Introduction

Diatom is a drawing program based on the Fourier Transform using an algorithm by Brian McGhie. It draws a wide variety of figures based on parameters supplied by the user or generated at random by the program. Drawings can be output to either an ImageWriter, a LaserWriter, or to an HP plotter. A 'Script' file may be created to 'play back' a series of drawings.

Diatom was written in Mac C 4.0 from Consulair Corp. (Portions are Copyright 1984 Consulair Corp.) I wrote the program mostly for fun, and mainly to learn how to make the Mac do all the wonderful things it does. It is being distributed as 'freeware'. Please feel free to give a copy of it to anyone. If you like the program please donate a few dollars so that I can justify the many hours I spent writing it to my wife. (That way, she might even let me develop another program of interest.)

To find out how the program works (including some of the quirks of using C with the ToolBox), send me $15.00 and I will send you a hardcopy annotated listing of the program (1000+ lines of C source and 350+ lines of resources).

I have provided a pre-addressed envelope at the end of this manual. Just fold it up, put a check inside, a stamp on the outside, seal it, and drop it in the mail.

The name Diatom was chosen because many of the drawings that the program produces reflect the shapes and patterns of the microscopic algae of that name.

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The Math

This section describes some of the mathematical basis for Diatom. Fourier transforms have many applications in science, mathematics and engineering. Discrete Fourier Transforms (DFTs) are fundamental to signal processing, speech recognition, digital imaging, acoustics, forms of digital audio, harmonic analysis, and many other areas of the technological explosion. The basic idea behind a DFT is to transform a function from one space into another space. In this new transformed space the original information may yield itself to better understanding or manipulation. The general equation for a DFT may seem a bit forbidding at first, but it simply takes n complex points and transforms them into n complex points. Given an input Z of n points, we then can calculate W, the output of n points. The general form of the DFT is:

$$W_j = (1/n) \sum_{k=0}^{n-1} Z_k[\cos((-2\_kj)/n) + \sin(-2\_kj)/n)i]$$

where i is the square root of minus one. But we can modify this since we know something about the data that is input. So our formula looks like:

$$W_j = (1/n)\{Z_a[\cos((-2\_aj)/n) + \sin(-2\_aj)/n)i] + Z_b[\cos((-2\_bj)/n) + \sin(-2\_bj)/n)i] \}.$$

Diatom actually calculates a sine and cosine table for the number of points (or complexity) and then calculates the DFT by indexing into these tables.

One way to look at the output of the DFT is to graph it. In Diatom we plot the results from the DFT by drawing lines from Wi to Wi+1 with the exception that Wn-1 is connected to W0. (The W points are first scaled to fit the chosen output device, be it a printer or a plotter.)

The hard part is to determine which set of input points looks the best when output. The prettiest diagrams result when the set of input points are all zero except for one or two points. Diatom only allows you to determine which two points in the set Z are to have a fixed non-zero value.

What looks pretty is of course up to the user. By some playing around with some different inputs, one begins to see patterns emerge. If the two inputs are equal you get a circle (e.g. 10,10 with points 127). By making the two inputs equal and closer to the median number of points, the circle gets thicker. If one of the two points is twice the other (e.g. 5,10 with points 301) you obtain one inner loop. If three times, then two inner loops; if four times then three inner loops, etc. If the two points have a factor in common with the total number of points, then the figure reduces itself to one of less complexity. There is much more to discover, so play with the program and see what you can come up with.

The Screen

'Stats' Box

The 'Stats' box in the upper left-hand corner of the screen displays the statistics of the current drawing. The first line is the number of points (or 'complexity') used to generate the drawing. The second and third lines show where the two pulses are placed in the array. An 'i' following a pulse position indicates an Imaginary (as opposed to Real) pulse at that position.

Drawing Area

The drawing area is the large box on the right-hand side. This is where the results of the DFT are displayed in the complex plane by connecting up the array points one after another.

Pause / Continue

The Pause and Continue buttons in the lower left-hand corner of the screen allow you to temporally suspend the operation of Diatom. Their main use is to stop the program while running in Auto mode when you see a pattern you like. You could try to stop Diatom in this case by turning Auto mode off, but Diatom may start calculating the next drawing before you can stop it. By clicking the Pause button instead, you can prevent Diatom from overwriting the current drawing. You can then write down the drawing's statistics so that you can later re-create it via the Set Pulses dialog or a Script file. Click the Continue button to resume the program's action.

Note: The Pause button will not immediately react to being clicked when the Calculating box (see below) is visible. Nevertheless, the event has been noted and Diatom will stop before going on to output the next drawing.

Calculating Box

The Calculating box appears when Diatom is busy calculating the sine and cosine tables for the DFT. This operation is coded in a tight loop and the program will put off the handling of all events until after the current operation is complete. (The events are not lost, but merely delayed until Diatom can get around to servicing them.)

Script File Box

The Script File box appears when a Script file as been successfully opened. It displays the name of the Script file and will remain on the screen until the file is closed.

The Menus

Open

Open a script file. A standard open file dialog is presented which lists all available files of type 'TEXT'. After a file is selected, a 'Script file' box will display the file name and the Run Script and Repeat items of the Control menu will become active.

Close

Close the current script file.

Page Setup

Setup the printing format for the current printer. Normally you do not need to use Page Setup since Diatom presets the printer format to Tall Adjusted. (Wide could also be used, but Tall should be avoided since it will distort the drawing.)

Note for LaserWriter users: The LaserWriter defaults to a line width that represents the line width on the ImageWriter. Ideally, the smallest possible line width should be used in order to show the maximum detail in a Diatom drawing. To accomplish this, the program sets the LaserWriter reduction factor to 25% and the scales the drawing up accordingly. The 'zooming' done by the printer then reduces the drawing to fill the page and thereby reduces the line width in the process.

Print

Print the current drawing. When using the ImageWriter select High quality printing for the best results.

Plot

Plot the drawing by sending HP-GL commands to an HP7475A (or compatible) plotter connected to one of the serial ports. The dialog box allows you to select which port the plotter is connected to, paper or transparency medium, and the pen number. (The pen number may also be enter