Getting Started 1

The 3D-XplorMath Consortium

The main steps in using the program are:

1) Choose a category to work with.

When the program starts up, the Surfaces category is chosen by default. However, you can change to a different category by choosing it from the Category menu. As soon as you have chosen a new category, the first menu to the right of the Category Menu changes to the name of that category, and I will refer to it as the Main Menu in what follows.

2) Select an object from the Main menu.

This will produce a default view of the object. Besides the pre-programmed objects you may, for most categories, choose User Defined... from the Main Menu, and this will bring up a dialog permitting you to enter formulas describing some object of the category. You can then click OK and go on to set various parameters etc., as described below, before creating a view of the object described by these formulas. (If you hold down the Option key as you select an object, you will be spared waiting for the default view to be drawn, and can go right to setting parameters.)

3) Optionally, using the Action and Settings menu, change from their default values various parameters that determine the shape of the object, its resolution and scale, etc.

These will all be explained in more detail below. Curves and surfaces can be specified in a number of different ways (see below for more on this) but one of the primary ways is "parametrically", as certain functions of a variable t for curves and of variables u,v for surfaces, and another item in the Settings menu brings up a dialog that permits the user to set the minimum and maximum values of these variables. The nonparametric way of describing a surface is implicitly, i.e. as the zero set of one equation. These examples are rendered either raytraced or in stereo, showing equidistributed random points on the surface. Of course, the raytraced images can be viewed as stereo pairs; surprisingly our eyes can also handle the randomly distributed points as stereo pairs. – Space curves can also be given implicitly, as the solution set of two equations. Sometimes it is interesting to view space curves on some surface: (i) curves on the sphere have similar properties as planar curves and (ii) we show knots on tori and on genus 2 surfaces. For the differential equations categories there is a Settings menu item that allows the user to set the initial conditions and length of time for which the solution will be traced, and also the step-size that will be used in the Runge-Kutta algorithm that computes the solution. Another Settings menu item, Set Light Sources..., allows the user to set the color and directions of five light sources used for displaying surfaces and polyhedra in color. After making all desired changes from the default choices, choose Create from the Action Menu to redisplay the object with the new choices.

4) Optionally, using the View Menu make various changes to how the object will be displayed.

For example, whether a surface will be "oriented" (and if so its orientation) whether it will be seen in perspective or orthographic projection, whether wire-frame or patches will be used, whether coordinate axes will be displayed, etc. You can choose between a white and black background by choosing the obvious items in the View menu. When viewing a three-dimensional object, you can choose between Monocular and three types of stereo vision: parallel view or cross-eyed view stereo pairs or anaglyph. (The latter requires inexpensive special red/green or red/blue glasses.

Depressing the option key will also prevent an object from being drawn when it is chosen from the Main menu. So it is possible to choose a new object and then make various changes using the View and Settings menus before displaying it for the first time.

5) There is an easy and convenient way to rotate a 3D object using the mouse. After creating a 3D object, the cursor changes to a semi-circular double-ended arrow. This is a signal that you have entered "Virtual-Sphere Mode". In this mode, as soon as you depress the mouse button, the 3D object will become temporarily embedded in a virtual transparent hard plastic sphere (called the virtual sphere) that is centered at the screen center. The equator obtained by intersecting the screen and the virtual sphere will be visible. Place the cursor anywhere on the top surface of the virtual sphere and drag the sphere to rotate it, carrying the embedded object along. (For speed, a surface will be shown in wire-frame style as you drag it, unless you depress the Tab or the Caps-lock key.) When you stop dragging an object to rotate it by releasing the mouse button,

it will continue to rotate until you click the mouse again. If, while you are rotating, you hold down the Control key, the cursor changes to four arrows and you can now translate the object in a plane parallel to the screen. There are two ways to zoom an object. If you hold down the shift key and drag the mouse up and down, you will merely change the magnification of an object. However, if you hold down both Shift and Option a 3D object will really move away or towards the viewpoint (although this is not really noticeable except in stereo where it can be quite impressive!).

In the Plane Curve Category or the Conformal Map category, if you click and drag then the object in the Graphics Window will follow the mouse around. If you now depress the Shift key and move the cursor up or down then the object gets smaller or larger. Morever, in these two categories, if you hold down Command and then drag out a rectangle in the usual Mac way, then when you release the mouse (with Command still down) your selection rectangle will zoom to the entire window.