Zomod Version 1.5.1 User's Manual

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Zomod is a "Classic" Macintosh program that creates a high-resolution image of a Zometool model from a string of commands in a text file. There is also a companion Ray Tracing program that uses the same model description files to create Photo-realistic images of Zometool models. (In Zomod the Zometool balls are shown without holes in them, whereas in the Ray Tracer the holes are shown.) With version 1.5 Zomod now requires the PowerPC processor, and System Software version 7 or later. Zomod can also run in emulation mode under Mac OSX. This manual assumes that you are familiar with the operation of the Apple Macintosh computer. A typical use of the program might go something like this:

• Start Zomod by double-clicking its icon. You will see a blank untitled image window.

• Choose the **New** command from the **File** menu to open a new text editor window.

• Build your model out of Zometool parts while simultaneously typing the Zomod instructions (described below) into the text editor window.

• Choose the **Build Model** command from the **File** menu.

• If there is an error in your input file you will be shown an error message. When you click the **OK** button, the text insertion mark (a.k.a. the caret) will be just after the point where your error occurred. If your file is OK a "wire-frame" drawing of your model will appear in the image window, and the text selection will be where you left it.

• At this point if you want to view and render your model in another program, you can choose **Export OBJ...** from the **File** menu. Give the file a name and click **OK** and Zomod will write out a file in the OBJ format that describes your model. This file can then be imported into any of the many programs that can read OBJ files. If you wish to view your model in Zomod, continue with the next step.

• To view your model from different angles, you can drag the image of the model with the mouse in the image window. To help keep you from becoming disoriented, you cannot rotate the model past the 'north pole' or the 'south pole'. Alternately you can open the **Camera...** or **Orbit...** (or both) dialog boxes from the **View** menu, enter the desired view parameters and click the **Apply** button or hit the Return key. The Camera and Orbit dialogs both allow you to

set the view you want of your model, but in different ways. The Camera dialog lets you position the camera anywhere in space and turn it any which way. The Orbit dialog lets you define a point as the "Center" of your model, how far you want the camera to be from that point, and in which direction. When you click the **Apply** button in the Orbit dialog the camera always points at the "Center" point. In addition the **Rotate Left**, **Right**, **Up**, and **Down** commands in the **View** menu provide you an easy way to "orbit" around your model in five degree increments. The camera's **Zoom Angle** and **Roll** can only be set in the Camera dialog. The zoom angle is the number of degrees visible horizontally in your image. The roll is the camera's tilt from side to side. You can also resize your image window by dragging the lower-right corner of the window.

• If you run short of memory, you can turn off the 'Blat' feature. When Blat is off Zomod draws directly to the window on your screen, but when Blat is on the program draws first into a block of memory, and only when the drawing is finished is it 'blatted out' (copied very quickly) to the screen. This gives a smoother animation.

• At this point you may wish to change the drawing mode from the **Mode** menu. The program starts in the **Wire Frame** mode. The three other choices available are 1) Solid - which draws a hidden-line image, 2) B&W Coded - which shows balls and yellow struts in white, blue struts in light-gray, green struts in dark-gray, and red struts in black with white outlines, and 3) Color Coded which shows the Zometool parts in their actual colors. All of these modes take a little longer to compute, so you may wish to stick with **Wire Frame** mode until you have the view set the way you want.

• When you are satisfied with how your image looks, you can save the image or the model description file. To save the image, bring the image window to the front and choose **Save** from the **File** menu. This allows you to name a file to hold a high-resolution PICT image of your model. (PICT is a type of image file commonly used on the Macintosh.) This is much preferable to taking a "screen shot" since that would yield a jagged, low-resolution (72 pixels per inch) image. The PICT files produced by the **Save** command can be opened and laid out in a number of programs and printed at the full resolution of whatever printer is used. Some programs may have problems reading PICT files correctly, for example Adobe Illustrator version 7.0 alters the image's colors beyond recognition. Other programs do not read high-resolution PICT images correctly. For example Apple's SimpleText will show the image at one-tenth its correct size. Microsoft Word 98 can read the files correctly.

• To save the model description file, bring the text editor window to the front and choose **Save** from the **File** menu. To use the file again you can open it from within Zomod using the **Open...** command from the **File** menu.

The Zomod Model Description Language

The program keeps track of a three-dimensional coordinate called the current position. At the beginning of each model description file, the current position is at the origin (0, 0, 0). Each command begins with a single letter as follows:

B Creates a Zometool ball at the current position. This command does not take any arguments. In Ray Traced implementation, each ball uses 48,844 bytes of memory on the heap (4606 bytes for the zomahedron + 1414 bytes for the pentagonal prism times 12 pentagonal holes + 1062 bytes for the triangular prism times 20 triangular holes + 402 bytes for the cube times 15 rectangular holes.)

S Creates a strut emanating from the current position, and moves the current position to the other end of the strut (with Zomod you never run out of parts!). This command must be followed by an argument specifying an axis, a direction, and a length, as described below. Note that no matter what you build with Zometool, all the Zomeballs always have the same orientation. This is what allows us to use the Zomeball to define a coordinate system.

M Moves the current position without creating any new objects. Like the S command, this command must be followed by an argument specifying an axis, a direction, and a length. For symmetrical models, it is often advantageous to begin with a move command to center the model on the origin. That way the model can be rotated while keeping it centered on the screen.

O Orient the model with the specified axis 'up'. This command must be followed by an argument specifying an axis and a direction, but no length. In the current version, this command applies only to parts of the model that precede it, so you will probably want it to be the last command in the file.

F Fast Render. The Zomeballs are geometrically much more complex than the struts, and thus they account for most of the rendering time. However it is usually possible to see the structure of a model from just the struts. The F command allows you to generate an image without the Zomeballs, so you can more quickly set up the camera. Fast Render is off by default. You can turn Fast Render on or off at any point in a Zomod file by just inserting an F.

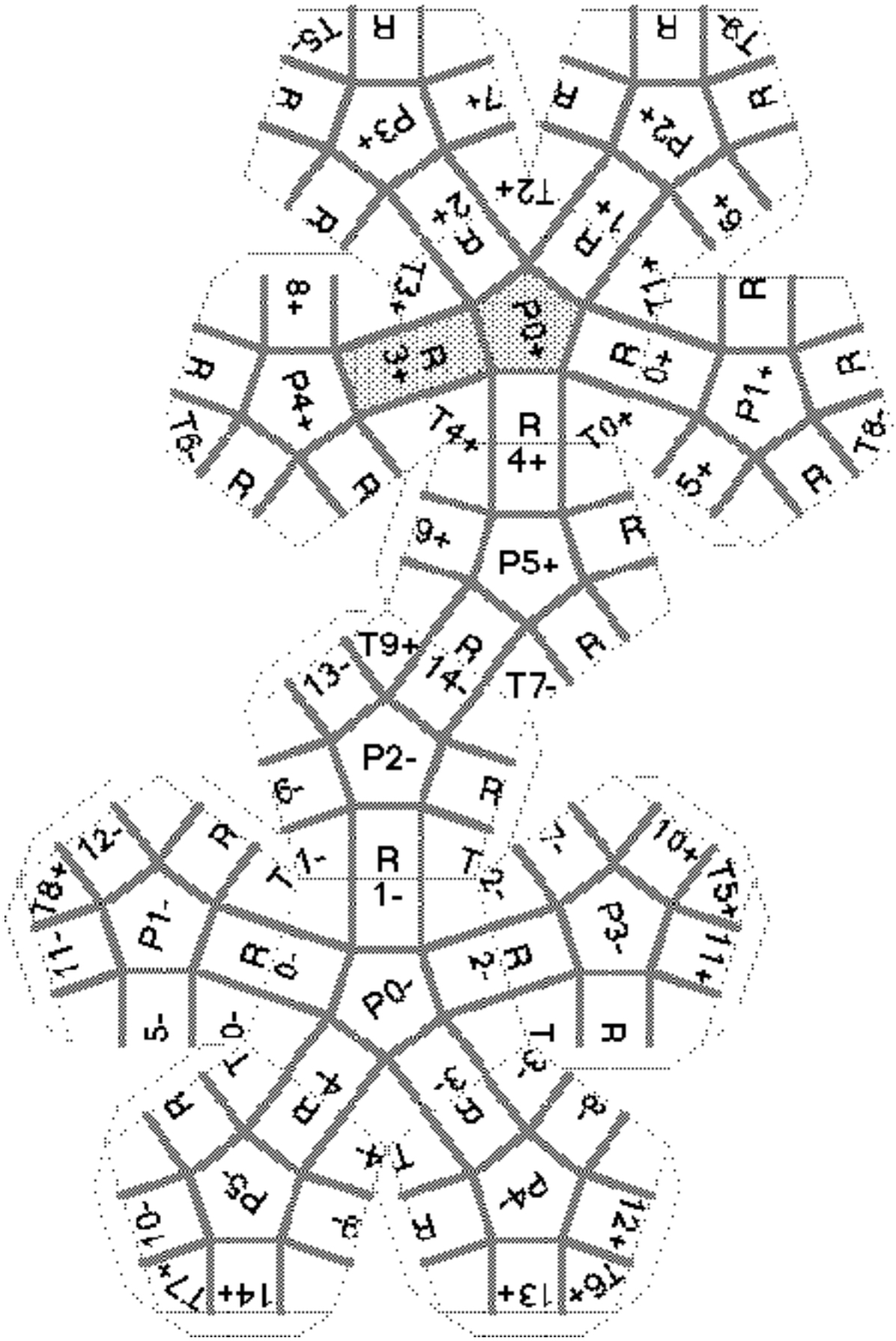
The axes and directions for the triangular (yellow), rectangular (blue), and pentagonal (red) struts are illustrated in the Zomod Axis Guide below. (We describe the struts by their shape rather than their color because the shape is intrinsic to the geometry, while the colors are arbitrary.) The default orientation of the Zomeball is with the R3+ axis pointing up, and the R10+ axis pointing to the right. The axes for the diamond (green) struts are described by a letter ‘D’ followed by a two-digit number. The first digit identifies the pentagonal axis for the hole into which the green strut is inserted. The second digit identifies the triangular axis toward which the strut leans. The sign for the

axis direction is based on the sign of the corresponding pentagonal axis. Thus the valid axis numbers for the diamond struts are:

00	10	21	32	43	54
01	11	22	33	44	50
02	16	27	38	49	55
03	18	29	35	46	57
04	15	26	37	48	59

The length argument is an integer from 1 to 9 inclusive, with 1, 2, and 3 representing the short, medium, and long struts respectively. The length argument can optionally be followed by "/2" to indicate a half-length strut. Thus a length of *a/b* can be interpreted as *tau* to the *a* power, divided by *b*. (Note that there is no provision in Zomod for green struts that are the same length as the blue struts.) Comments may be inserted in a model description file by preceding them with a semicolon. All text from the semicolon to the end of the line is ignored by the Zomod interpreter. In addition, all text in between the symbols #| and |# is ignored. This can be useful for inserting long comments, to skip over parts of a model for debugging purposes, or to generate images of a model at various stages of construction.

Spaces are also ignored except if they occur within a number. (i.e. 10 not 1 0) Zomod is case-insensitive, in other words upper and lower-case letters are interchangeable.



Zomod Axis Guide

Here is an example of a model description file for a dodecahedron made with the short struts:

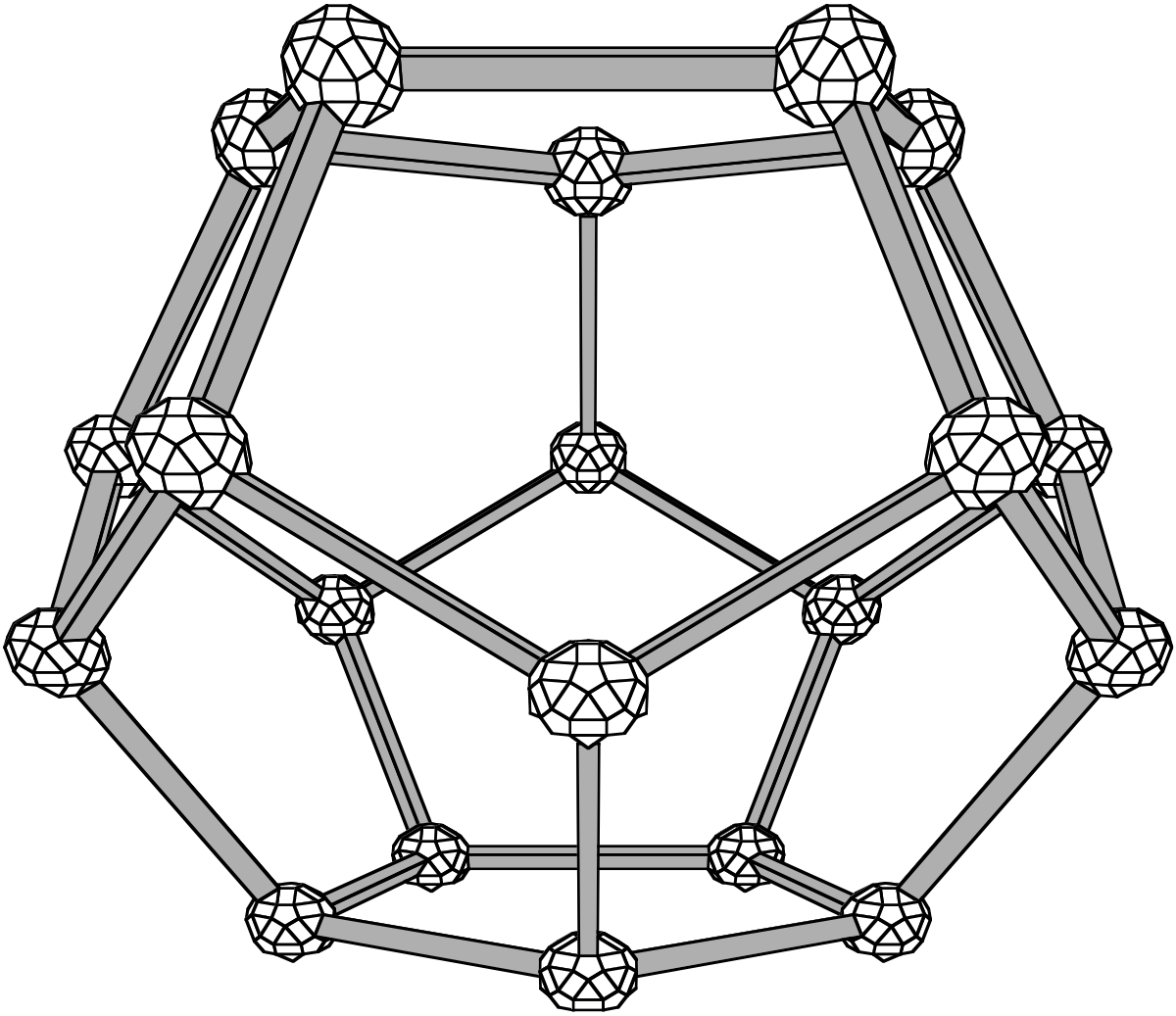
```
; Dodecahedron

MT1-2  ; Center the figure on the origin
; Starting with the bottom Pentagon
B SR14+1 B SR12+1 B SR10+1 B SR13-1 B SR11-1
SR3+1 B SR7+1 B SR9-1 B SR2-1
MR2+1 SR6+1 B SR8-1 B SR1-1
MR1+1 SR5+1 B SR7-1 B SR0-1
MR0+1 SR9+1 B SR6-1 B SR4-1
MR4+1 SR8+1 B SR5-1
MR5+1 SR1+1 B SR10-1
B SR0-1 MR0+1 SR13+1
B SR4-1 MR4+1 SR11+1
B SR3-1 MR3+1 SR14-1
B SR2-1 MR2+1 SR12-1
```

You can use any knowledge you have about the model you are building to check Zomod file. In the case of the dodecahedron, we know that there are two edges in each of the fifteen rectangular coordinate axes. The above model satisfies that requirement.

Here is an example of a model description file with one diamond strut in each pentagonal hole.

```
B
SD00+2 MD00-2 SD00-2 MD00+2
SD10+2 MD10-2 SD10-2 MD10+2
SD21+2 MD21-2 SD21-2 MD21+2
SD32+2 MD32-2 SD32-2 MD32+2
SD43+2 MD43-2 SD43-2 MD43+2
SD54+2 MD54-2 SD54-2 MD54+2
```



Example of Dodecahedron rendered in B&W Coded mode.

Appendix A - Version History

For version 1.1 June 9, 1998

- Show watch cursor during model building, visibility calculation and drawing.
- Fixed bug in which text could become highlighted in inactive dialogs.
- Fixed bug in which change to "Position" in "Camera" dialog would not update "Center" field in the "Orbit" dialog.
- Fixed bug in which an image file could be corrupted if memory was compacted during a file save.
- Modified PICT files so that they open in Simple Text when double-clicked.
- Now writing out PICT files in Version 2 format.
- Increased resolution of PICT file coordinates to 720 pixels per inch.
- Safe file writing so even if power fails during a file save, existing files will not be damaged.
- Fixed bug in which file creator & signature were not changed when a file was saved over an existing file created by another program.
- Modified so that visibility calculations are not done when switching applications, uncovering parts of the picture window, or changing from one solid view to another.
- Flat shaded color.
- Use binary insertion sort optimized for minimum tree depth - about 3 times faster than the old linear insertion sort.
- Fixed bug in which background color was not recorded in PICT files.

For version 1.2 March 21, 1999

- Added **Export DXF...** command to **File** menu.

For version 1.3 March 7, 2000

- Added **Image Size...** command to **View** menu.

For version 1.4 July 6, 2000

- Added the “D” axes, a.k.a. “the green lines”.

For version 1.5 April 15, 2003

- Added the built-in text editor.
- Improved error-handling and reporting.

- Added support for the half-length struts.
- Fixed bug in which some diamond struts did not appear in the correct axes.

For version 1.5.1 May 8, 2003

- Added feature to rotate model about the origin by dragging with the mouse in the image window.
- Maximum axis length (power of tau) extended from 3 to 9, including half lengths thereof.
- Fixed bug in which the **Save** command was deactivated when the image window was in front.
- Fixed crash bug that occurred when using **Save As...** on a text file that had already been saved.