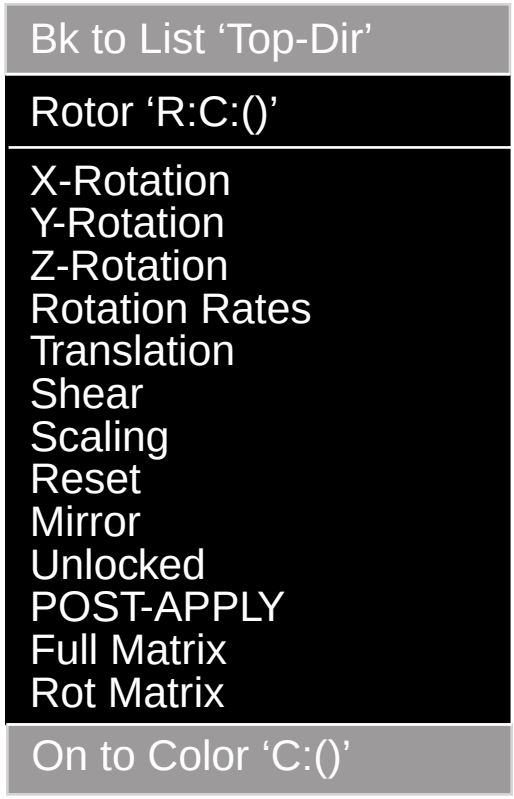
If you actually deleted the filters, replace them by inserting the color first and then the rotor.

Return to the top of the file tree by selecting **Exit Submenu** until the menu shown in the right-hand column appears. We now want to name the *list* we have inserted.

Select the **Child Menu**.

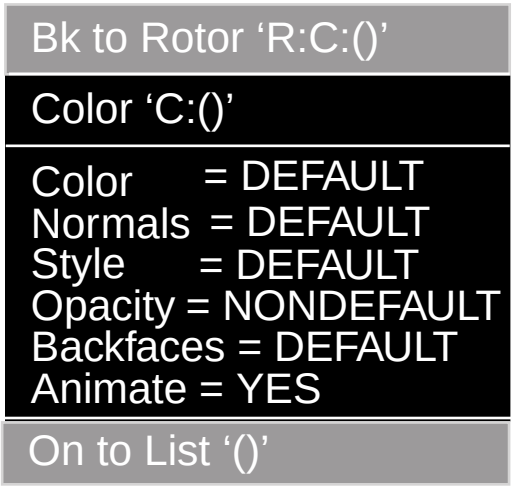
The **()** indicate the *list* has no name.

The **Rotor Menu** will appear.



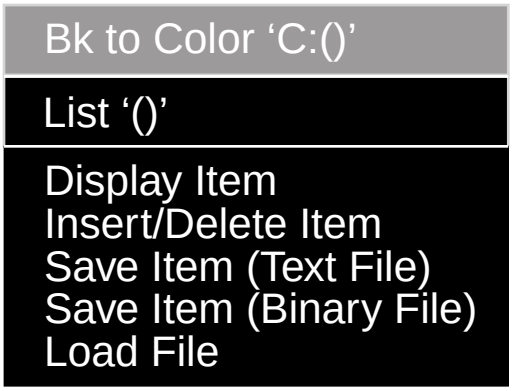
Click on the **Child Menu**.

The **Color Menu** will appear.



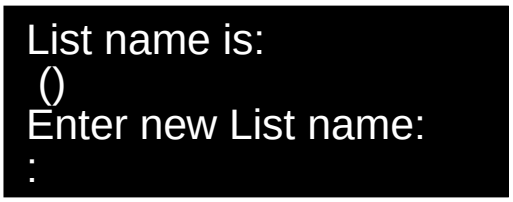
Select the **Child Menu**.

Finally the **List Menu** will appear.



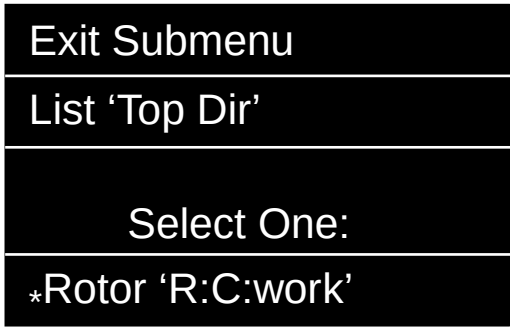
Click on **List '()'**.

You will be confronted with the menu showing the old list name, **()**, and requesting a new one. Type in **work**, the new name for the *list*, and hit return. The name **work** will replace the parentheses where they had occurred. Thus **Color 'C:()'** will be replaced with **Color 'C:work'** and **Rotor 'R:C:()'** will be replaced by **Rotor 'R:C:work'**.

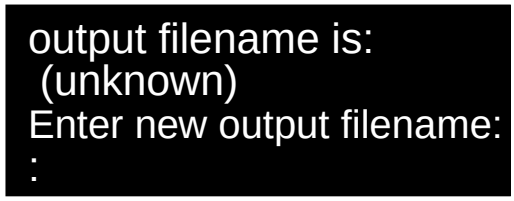


Before loading the demonstration file save the *list* **work**. Click on the **Parent Menu** until you reach the **List 'Top-Dir'** entry. Select **Save Item (Binary File)** from the **Main Menu** and the **Select Menu** will appear. Although we have only one choice, there can be several possible

files to save and you must select the one you want by clicking on it.



Select **Rotor 'R:C:work'**

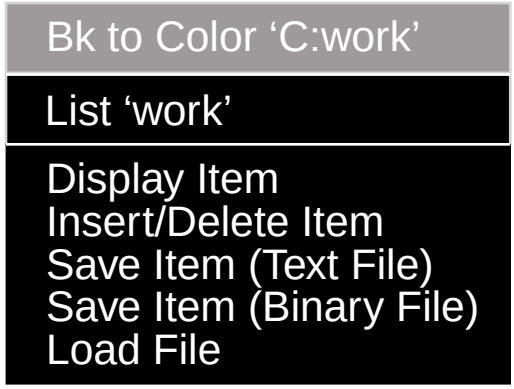


You will be asked to name the file. Type in **work** and hit return.

A message appears when the file has been written to disk. Click on continue. **Note: Skandha does not have an automatic save feature.** Thus **you should save data frequently**. Also note that **the Unix operating system does not make multiple copies**. Data that is written to disk **replaces** files with the same name.

You are now ready to load the file **pisces**. The **List 'work'** menu is at the bottom of the file tree. Keep in mind the color coding for the menu types and click on the **Child Menu** (green) until you get to the **List 'work'** menu. You can tell when you are at the proper menu because the title, **List 'work'**, is found on the second line. Since this is the bottom of the file tree there will be no **Child Menu**. You should see a menu similar to that at right.

Give the command to load a file.



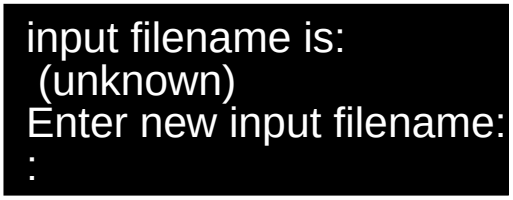
Select **Load File**.

Select the file to load into memory.

You should see the **Input Menu**.

Type in the filename, **pisces**, and hit **return**.

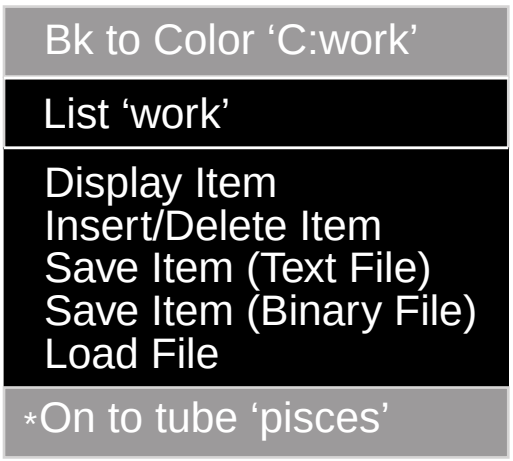
The name of the file will appear at the top of the menu area during the loading process.



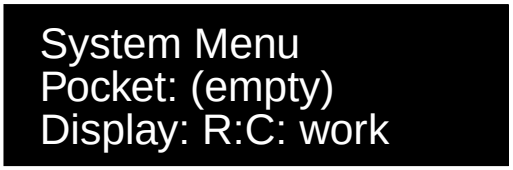
Digression: The file tree that has been generated has a *tube* under a *list* with filters attached to the *list*. The observant student might ask, “Why not just attach the filters directly to the *tube* and eliminate the *list*?”. That certainly is the most efficient way to construct the file structure in this particular case. However, the vast majority of objects you will be dealing with have more than one *tube* and if they are to share the same properties it is much easier to have the *tubes* under a *list* with a single set of filters attached to the *list*, rather than filters attached to each *tube*. In fact it is the only way to apply a rotor to a collection of tubes

When the file is loaded the **List ‘work’** menu will re-appear with a **Child Menu** added.

Next, you will display the file that you have loaded. Note that the **System Menu** “area” at the bottom of the **Main Menu** has three entries. The top line, **System Menu**, calls up the **System Menu** itself (page 7); the middle line shows the object that was last deleted to the pocket; the bottom line shows which object has been selected for display and, when you click on it with the mouse, causes the object to be displayed.



Select **Display: R:C: work**.



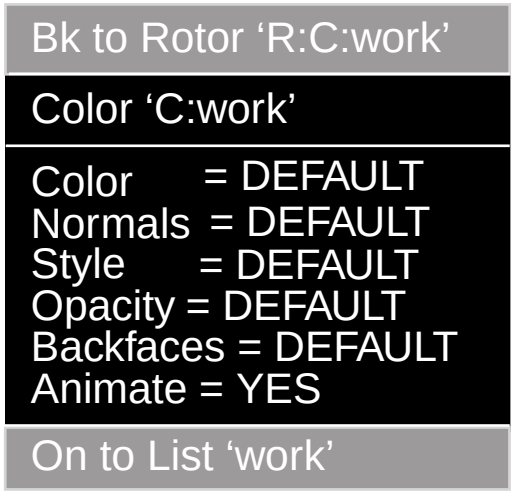
The object will be displayed as contours in its default color (red) and orientation. The default orientation is the orientation in which the object was digitized. In the case of **pisces** it was digitized from head to tail so you are looking head-on at the stylized fish.

If, by chance, you should see **Display: pisces** instead of **Display: R:C: work** return to the top of the menu tree. Select **Display Item** from the **List 'Top-Dir'** menu. A menu listing the items that can be displayed will appear. For this example it will show only **Rotor 'R:C: work'** but you still must select it (by clicking on it). Then go to the bottom of the **Main Menu** and you will see **Display: R:C: work**. Click on it and **pisces** will be displayed.

Digression: Note that displaying an object is basically a two step process. You must **first select** the object to be displayed and then **give the command** to display it. It is not unusual for an unexpected object to be displayed because the user forgot the first step. When that happens check the bottom line of the **Main Menu** to see what is actually selected. Then go to the appropriate level of the menu tree and use the **Display Item** command to select the object you want to display.

To display **pisces** as other than contours back up the file tree one level by selecting **Bk to Color 'C:work'**. You should see the menu on the right.

Select **Style =.**

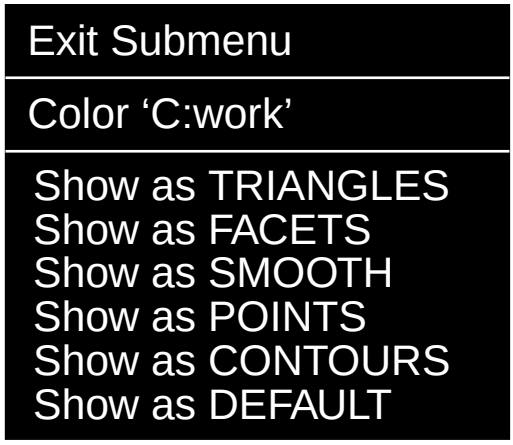


The **Style Menu** will appear.

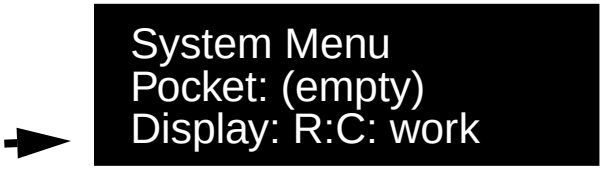
In order to see how a solid object is built from the contours you will go through the same steps **Skandha** does. First display **pisces** as triangles, then facets and finally, smooth.

Select **Show as TRIANGLES**.

It may not appear that anything happens but if you select **Exit Submenu** the color filter will now show **Style = TRIANGLES**.



Select **Display: R:C: work**.



The object will be displayed as triangles in its default orientation.

To display the object as facets select **Style =** and the **Style Menu** will re-appear. Select **Show as FACETS** and then **Display: R:C: work**. The object will be displayed as facets and should look “lumpy”. By now you should be able to recognize the default orientation has the head of the fish facing the user.

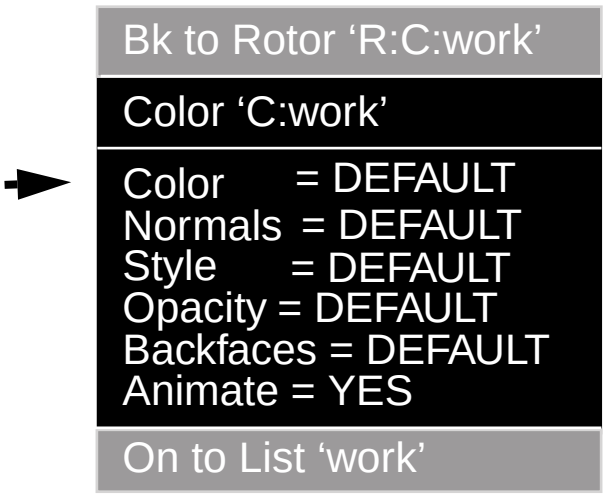
At this point you have not selected **Exit Submenu** so you should still be in the **Style Menu**. Select **Show as SMOOTH** and then **Display: R:C: work**. The object will be displayed as smooth. Contrast this style with facets.

Digression: Recall that when triangles are surfaced they create facets and the light intensity, which is determined by the dot product between a point light source and a vector normal to the facet (the facet normal), is constant across the facet. To generate a smooth surface, the intensity value at the vertices of each polygon (triangle) is determined by the dot product between the vertex normal and the point source of light. All other intensities for the surface are determined using a linear intensity interpolation scheme that was developed by Gouraud.

You might as well try some of the other options at this point in the menu system. First, change the color of the fish. If everything has worked out as per instructions, you will be in the **Style Menu**.

To return to the color menu, you need only click on **Exit Submenu** and you will move one step up the file tree to the **Color Menu**.

Select **Color =.**



You will be confronted with the **Color Choice Menu**. If you select **DEFAULT** the color is determined by the next color filter up the menu tree or the program default color whichever comes first. The other seven colors will be applied to the object as you have defined those colors in the **System Menu** (page 9).

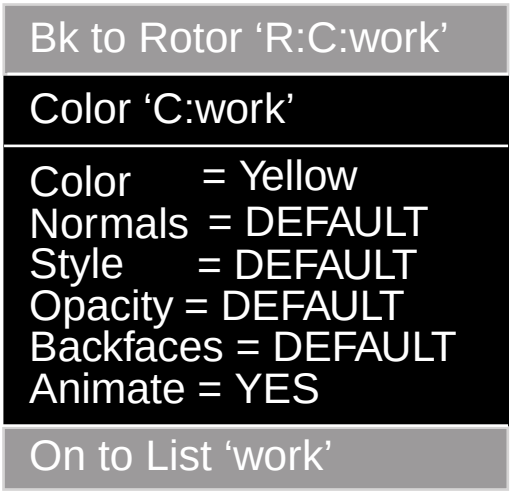
Digression: The three basic colors of a color video display are red, green and blue. The remaining four colors are combinations of the basic colors. Red, green and blue combine to make white; red and green produce yellow; blue and green combine to produce cyan; red and blue make magenta. And, of course, no color makes black.

Select **Yellow**.

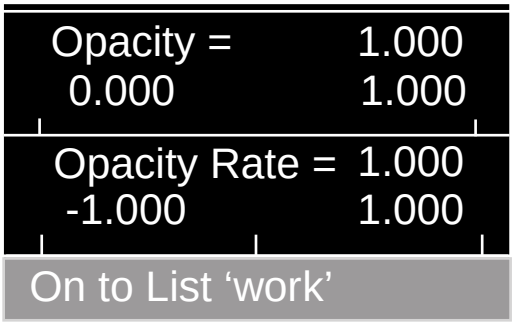
Return to the color filter by clicking on Exit Submenu. You will now note that instead of **Color = DEFAULT** you will see **Color = Yellow**. The next time you display the fish it will be drawn as yellow.

Next, try to change the opacity of the fish.

Select **Opacity = DEFAULT**.



The line will change to **Opacity = NONDEFAULT** and two entries will be added to the **Color Menu**. The **Opacity** entry is used in normal operation to set the opacity while the **Opacity Rate** is used with video animation and represents the change in opacity each time the image is drawn. Clicking on the top line of either entry allows the user to enter a value from the keyboard while clicking on the bottom line between the endpoints will cause the corresponding opacity or opacity rate to be entered.



Enter several opacity values and display **pisces** to see the resulting affect.

To return to the default setting, select the line **Opacity = NONDEFAULT**. The line will now read **Opacity = DEFAULT** and the menu extension will disappear.

Digression: Currently the alpha channel is not used to generate opacity and the affect is produced by not drawing some of the pixels. Except for 50% opacity a visible pattern is generated by this method that is undesirable but must be tolerated if an opacity affect is desired.

Color, Style and Opacity are the three functions of the **Color Filter** used most often. The **Normals** entry is a three position switch with values of **DEFAULT**, **OFF** or **ON** that affects the vertex and facet normals. Each time you click on the line **Normals =** the entry will cycle from **DEFAULT** to **OFF** to **ON**. Displaying an object with the normals on can produce some interesting results but isn't especially useful and is mostly used for de-bugging. For example, when attempting to identify the part of an object the filter applies to, you may wish to turn on the normals to make it "stand out from the crowd".

The **Backfaces** entry is also a three position switch with values of **DEFAULT**, **OFF** or **ON** that determines how hidden surfaces will be drawn. Each time you click on the line **Backfaces =** the entry will cycle from **DEFAULT** to **OFF** to **ON**. Since not drawing the hidden surfaces results in a slightly faster drawing time, the switch is usually set to **DEFAULT** or **OFF**. However, there are times when the hidden surfaces should be drawn. For example, if you draw **pisces** in the head-on view with the backfaces off you will be able to see the background through the mouth opening. Looking down a slightly skewed tube is another example. In that case the closest backfaces are not actually hidden by the foreground and should be drawn but won't be unless backfaces are set to on.

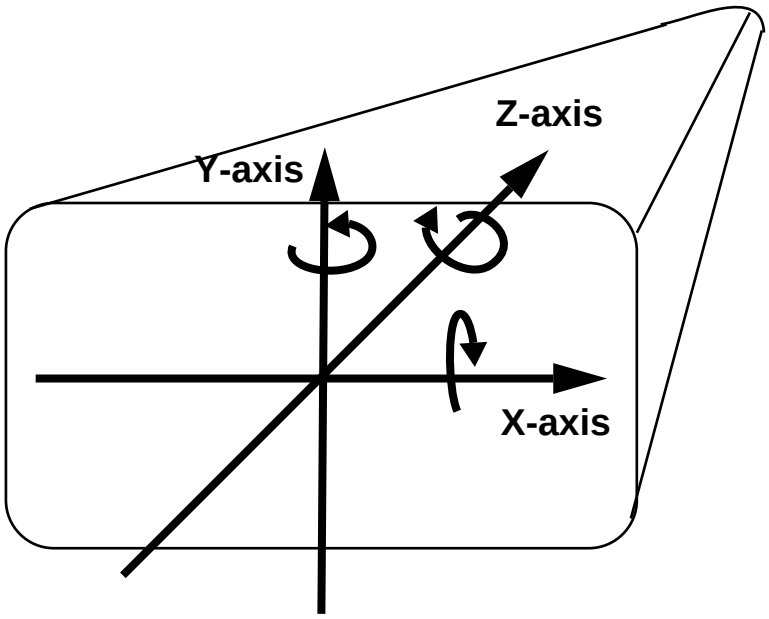
Digression: You may note an aurora affect around the periphery of **pisces**. This results from a discontinuity of the normals at the boundary between the visible and hidden surfaces. You can eliminate the affect by entering the **System Menu** and turning the **back/flip** entry off (see page 8).

The **Animate** entry is a two position switch that determines if the video animation part of Skandha will have access to this filter. Then **Animate = YES** the filter can be accessed through the **Videotape** entry on the **System Menu** (see page 13). When **Animate = NO** it cannot. Clicking on the entry changes from one to the other.

The next lesson involves learning to use the **Rotor** filter so the fish can be displayed statically at whatever angle you desire. Although it is not true of most objects you will deal with, the fish has a small enough number of polygons so that it can be rotated in real time on the Personal Iris so we will also see how to set parameters for real-time rotation with the **Rotor**.

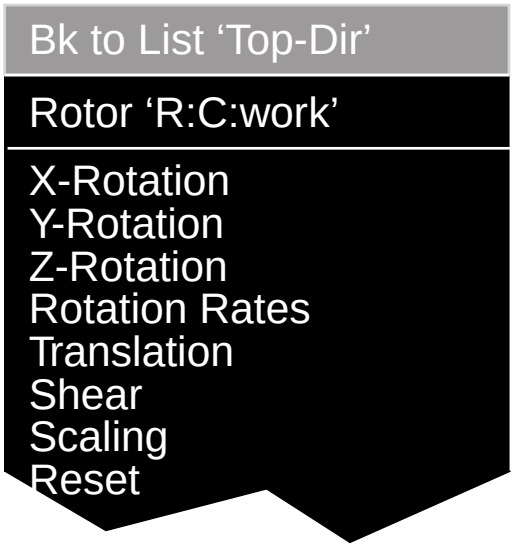
Before moving on to use the filters themselves, let's review the coordinate system. The conventions for the three axes are shown in the diagram on the next page. The diagram assumes that you are facing the screen. The **X-axis** is parallel to the floor and the *positive* direction is to the *right*. The **Y-axis** is perpendicular to the floor with the *positive*

direction *upward*. The **Z-axis** is perpendicular to the face of the screen and the *positive* direction is *into* the screen.



The right-hand rule is used to determine the direction of positive rotation. **Hint:** If you have forgotten the right-hand rule, place your right hand along the axis with the palm parallel to the axis and the thumb pointing in the positive direction. Let your fingers curl around the axis and they will curl in the direction of positive rotation. Positive rotation for the **Y-axis** will cause points on the r*ight hand margin* of the computer screen to move *inward*. For the **X-axis**, positive rotation causes points at the *top* of the screen to move *toward the user*. Points will move in a *clockwise* direction when the object is moved in the positive direction around the **Z-axis**.

Selecting the **Parent Menu**, **Bk to Rotor 'R:C:work'** should result in the **Rotor Menu**, part of which is shown at right. We will first rotate the fish on the **Y-axis**.



Select **Y-Rotation.**

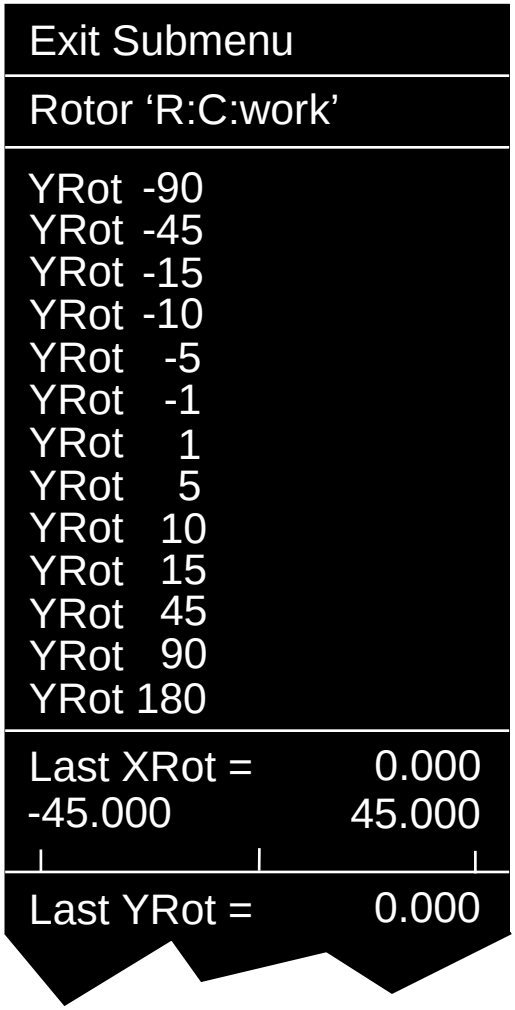
The **Y-Rotation** submenu, part of which is shown on the next page, will appear.

Digression: Currently you are looking at **pisces** head on. You want to rotate the fish so it will be facing to your right. That means **pisces** would be rotated 90^{o} but is it $+90^{o}$ or -90^{o}? If you apply the right-hand rule your thumb should point to the top of the screen and you will see that *positive* Y rotation will rotate the fish so

the head is at the right-hand side of the drawing window.

Since the steps are cumulative you can click on any combination of values that adds to 90^{o}. For example, you could click on **YRot 45** twice or **YRot 10**, nine times. But to keep it simple, click on **YRot 90**.

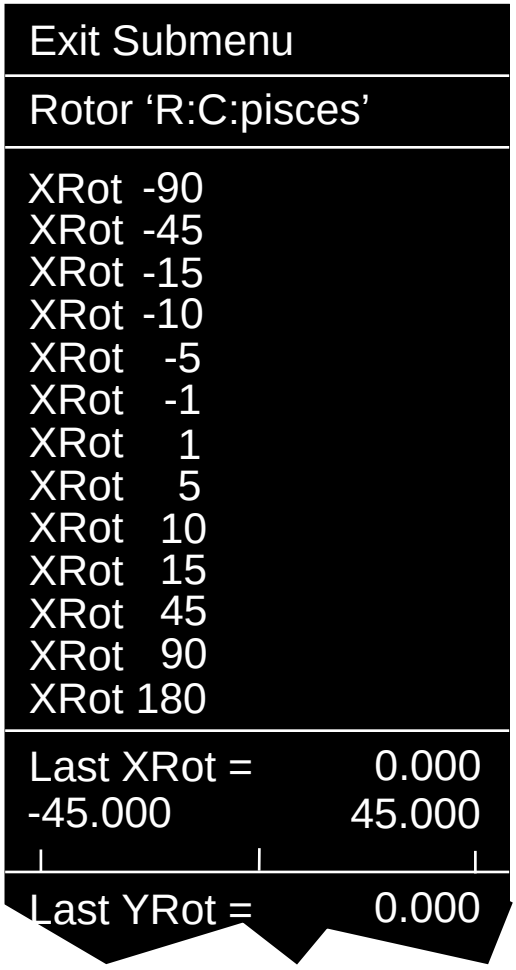
Select **YRot 90**.



Select **Display: R:C:work** at the bottom of the screen. The fish should begin drawing and oriented facing to the right.

Next, let's rotate the fish so you are looking down on the dorsal fin. First, select **Exit Submenu** which will return you to the **Rotor Menu**. Then select **X-Rotation** and you will be faced with the **X-Rotation** menu similar to that shown on the next page.

Digression: Again, the question is "Should the rotation be plus or minus?" To apply the right-hand rule place your hand parallel to the table, palm up. Your thumb will point to the right and you will note that the direction your fingers curl will cause the dorsal fin to move toward you. In other words, a *positive* X rotation will rotate the fish into the desired orientation.

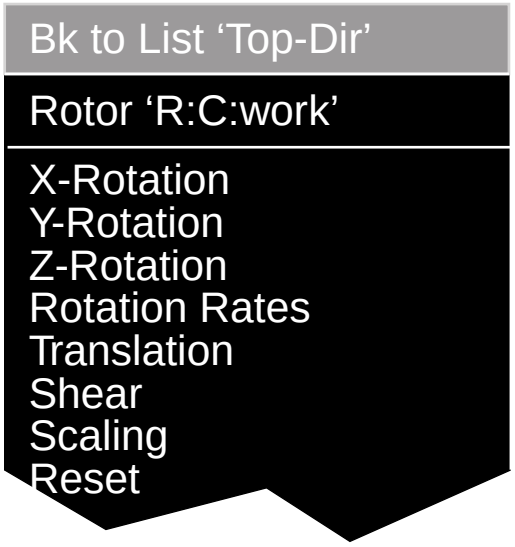


Select **XRot 90**.

Select **Display: R:C:work** at the bottom of the screen. The fish should begin drawing and you will be looking down at the dorsal fin.

Most of the files that you will be working with are too large to rotate as a solid object in real-time on the Personal Iris. However, **pisces** is small enough to be rotated although the movement is somewhat jerky.

First, re-orient the fish to its default orientation. Exit from the **X-Rotation** menu back to the **Rotor Menu**. Select **Reset** and when you display the fish it should be oriented facing you.



Select **Rotation Rates.**

Digression: Each of the **X**, **Y** and **Z-Rotation** menus has an entry to rotate the object in the individual plane. However the **Rotation Rates** menu allows you to select rotation in any of the three planes as well as zooming and moving the object laterally.

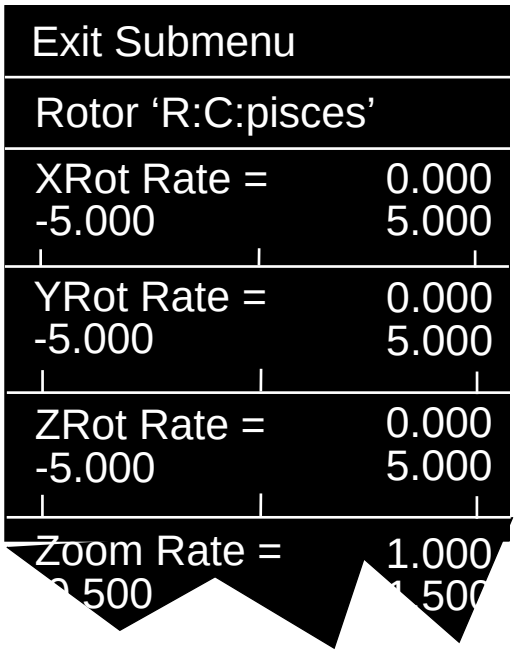
Part of the **Rotation Rates** menu is shown below, right. Clicking on the top line of each entry allows the user to enter an exact value from the keyboard while selecting the bottom line between the endpoints will cause the corresponding rate to be entered. First, rotate **pisces** on the Y axis.

Digression: Real time rotation is a two step process. You must first select the rate at which you wish to rotate the object; then you must set the object in motion.

First, *select the rate* at which the object will rotate.

Select **YRot Rate.**

A submenu will appear asking for a value. For starters, enter 2.

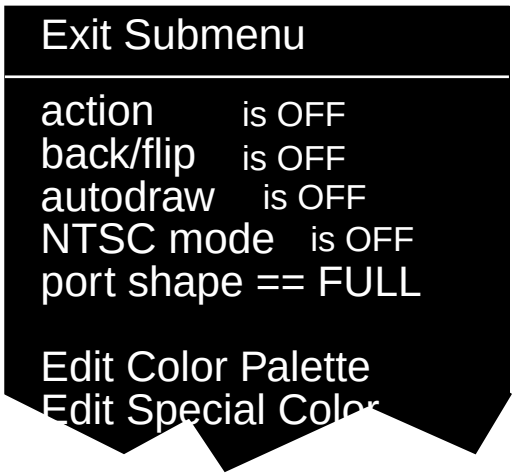


Second, *set the object in motion*. To do this select **System Menu**, located near the bottom of the **Main Menu**. The system submenu will appear, part of which is shown at the right.

Select **action is OFF.**

action is a two position switch and when you click on it, it will change from **OFF** to **ON** and **pisces** should begin rotating.

Leave **action** on and exit from the **System Menu**. This should place you bace in the **Rotation Rates** menu. Experiment with different **YRot** rates by clicking on the bottom line between the +5 and -5 endpoints. Note that even with an object



as small as the fish, real-time rotations of a solid object are rather jerky on the Personal Iris.

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