

3DMatrix v1.5 User's Manual

Julian Cochran

3DMatrix User's Manual may be replicated and/or distributed provided the content is not extended, shortened or adjusted in any way. All material Copyright © 2000 - 2003 Julian Cochran.

3DMatrix is a cross platform 3D modeling product that is freely available for your evaluation. 3DMatrix can be downloaded from www.digitalscores.com/3dmatrix/downloads.html

Product information available at www.digitalscores.com/3dmatrix

Contents

1. About 3DMatrix

2. Getting Started

- 2.1 Installing 3DMatrix
- 2.2 Understanding the 3DMatrix environment
- 2.3 Jump start

3. Essentials

- 3.1 Adding polygons
- 3.2 Moving polygons
- 3.3 Transformations
- 3.4 Coloring and deleting polygons
- 3.5 Saving and restoring files

4. Selected features in detail

- 4.1. Bisect largest polygons
- 4.2. Surface simplification
- 4.3. Surface relaxing
- 4.4. Create block from 2D object
- 4.5. n-Vertex polyhedra
- 4.6. Personalizing 3DMatrix

1. About 3DMatrix

3DMatrix allows you to create 3D models out of polygons. Everything that is made in 3DMatrix is a collection of three-sided polygons. These primitives can represent anything in the real world and they are suitable for use within games because of their relatively high rendering speed.

You may wish to produce models that are ready for games, simulations and animation sequences. If you are a visual designer with limited experience in 3D then you can use 3DMatrix to produce and manipulate 3D objects for still image design. You can design 3D models and change the orientation and lighting in 3D and save the result as a high resolution JPG file for further processing with a graphics design application such as Adobe Photoshop.

3DMatrix is a simple modeler and can be mastered in a matter of hours. Unlike other 3D modelers 3DMatrix does not require that you carry any previous experience working in 3D. Interesting objects can be produced in a single step and polygons can be selected and manipulated using a variety of practical tools. If you have played flight simulators then you be able to move the camera around easily.

The application runs through a Java Virtual Machine allowing it to work reliably on systems ranging from Mac OS X and Windows XP to Red Hat Linux and Iris Silicon Graphics.

2. Getting Started

2.1 Installing 3DMatrix

3DMatrix is a software application in the form of Java Byte Code. This type of code can be executed from any computer system that has Java Runtime Environment software installed.

If you are installing 3DMatrix for Windows then the JRE is included with the installation. Windows users simply load the installation programme and follow the install instructions.

Non-Windows users will need to install 3DMatrix for Java. The general process to install the Java version of 3DMatrix is as follows:

- A. Ensure that your system has a Java Runtime Environment. Updated instructions for downloading the right Java Runtime Environment for your system are provided at www.digitalscores.com/3dmatrix/downloads.html
- B. Create a directory anywhere on your system and copy all on files within your 3DMatrix.zip file into that directory
- C. Open the directory and start 3DMatrix by clicking the file 3DMatrix.jar

If you have correctly installed a Java Runtime Environment then any .jar file on your system will be treated as an executable file. If 3DMatrix.jar does not execute then you will need to re-install a Java Runtime Environment.

Note that it is not sufficient to have only a Java Runtime Environment installed somewhere on your system. Having a Java Runtime Environment does not guarantee that .jar files will be treated as executable files on your system.

If you have the Java Runtime Environment installed then you would normally be able to execute 3DMatrix.jar directly. However if you cannot run it directly then you can execute it by typing

```
javaw -jar -Xmx250m 3DMatrix.jar
```

at your command prompt provided javaw.exe is in your system's path. The parameter -Xmx250m allows 250MB of memory to be given to 3DMatrix.

■ **Tip** Mac OS X ships with the Java Runtime Environment so Mac OS X users can simply click the file 3DMatrix.jar to start 3DMatrix.

2.2 Understanding the 3DMatrix environment

3DMatrix has a unique desktop environment with different rules to your operating system. Windows can be opened by right-clicking the 3DMatrix desktop and selecting a window from the menu.

Most windows can be closed by double-clicking their title bar. Nearly all windows have short-cut keys that allow them to be opened and closed.

■ **Tip** It is a good idea to close windows after using them to keep the 3DMatrix desktop space tidy.

2.3 Jump start

Start a fresh model by selecting 'New' from the File menu.

If the black Perspective View window is not opened then type 'SHIFT-P' to open it. Now open the Display window by typing 'd' and make sure that 'Starfield' is selected. You should see a field of stars in the Perspective View window.

Open the Geometry window by typing 'g' and select the 'Supertoroid' option. Now click the 'create' button to produce the object. You will most likely see the toroid (a donut shaped object) in the Perspective View window. If you cannot see it then it will be behind the camera.

Practice navigating the camera. Open the Camera window by typing 'r'. Change the direction of the camera by pressing and holding the mouse button over 'Dir pad' button. This stands for 'Direction Pad'. You will find that it is easy to change the direction of the camera using this technique and you will discover that the starfield is not merely a gimmick. The starfield helps to signal in what manner the camera's direction is being changed.

Now practice moving the camera using the keyboard. Use the comma and full-stop keys to move the camera forwards and backwards. Use the left and right arrow keys to rotate the camera and the up and down keys to change the camera's pitch. Practice by navigating the camera around the toroid, flying around and through the toroid. Move inside the toroid and actually fly through its interior.

Congratulations, you have now been introduced to a fun side of 3DMatrix – exploring your objects can be much like playing a space flight simulator.

You can choose between navigating the camera using the keyboard or keeping the Camera window open and using the three 'Pad' buttons to re-position the camera more rapidly.

In the next section we will look more closely at the various ways that 3DMatrix allows you to add and manipulate polygons to create your 3D models.

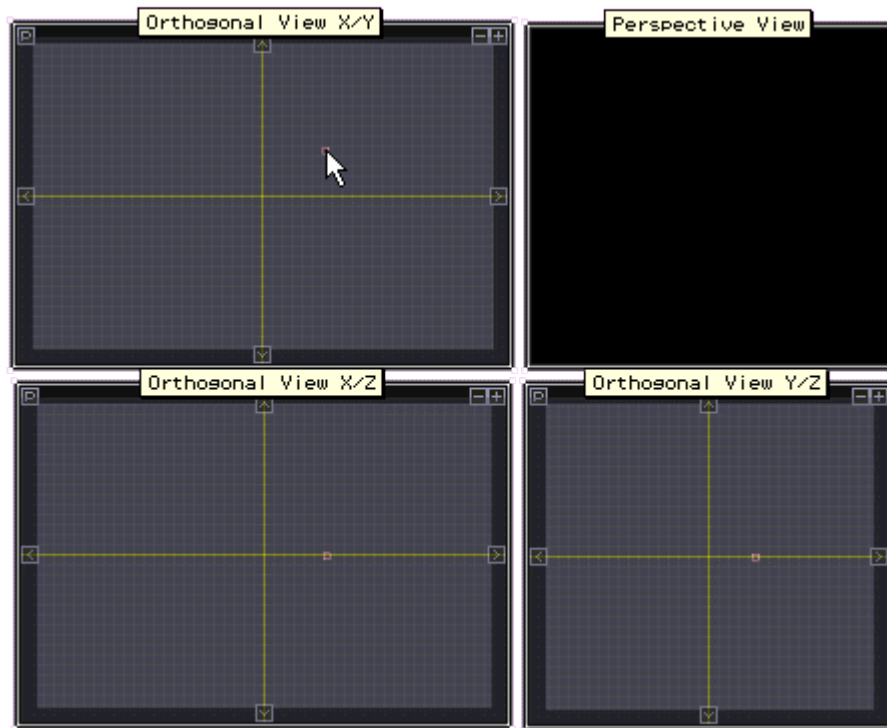
■ **Tip** You can always type CTRL-Z to undo any action and CTRL-Y to re-do an action, so feel free to experiment.

3. Essentials

3.1 Adding polygons

Typing 'a' and then clicking three positions in any of the Orthogonal View windows will add a polygon. As you click the third position the polygon is formed. It is that easy.

To have real control while adding polygons you need to understand the concept of the Locator. The Locator is a 3D cursor with its position indicated by two yellow lines in each of the Orthogonal View windows. To see these yellow lines, zoom out of each of the Orthogonal View windows by pointing the mouse over the small '-' button in the top-left corner of each Orthogonal View window and holding down the button.



Practice dragging the yellow lines around. The intersection of these lines corresponds to the 3D cursor (a single point in 3D space) referred to as the Locator. The Locator is used in 3DMatrix for different purposes including adding polygons, identifying where geometric objects are to be added, moving the camera or light sources around rapidly and defining lines or planes with which transformations are applied. In this section we clarify how the Locator is used when adding individual polygons.

After typing 'a' you will notice that as you move the mouse over any of the Orthogonal View windows, a small red square appears. This red square is called the Vertex Cursor. Notice that if you are moving the mouse over the Orthogonal View X/Y window then you can control the X and Y co-ordinates of the red cursor. The Z co-ordinate of the Vertex Cursor is determined by the Z position of the Locator. Likewise if you are moving the mouse over the Orthogonal View X/Z window then you can control the X and Z co-

ordinates of the cursor directly and the Y co-ordinate of the Locator determines the Vertex Cursor's Y co-ordinate.

That might sound complicated but the principle is simple. When adding polygons and specifying the position of each vertex you can control two of three axis positions by moving the mouse over any of the Orthogonal View windows, while the third axis position follows the appropriate Locator line in the other two Orthogonal view windows. Practice adding a few polygons and positioning the Locator and the process will soon become natural and fast.

■ **Tip** It is possible to drag the Locator while you are in the middle of adding a vertex.

When adding polygons, the Vertex Cursor jumps to the vertexes of polygons that were previously defined. This results in polygons being perfectly locked together.

You can single-click within the margin region of any of the Orthogonal View windows to produce blue guidelines. Vertex cursors will also follow the guidelines for very precise positioning. Guidelines can be dragged about and they are deleted by dragging them completely out of an Orthogonal View window. Guidelines can be positioned precisely by opening the Locator window (type 'L'), typing in the guideline co-ordinates and clicking the appropriate 'Create guideline' button.

3.2 Moving polygons

With 3DMatrix when thinking about moving polygons one needs to think in terms of moving the polygon's vertexes. To move vertexes you must first select the vertexes that you wish to move.

Vertexes are selected by holding the mouse button over any Orthogonal View window and dragging the mouse to expand the green box around the vertexes you wish to select. A small green marker will then highlight each selected vertex. You can then hold SHIFT while dragging another green box to select more vertexes without losing the previous selection. To deselect vertexes you can hold the ALT key while dragging the box (which appears red while holding ALT) to surround the vertexes you wish to deselect.

When you have selected the vertexes that you wish to move, you may hold them mouse button over one of the selected vertexes and drag the group around any of the Orthogonal View windows. Alternatively you open the 'Vertex Editor' window by typing 'v' and moving the vertexes by the distance specified in the 'Movement' input box.

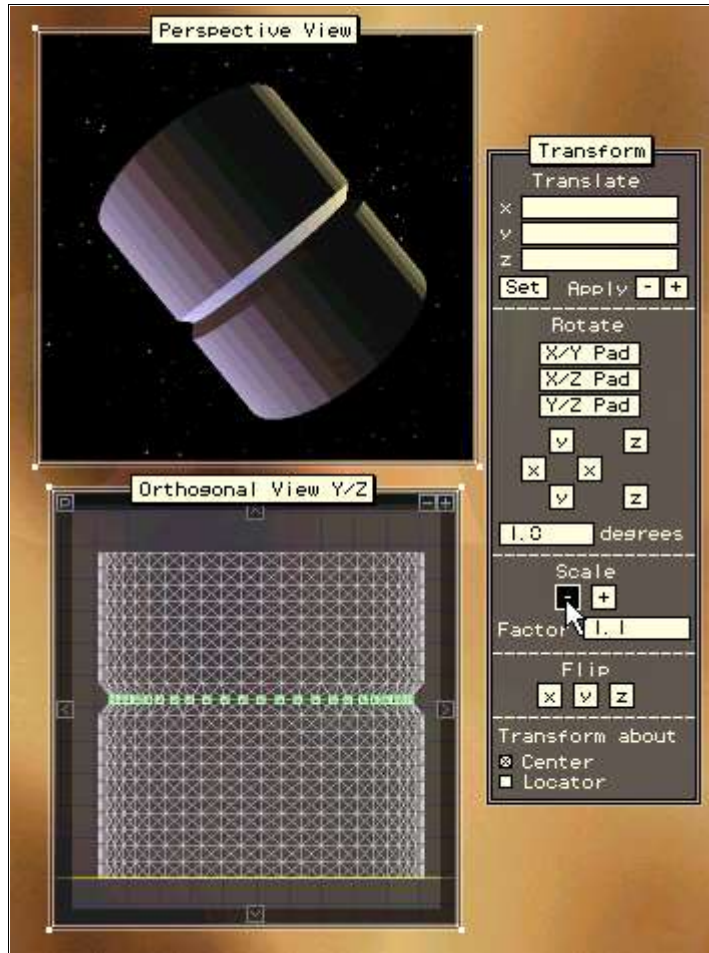
The 'Vertex Editor' window allows you to type precise co-ordinates for the selected view vertexes. For example, to flatten a 3D object over the X/Y plane, select all of the vertexes and enter a value of '0' into the 'Z' input box of the 'Vertex Mover' window.

Sometimes you will want to work in larger units. For example, to keep all co-ordinates as whole numbers you can select 'lock to grid' in the 'Vertex Mover' window and set the value of 'Movement' to 1.0. As you move individually selected vertexes around they will then jump in multiples of 1.0 (whole numbers).

■ **Tip** As a shortcut to select all polygons, click the Polygon Group within the Object Browser or type CTRL-A.

3.3 Transformations

The Transformation window allows you to rotate, flip, scale or translate your 3D model. In particular, combined with vertex selection techniques the Transformation window is useful for distorting or deforming models in useful ways.



Transformations are always applied to the selected vertexes. They can either be applied in relation to the Locator (indicated by the two yellow lines within each Orthogonal View window) or against the arithmetic center of the selected vertexes.

For example, to create bevels within a cylinder, open the Geometry window by typing 'g' and create a cylinder with a 'Length divisions' setting of 20. From the Orthogonal View X/Z window or the Orthogonal View Y/Z window select a single horizontal line of vertexes by holding the mouse button and dragging the green vertex selection box across the cylinder. The selected vertexes will appear surrounded by small green squares. Now open the Transformation window,

ensure that 'center' is selected below the text 'Transform about' and then click the '-' button below text 'Scale'. To create an outer bevel, click '+' instead of '-'.

The variety of uses for the Transformation window to distort your model is endless and if you have a good imagination you will be able to use the Transformation window to great effect.

3.4 Coloring and deleting polygons

To color or delete polygons you need to understand how polygons are selected. In 3DMatrix you can select vertexes and you can select polygons and they are different concepts. If you want to move polygons around you need to select vertexes. If you want to color polygons, delete polygons or apply polygon based effects such as 'Bisect largest polygon' (Toolbox window) then you need to select polygons.

Selecting polygons is similar to selecting vertexes except that you hold the CTRL key while pressing the mouse button and dragging the selection box within any of the Orthogonal View windows. While holding CTRL the selection box appears blue instead of green to signal that you are selecting polygons instead of vertexes. You must completely surround the polygons that you wish to select.

As an alternative to holding down the CTRL key – some people do not like to hold down keys with mouse operations – you can open the 'Polygon/Vertex Selection' window and choose 'Select polygons'. This will cause selection boxes to appear blue rather than green as the default.

Another way to select polygons is to single-click the polygon's center within any of the Orthogonal View windows. Selected polygons become colored in within the Orthogonal View windows. If you click the same position twice, the next closest polygon is selected, and then the next closest and so on. By holding down SHIFT with any of the select polygon methods you will select multiple polygons.

Lastly polygons can also be selected by clicking directly over the Perspective View window. This is a useful way to select polygons when you are making final touches to polygon colors.



To change the color of polygons, open the 'Polygon Properties' window by typing 'p'. You can directly type in the red, green and blue values for the polygon. To change the polygon color with more control, for example to gradually increase or decrease the amount of red in the select polygons, move the mouse over the 'R Pad' button and hold the mouse button down while moving the mouse up (down). The red value of all select polygons will be increased (decreased) in real-time in relation to the mouse position.

3DMatrix includes a random toner feature that is useful if you want multiple polygons to have approximately the same but not exactly the same color. The random toner options appear in the 'Polygon Properties' window and apply across all selected polygons.

To delete the selected polygons you can either type Delete from the keyboard or click the 'Delete polygons' button within the 'Polygon Properties' window.

3.5 Saving and restoring files

You can save your models by clicking 'Save As' from the File menu. Models are saved in an XML format and all of the information shown in the Object Browser is saved (folder organization, position of lights, and so on).

You can also save the screen environment using the Screen Environment window (short-cut 'e').

■ **Tip** It is only possible to open one file at the same time. You can however create folders within the Object Browser to cater for multiple models. Polygons can be moved from one group into another group by typing CTRL-A to select all polygons, CTRL-C to copy polygons and CTRL-V to paste polygons.

4. Selected features in detail

4.1 Bisect largest polygons

Tool-box window



In each iteration this function identifies the largest polygon that is selected and replaces it with two polygons by bisecting the longest side. Sometimes a single iteration involves two polygons being bisected in order to guarantee that polygons

only meet at vertexes.

The 'Bisect largest polygons' feature is useful for increasing the polygon complexity within a selection region of a polygon surface. You can then perform more detailed vertex positioning or polygon shading.

The feature is also useful for creating smoother edges within your model. This can be achieved by following 1,000 or so iterations of 'Bisect largest polygons' with 'Surface relaxing'.

4.2 Surface simplification

Tool-box window

This function eliminates the two smallest selected polygons during each iteration and adjusts the positions of the surrounding polygons.

This feature is useful for reducing the complexity of your 3D model for faster rendering within real-time applications or to reduce the file size and loading time of your model.

In particular, polygons producing flat surfaces can be selected and simplified without distorting the shape of your model.

4.3 Surface relaxing

Tool-box window

Unlike the other features within the Toolbox window, 'Surface relaxing' requires that vertexes are selected. It works by moving the position of each vertex closer to the mid-

point of the surrounding vertexes. A single iteration moves all selected vertexes and so only a few iterations are needed to produce a large effect.

'Surface relaxing' is useful for creating rounded edges when combined with many iterations of 'Bisect largest polygons'. It can also be used to create smooth mountainous terrain.

4.4 Create block from 2D object

Tool-box window

This feature constructs a 3D object by treating the selected polygons as the face of the block and automatically adding the other face and the sides matching the specified width.

Applications for this feature include converting a floor plan to a room (which in the 3DMatrix Starter demonstration file was also converted to a cave using iterations of 'Polygon bisection' and then 'Surface relaxing') and creating 3D lettering.

4.5 n-Vertex polyhedra

Geometry window

The n-Vertex polyhedra is created by positioning the arbitrary number of vertexes as far away as possible from each other over a sphere. If each vertex over the sphere was an identical negatively charged particle then these particles would repel each other and settle in positions as far as possible away from each other. That is how 3DMatrix constructs the n-Vertex polyhedra. Finally polygons are constructed from these vertexes.

This produces some interesting regular objects for small values of 'n' and as n increases the polyhedra approaches a sphere with very even triangulation.

Creating n-Vertex polyhedra for large values of n is very CPU intensive. If you wish to only create polygon spheres then it is faster to create a Superellipsoid with equal values for the X radius, Y radius and Z radius, and then applying many iterations of 'Surface simplification' to remove the small redundant polygons near the two poles.

4.6 Personalizing 3DMatrix

The colors of all windows within 3DMatrix can be changed by editing the text file titled colors.cfg. The background graphic can be removed by deleting the file background.jpg or a new desktop background graphic can be added by saving any .jpg file over background.jpg in your 3DMatrix directory.

3DMatrix uses a fixed desktop size however you are invited to choose a desktop of any width and height if you have purchased 3DMatrix.