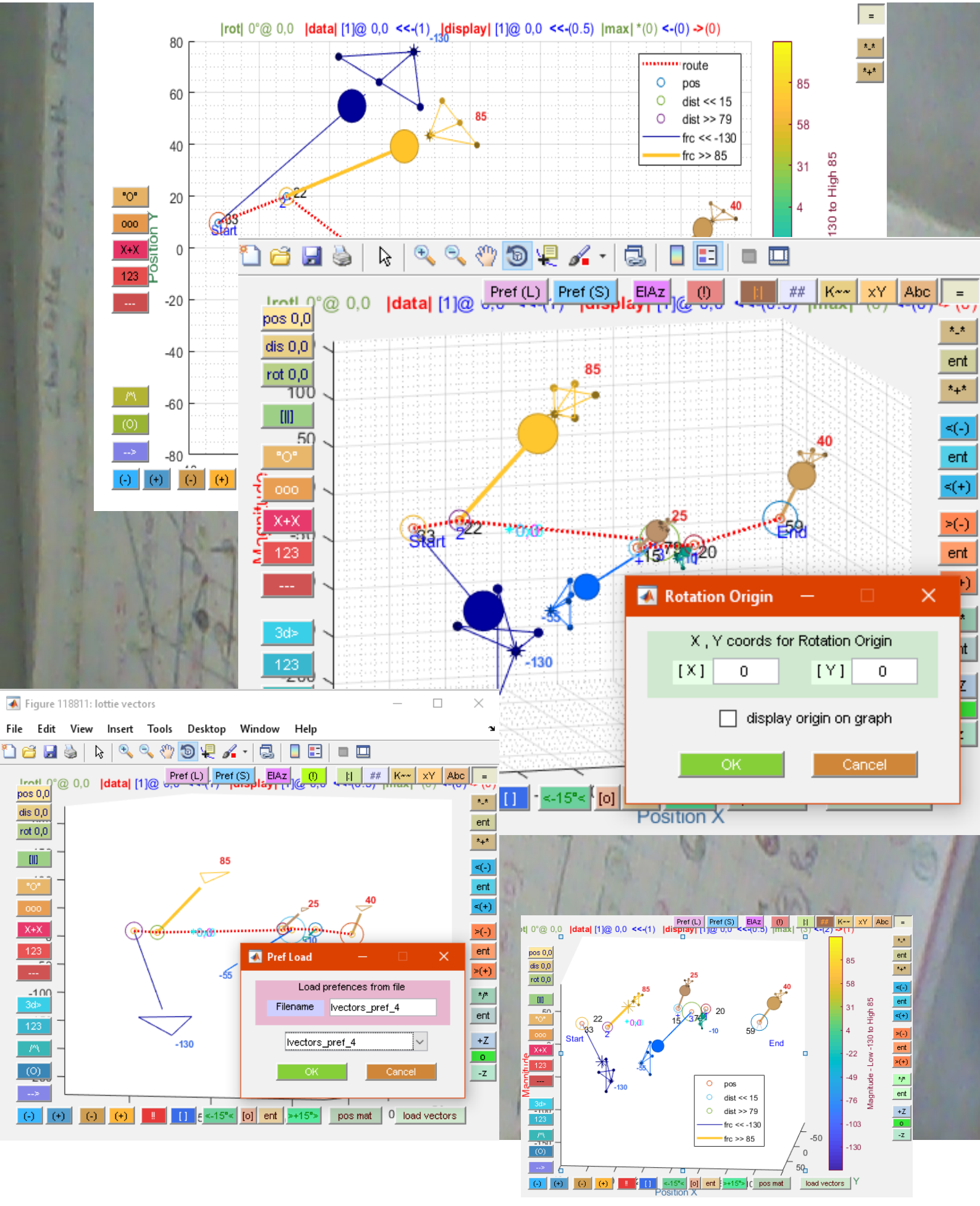
Lottie Vectors

A Great Way To Display Vectors ! — *twitter.com/mathlottie*



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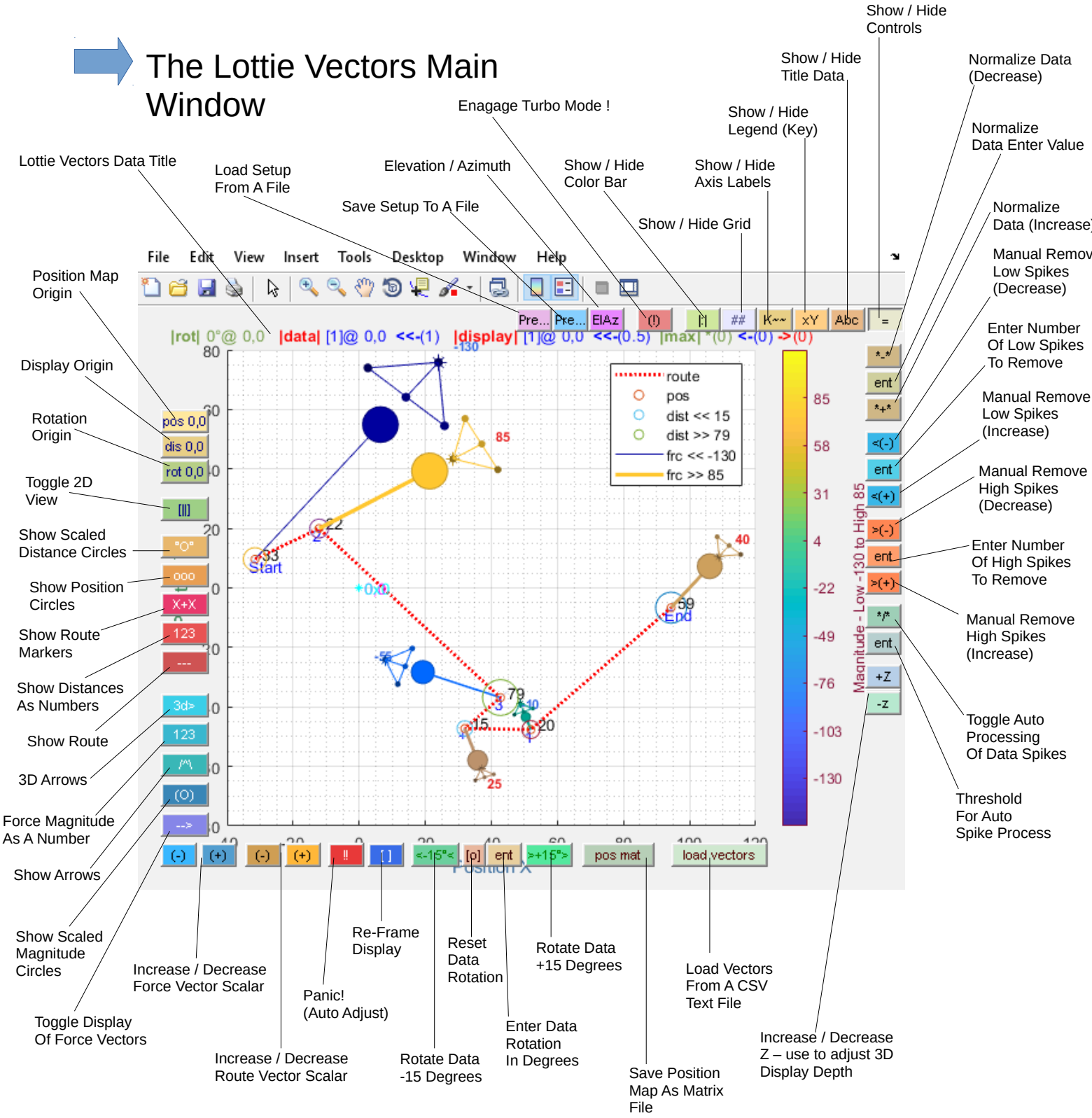
The Lottie Vectors Main Window



What Is Lottie Vectors?

Lottie Vectors is an application for Matlab(tm) that alows you to do some pretty neat things -with vectors. More exactly -displaying them in ways that hopefully will allow you to explore and better understand your vector data. It's also a great tool for students to learn about vectors and gives you the chance to explore different forms of representation.

The basic idea is simple. Take a vector defined in one of a few different types of data formats and mat it on the screen. Add another vector and you start to form a 'route'.

Vectors which make the route are called position vectors. As well as these for each step along the route, a force vector can be assigned. This can be used to show something acting on a postion with a direction and positive or negative magnitude. More force vectors can be added though.

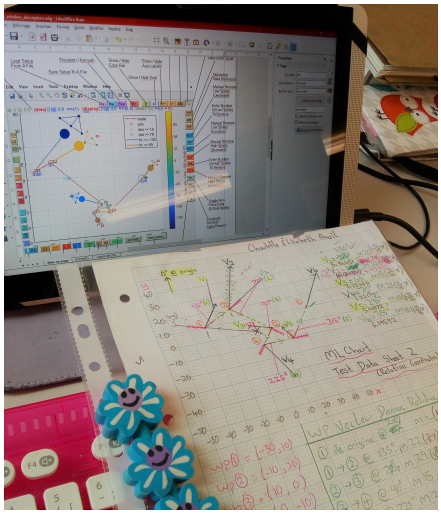
Finally you can give each position a tag to display on screen. This could be a common math symbol or greek letter, start/end signposts, or a number of the position. Either from the beginning or after a 'reset'.

After all the information has been loaded for your dataset. Either passed on the command line as a matrix, or in a text file. Lottie Vectors displays inside a figure that you can resize, rotate, and turn 2D positions into a 3D picture with forces.

Check out the files on the official page have fun!

Charlotte Élisabeth Ameil - August 2018

(Manual 1.0 please lookout for the next version of these instructions, I had to rush a bit in writing these and am hoping to have something more polished soon!)



twitter.com/mathlottie

- download the latest version with the filename
Lottie Vectors.mlappinstall
in 'release_current ' at either

https://github.com/lottiemath/lottie_vectors

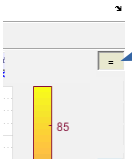
or

https://sourceforge.net/projects/lottie-vectors/

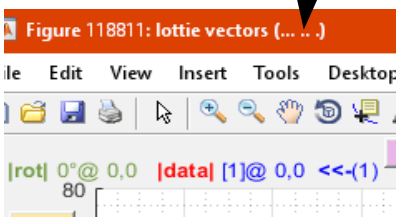
Lottie Vectors – Quick Tour Summary of Main Window Controls

When you start Lottie Vectors it defaults to it's built-in demo data. This gives you the chance to work with it right away ! However you can load in your own vector data by clicking on the Load Vectors button on the bottom on the window. If you can't see the buttons you may need to undock and maximize the figure window. If there are no buttons around the figure window you'll need to click on the hide/show controls button inside the figure are the top right.

Lottie Vectors is busy updating the window
The (… .. .) disapears when ready.



Show / Hide Controls



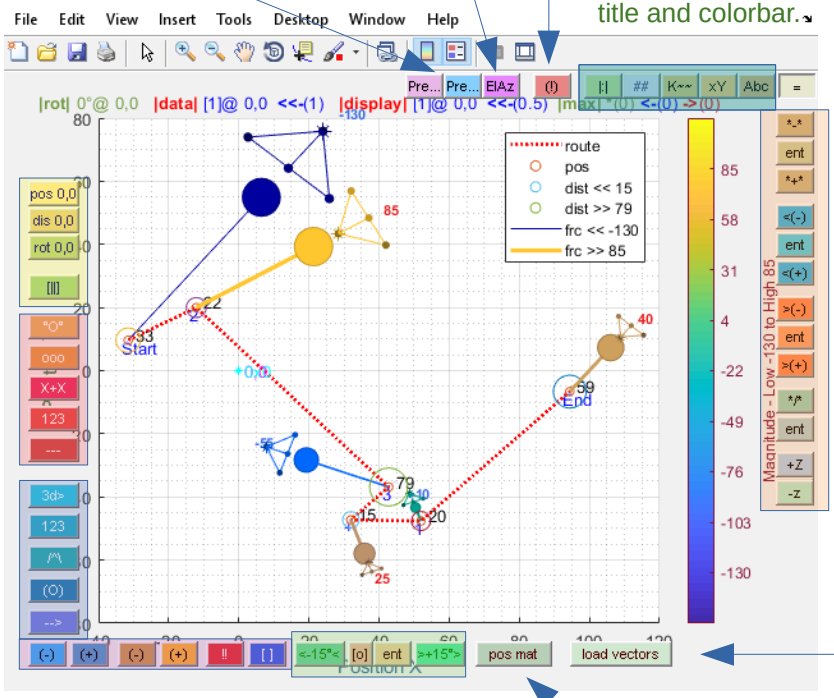
Below is summary of the groups of controls on the main window. *See Page 2 for a detailed list.*

Enter an elevation and azimuth

Turbo mode for faster updates.

Load / save current setup to a file.

Figure display options such as title and colorbar.



Various origins and 2D toggle.

Aspects of the display of position vectors.

Aspects of the display of force vectors.

Controls for processing out of data high peaks and dips to make viewing the smaller differences in forces easier.

Load vectors from a text file.

Controls for scaling force and position vectors.

Controls for rotating the raw vector data.

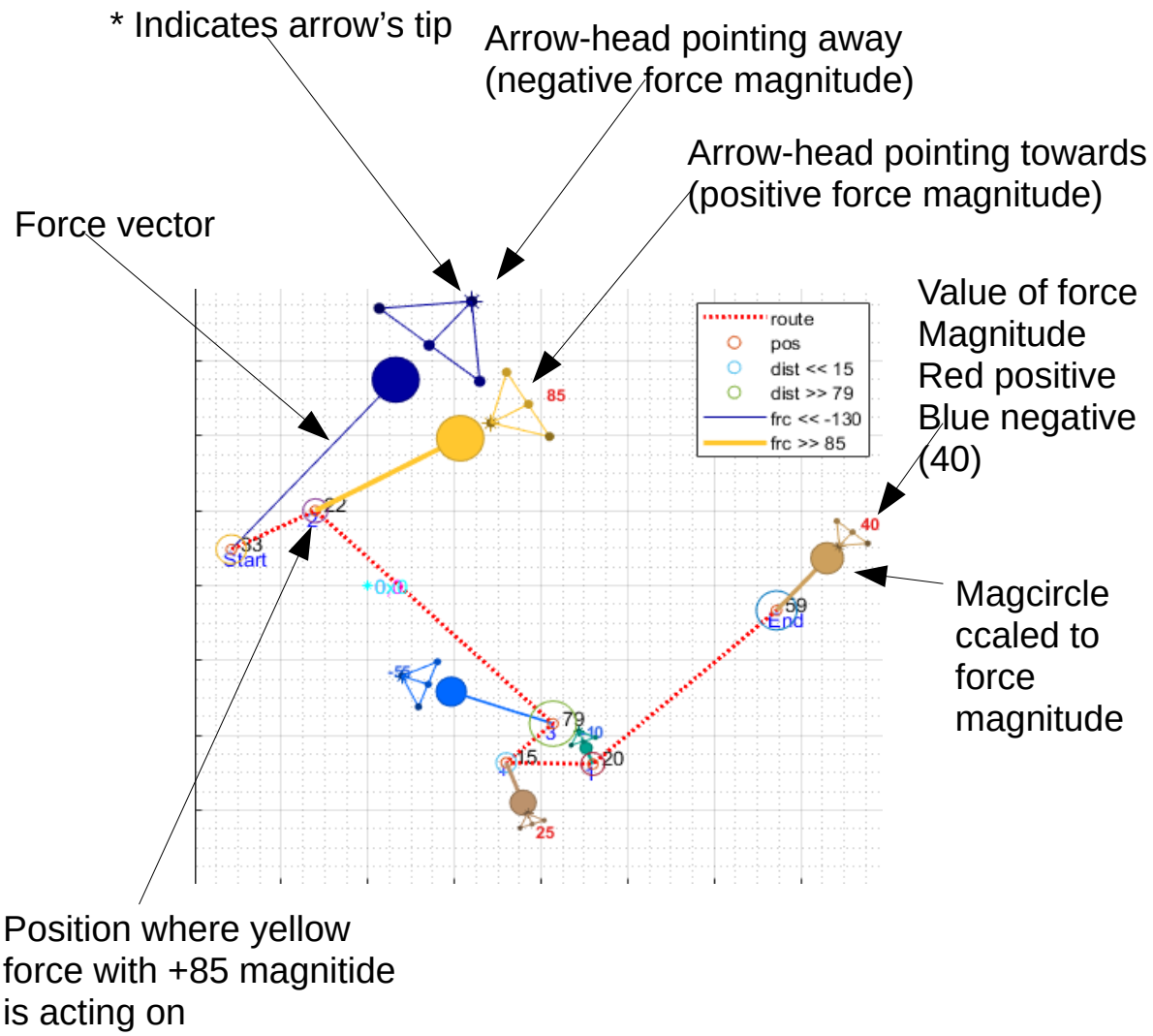
Save processed vector data as a matrix.

Lottie Vectors – Quick Tour Displaying Forces

The program will try and fit all your vector data on one screen. You can choose to either use the normal methods of zooming in and out from the figure toolbar, or use the program's options. Many of the controls only effect the display of the vectors and not the vector data itself (if you wish to save the position map as a matrix changes such as the rotate buttons will be shown in what is saved).

Descriptions of the display, and what it shows, is given below. You can use the demonstation data at the start to explore.

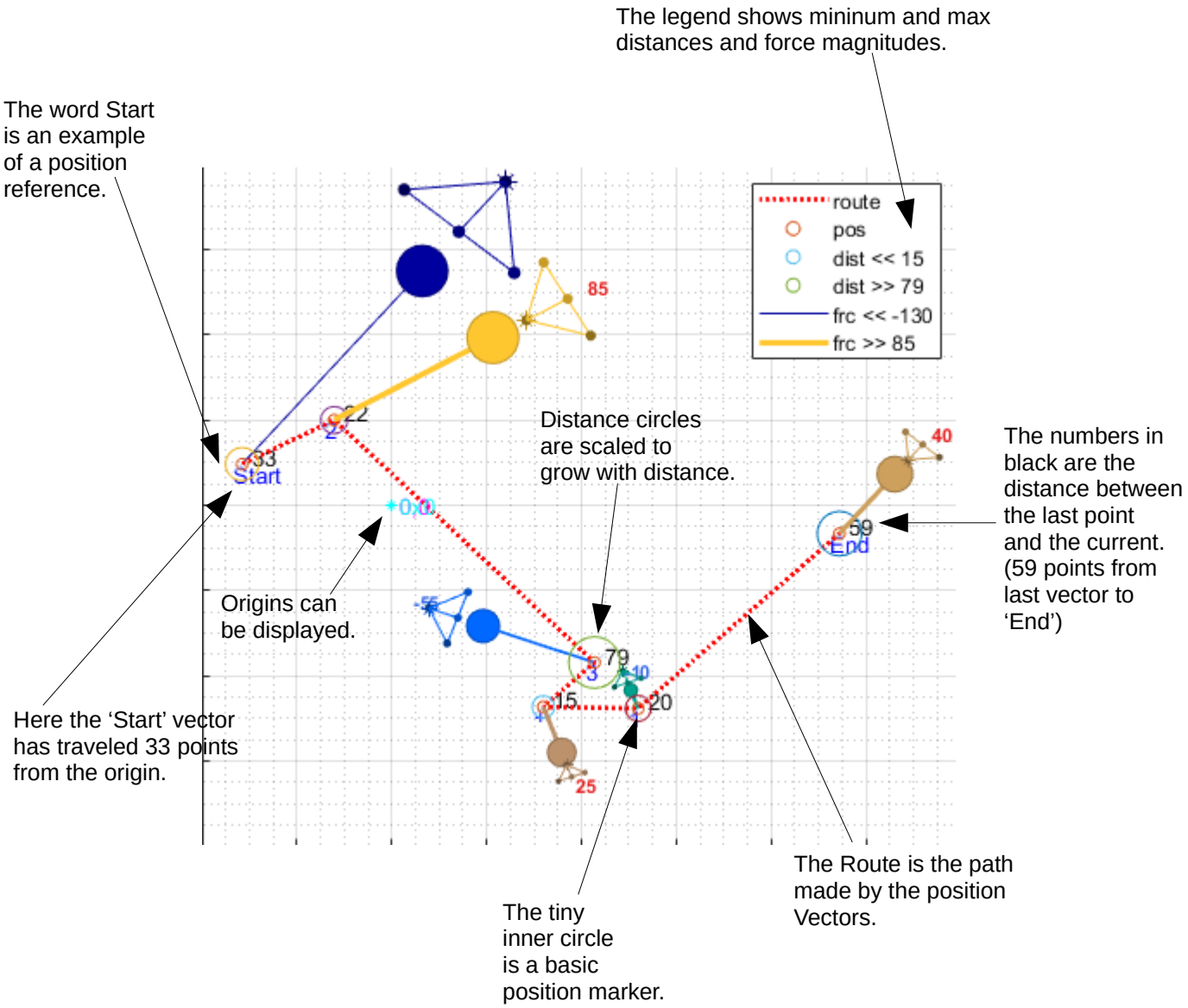
Below shows how force vectors are displayed



Lottie Vectors – Quick Tour Displaying Positions

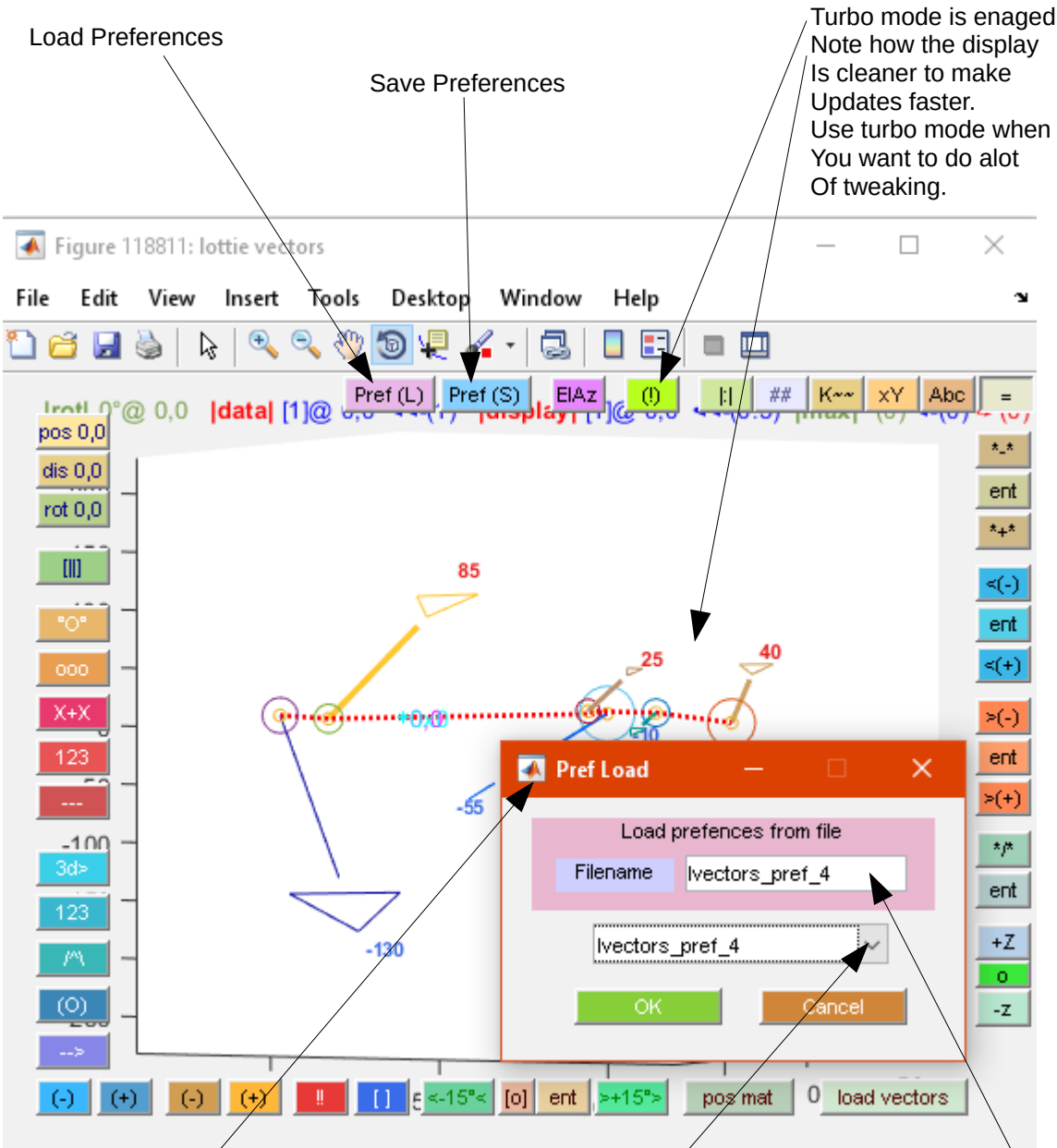
The positions can be displayed and a route mapped, or you can switch off the route leaving something like a vector field with only forces displayed from various positions. I tried to keep the program as flexible as possible so you could end up with some strange combinations !

Below shows how Positions are displayed in the figure window.



Lottie Vectors – Preferences

When you have tweaked the display for your vector data you can save the setup in a file and recall it later. You can have multple files with different preferences which can be loaded in on the main window.

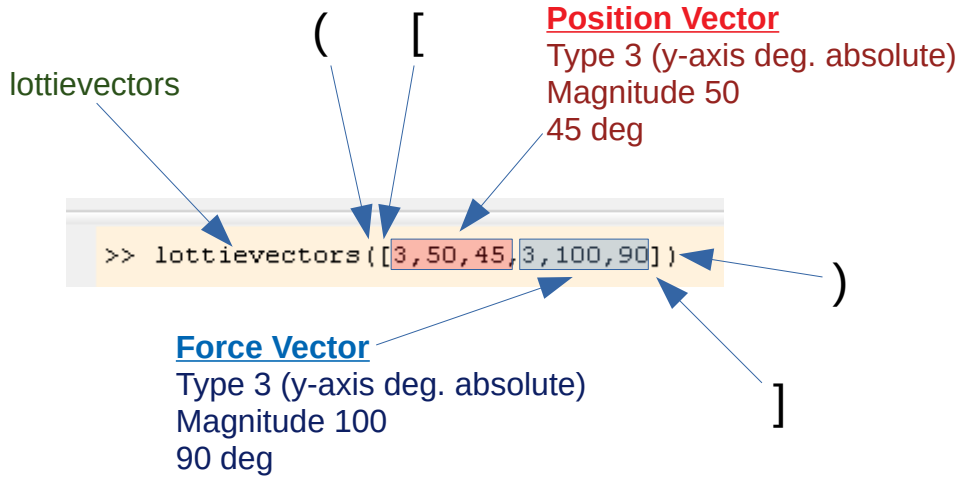


Lottie Vectors – Entering Vectors On The Command Line

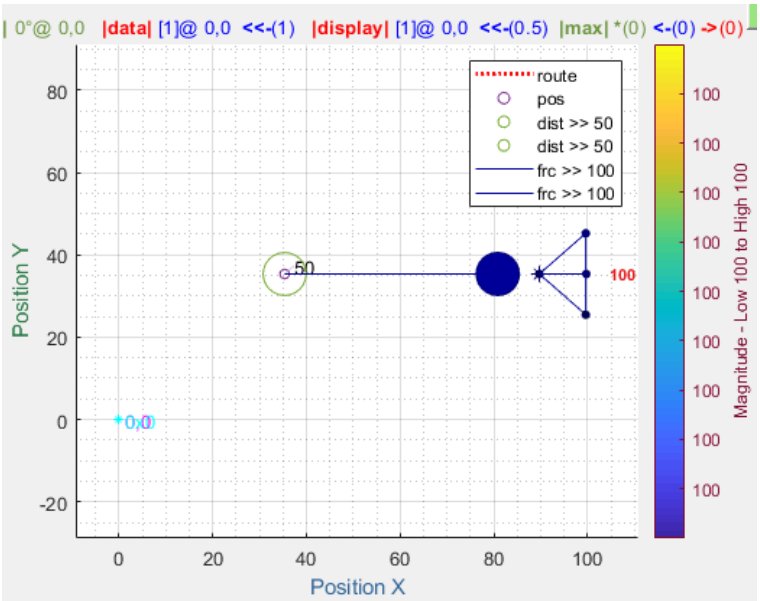
There are a few different ways to pass vectors to Lottie Vectors. You can do so at the command line, either as a variable or in [] notation. Or you can create a text file, give it a .dat extension and write your vectors in that.

To see how files are formatted take a look at the next section. We start with simply entering variables on the command line.

If in Matlab(r) command window you simply enter lottievectors() the figure is displayed with the demo data shown. You can load a blank window by entering lottievectors([0]), or if you want to enter your own vectors at the start use the format below



This will display the following window :



Note that the window has been scrolled with Matlab(r) hand tool to show the origin in blue at the bottom left of the display.

What is seen here is a starting position vector that traveled at an angle of 45deg and a magnitude of 50 from the 0x0 origin in blue. The 50 shows the distance, the larger circle is scaled also to show this.

From this position vector a force vector is drawn at an angle of 90deg and with a magnitude of 100. Because the magnitude is positive by default the arrow points towards the position. The filled blue cirlce on the force vector is scaled by it's magnitude.

Lottie Vectors – Entering Vectors Through the Workspace

The format for vectors is always the same no matter if it's by the command line, within a file, or with the next method as a variable in the Matlab(r) workspace.

There are some advantages to entering your vectors as variables. One you can use Matlab(r)s tools to view and edit the variable on screen as in a spreadsheet. This saves the need for editing in a text word processor. Others include, you can save them, give them directly on the command line, possibly calling up lottievectors from a program. You can also load in many sets of vector data and display them without going through files each time.

The downside is that unlike a text file, the variables are not normally readable in other programs. So could also write text vector files on other devices, and import them from other sources.

From the Matlab(r) prompt type

```
>> mat=[3,50,45,3,100,90]
mat =
     3    50    45     3   100    90
>>
```

Here you have just defined a matrix 'mat'

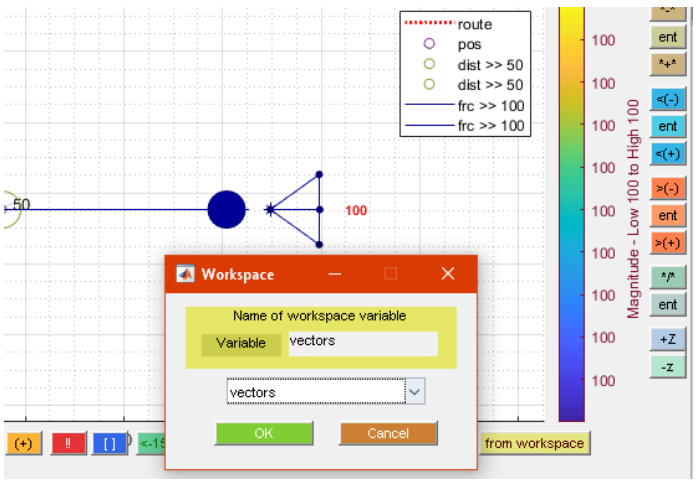
with the row 3,50,45,3,100,90

these are the same two vectors as before.

Because they are now stored the workspace, you can process them as any other variable and of course you only need to give the command lottievectors(mat) and

```
>>
>> lottievectors(mat)
ans =
  Columns 1 through 12
   35.3553   35.3553   50.0000   45.0000   45.0000         0         0         0         0         0         0   35.3553
         0         0         0         0         0  100.0000  100.0000   90.0000   45.0000  100.0000    0.0000         0
  Column 13
   35.3553
         0
```

is displayed along with the window as before. I've included the position map here because by default it's always given just before the vectors are displayed. More on the position map later. But the numbers which are lower in the columns preceeded by 0 at the top are the force vectors. The position vectors are all in the top row. The reason for this is that before a force vector can be, it's needs a position to act on.



You can also load workspace variables from the main window by clicking on the 'from workspace ' button in mustard color at the bottom right of the display.

You are asked to make a selection from the following possible names of variables in your workspace to use.

vectors, vectors1, vectors2, vectors3, vectors4, m , mat, or ans

Lottie Vectors – File Formats

```
=====================================================
Example 1
=====================================================
(Position vectors only with refences)

33, 288, 1
22, 63, 0
79, 134, 0
15, 228, 3
20, 90, 4
29, 43, 2


```

By default the filenames location is whereever MatLab(tm) looks for files, this is probably the directory you loaded Lottie Vectors from. You can load in vectors right from the window, just click on the Load Vectors button at the bottom. If you cant see the button you may have to undock the figure window to get to a size where all the buttons are available.

The format of the file is CSV. This means there is only numbers sperated by commas, and no text. Save the file in .TXT format, use a text editor like Notepad to create the files.

Lottie Vectors regonizes a few different types of file and each is listed below. The reason for different types is to help speed up entering vectors. Each format adds another field giving you more flexibility in the type of data you want to use.

- **Format 1**

  Simple Magitude and Degree Vectors

  1 Magnitude of position 2 Degree of position 3 Magnitude of force 4 Degree of force

---

- **Format 2**

  As format 1 but with a reference number at the end (see a later page for what the reference numbers display.

- **Format 3**

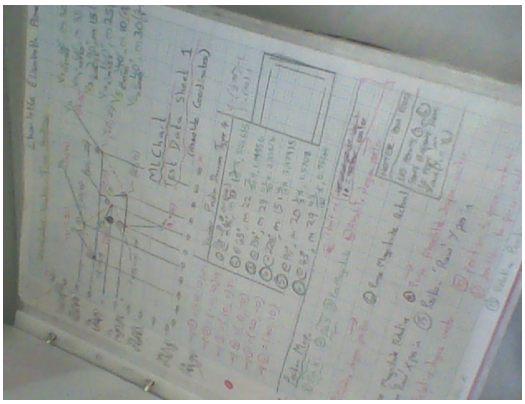
  1 Position vector type 2 Position vector data 1 3 Position vector data 2 4 Force vector type 5 Force vector data 1 6 Force vector data 2

- **Format 4**

  As format 3 but with a reference number at the end

Lottie Vectors — File Formats Continued

A typical vector data file looks like the listing below



6, 33, 5.00909, 3, -130, 40, 1

6, 22, 2.35619, 3, 85, 60, 5

6, 79, 1.29154, 3, -55, 290, 5

6, 15, 1.57080, 3, 25, 160, 7

6, 20, 3.92699, 3, -10, 340, 8

6, 59, 5.49779, 3, 40, 40, 2

Each line has the data for two vectors. The first is the position vector, and the second as a force vector. The format shown contains all the fields that could be used in a file.

The first column is the Vector Type for the position vector, then there is the magnitude, and in the 3rd column it's angle in radains.

The 4th, 5th, and 6th columns repeat the same information but for the force vector.

The final 7th column is a reference number that is shown onscreen. It's number refers to a table of symbols that could be displayed at the position.

Vector Types

There are 8 different Vector Types or ways of expressing them. Some are common, others less so and are more for educational purposes as they are not really vectors !

There are two basic types. The vectors with magnitude and angle, either in degrees or radians. There are also two others where the vector's position is expressed in either fixed, or relative cartesien coordinates.

The Vector Type numbers are listed below and are seen in columns 1 and 4 or the example file above. You can mix types and change them at any point in the data.

List of vector type numbers

0 = ignore vector
1 = vector is a global carteisen coordinate as position
2 = vector is a relative careisen coordinate to the position

3 = vector is a magnitude first then global angle in degrees taken from the y axis going clockwise
4 = vector is a magnitude first then global angle in radians taken from the y axis going clockwise

5 = vector is a magnitude first then relative angle in degrees
6 = vector is a magnitude first then relative angle in radians

7 = vector is a magnitude first then global angle in degrees taken from the x axis going anti-clockwise
8 = vector is a magnitude first then global angle in radians taken from the yxaxis going anti-clockwise

Lottie Vectors — File Formats Continued

Vector References for use in files

The following are the number to displayed results for the vector references in files. This is always the final column. You do not need to specify a reference, but if you do then you need to include one at the end of each line.

0 = nothing is displayed
1 = display the position vector number from the start
2 = display the position number from last text
(resets to 1 on any other input)

3 = start
4 = end
5 = x
6 = X
7 = o
8 = O
9 = a
10 = b
11 = c
12 = A
13 = B
14 = C
15 = i
16 = j
17 = k
18 = I
19 = J
20 = K

21 = alpha (lower case)
22 = beta (lower case)
23 = gamma (lower case)
24 = Alpha (upper case)
25 = Beta (upper case)
26 = Gamma (upper case)
27 = delta (lower case)
28 = phi (lower case)
29 = omega (lower case)
30 = Delta (upper case)
31 = Phi (upper case)
32 = Omega (upper case)
33 = theta (lower case)
34 = lambda (lower case)
35 = sigma (lower case)
36 = Theta (upper case)
37 = Lamda (upper case)
38 = Sigma (upper case)

Examples of vector files

The following are all entered in a basic World Processor such as Notepad and then saved in .TXT format. When saving files the format might be shown as Raw, ASCII, Text or TXT in your word processor. You can find demo data online. See the back of the first page for web addresses.
By default I chose to use the .dat extension to the datafiiles but you can specify a .txt file if the .dat extension causes problems when editing.

Default position only data

100, 45
50,90
25, 180
30, 12

go 100 points @ 45 degrees
go 50 points @ 90 degrees
go 25 points @ 180 degrees
go 30 points @ 12 degrees

Position and Force data

3, 50, 90, 3, 20, 120
6, 100, 3.92699, 1, 50, 40

go 50 points @ 90 degrees
force of 20 points @ 120 deg

go 100 points @3.92699 rad
connect 'force'to x=50, y=40
(the use of cartesien coordinates here is obviously not a true vector, but it could be used for particlar applications of data to be displayed)

Position, Force and References

1, 30, 25, 3, 100, 90, 3
3, 50, 90, 3, -40, 80, 34

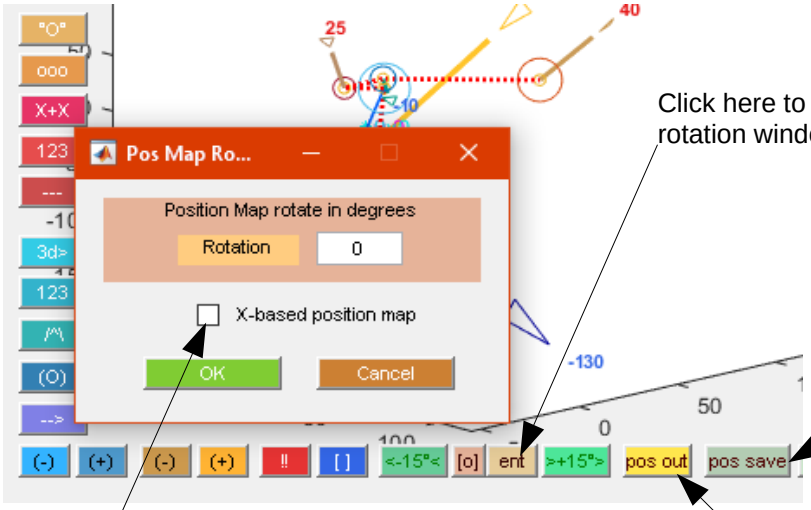
go to x=30, y=25
force of 100 points @ 90 deg
display the word 'Start'

go 50 points @ 90 deg
force -40 points @ 80 deg
display lower-case lamba

Lottie Vectors – Position Map (The Result)

The position map is a matrix of data that Lottie Vectors stores in the Matlab(tm) workspace after computing the vectors.

The data consists of cartesien coordinates of the vectors route, along with forces and copies of both sets of vectors magnitude and degrees. *The default for absolute angles is that they are read clockwise from the Y axis. You can change this by ticking the box on the rotate option.*



Click here to bring up the rotation window

Click here to save the position map matrix to a file you can load into matlab(r) later with load <filename>

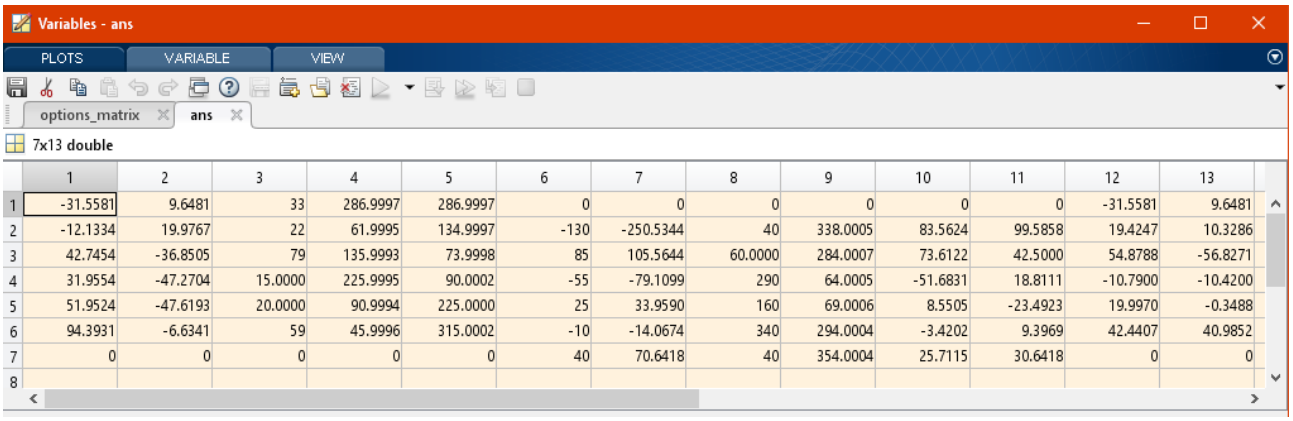
Click here to change absolute angels from Y clockwise based to X anti-clockwise where 0 deg is on the X axis and 90deg is '12oclock'.

Output the position map matrix to the Commnand Window. The position map will change Depending on certain processing like the rotation shown.

POSITION MAP DATA

If you supply a variable to lottievectors when you run it from the command line such as mymat=lottievectors() . Then the first position map will be stored in mymat.

You can open the position map from your main workspace using Matlabs(r) variable viewing tool by typing openvar and then the name of the variable, or clicking in it within the workspace browser. A typical position map opened within the variable editor is shown below.



	1	2	3	4	5	6	7	8	9	10	11	12	13
1	-31.5581	9.6481	33	286.9997	286.9997	0	0	0	0	0	0	-31.5581	9.6481
2	-12.1334	19.9767	22	61.9995	134.9997	-130	-250.5344	40	338.0005	83.5624	99.5858	19.4247	10.3286
3	42.7454	-36.8505	79	135.9993	73.9998	85	105.5644	60.0000	284.0007	73.6122	42.5000	54.8788	-56.8271
4	31.9554	-47.2704	15.0000	225.9995	90.0002	-55	-79.1099	290	64.0005	-51.6831	18.8111	-10.7900	-10.4200
5	51.9524	-47.6193	20.0000	90.9994	225.0000	25	33.9590	160	69.0006	8.5505	-23.4923	19.9970	-0.3488
6	94.3931	-6.6341	59	45.9996	315.0002	-10	-14.0674	340	294.0004	-3.4202	9.3969	42.4407	40.9852
7	0	0	0	0	0	40	70.6418	40	354.0004	25.7115	30.6418	0	0
8													

Lottie Vectors – Position Map (The Result Continued)

A typical position map seen through the command window is shown below.

```
position_map =
  Columns 1 through 10
  -31.5581    9.6481   33.0000  286.9997  286.9997         0         0         0         0         0
  -12.1334   19.9767   22.0000   61.9995  134.9997  -20.0000  -38.5437   40.0000  338.0005   12.8558
   42.7454  -36.8505   79.0000  135.9993   73.9998   85.0000  105.5644   60.0000  284.0007   73.6122
   31.9554  -47.2704   15.0000  225.9995   90.0002  -15.0000  -21.5754  290.0000   64.0005  -14.0954
   51.9524  -47.6193   20.0000   90.9994  225.0000   25.0000   33.9590  160.0000   69.0006    8.5505
   72.8131  -27.4740   29.0000   45.9996  315.0002   10.0000   14.0674  340.0000  294.0004   -3.4202
         0         0         0         0         0   30.0000   52.9813   40.0000  354.0004   19.2836
  Columns 11 through 13
         0  -31.5581    9.6481
   15.3209   19.4247   10.3286
   42.5000   54.8788  -56.8271
    5.1303  -10.7900  -10.4200
  -23.4923   19.9970   -0.3488
    9.3969   20.8607   20.1452
   22.9813         0         0
```

If you process data later on within the program you'll neen to save it from there. However you can also use the save startup prefs to store all your changes, quit the program, then run again as mymat=lottievectors() and the program will perform your processing and store the results in mymat.

HOW POSITION MAP DATA IS FORMATTED

Shown below are the columns in the matrix and their meanings. If you don't have any force vectors then lottievectors automatically removes them so you end up with a 6 column matrix instead of a 13. The force vectors are easy to tell apart from the position vectors as they all start one row below the position vectors and so have zeros on the first row for their columns.

- Column 1 : Position X Coordinate
  Column 2 : Position Y Coordinate
- Column 3 : Position Magnitude
- Column 4 : Position Degree Absolute (Where 0 degree is x=x y=+inf)
  Column 5 : Position Degree Relative (Where 0 degree is direction of last heading)

Column 6 : Force Magnitude Absolute
Column 7 : Force Magnitude Relative (Relative to force's direction with last heading and position magnitude)

Column 8 : Force Degree Absolute (Where 0 degree is x=x y=+inf)
Column 9 : Force Degree Relative (Where 0 degree is direction of last heading)

Column 10 : Position to Force vector tip X Coordinate
Column 11 : Position to Force vector tip Y Coordinate

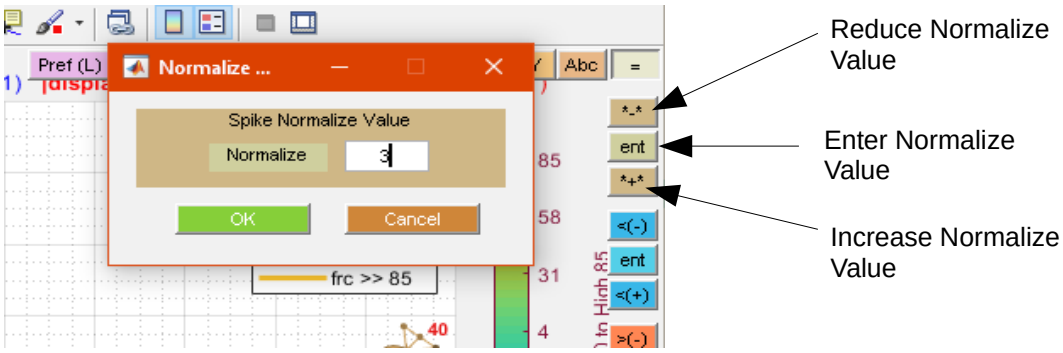
Column 12 : Position relative X Coordinate (relative from the last position)
Column 13 : Position relative Y Coordinate (relative from the last position)

Lottie Vectors – Data Processing / Smoothing Spikes

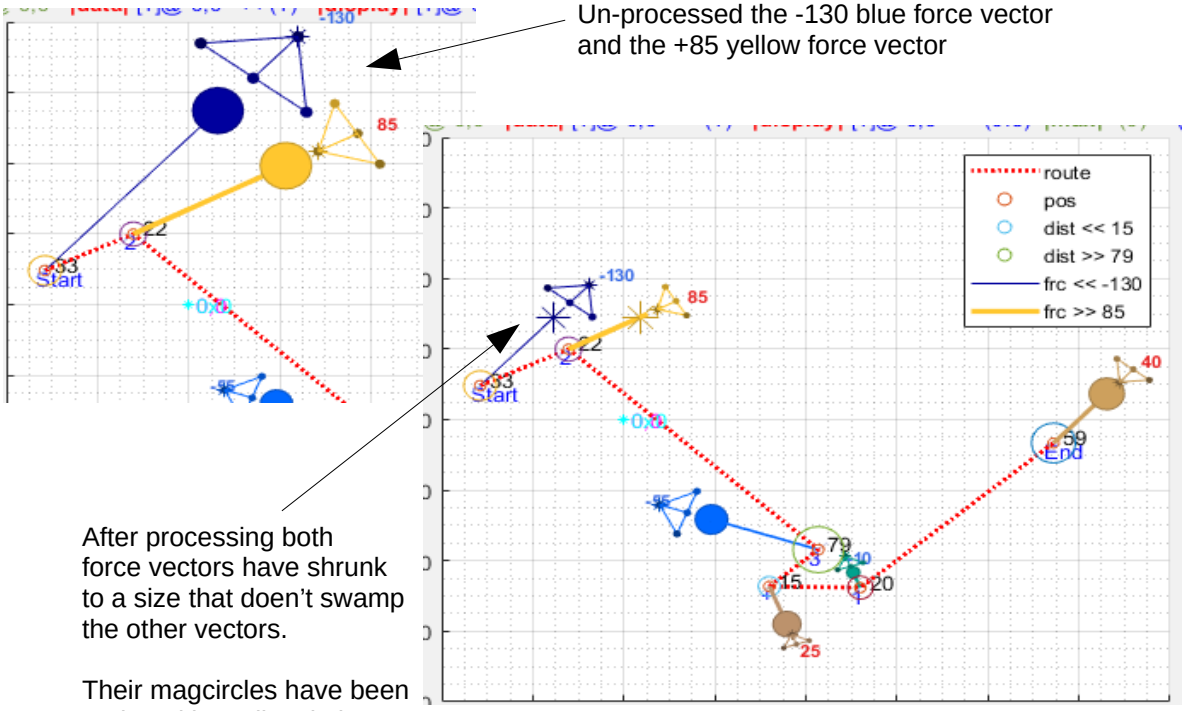
If you have a vector data where the majority of the force data is within a small range, but you have a few points where the magnitudes are much higher or lower. These kind forces can take up most of the display, making it harder to see trends in the rest of the data.

No fear ! Lottie Vectors has a handful of processing devices you can apply to your data directly from the window. Allowing you to smooth off the peaks and troughs and along with the other controls to explore and go deep !

Normalizing trims off spikes from the top and bottom of the dataset starting with the largest. The value is the actual number of spikes to cut. Even if the spike isn't really a spike, normalize will go on until the value is reached.

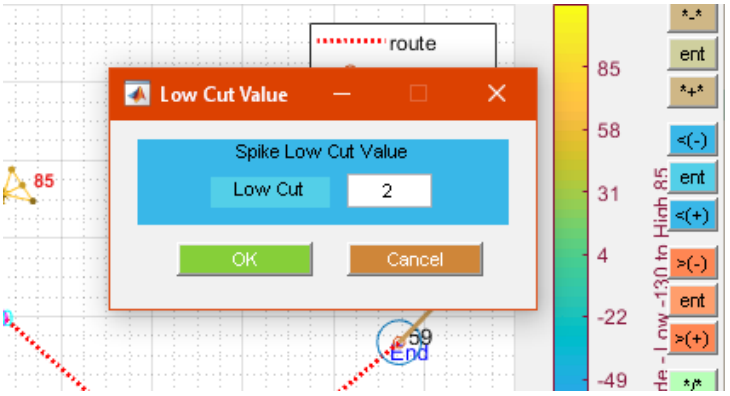


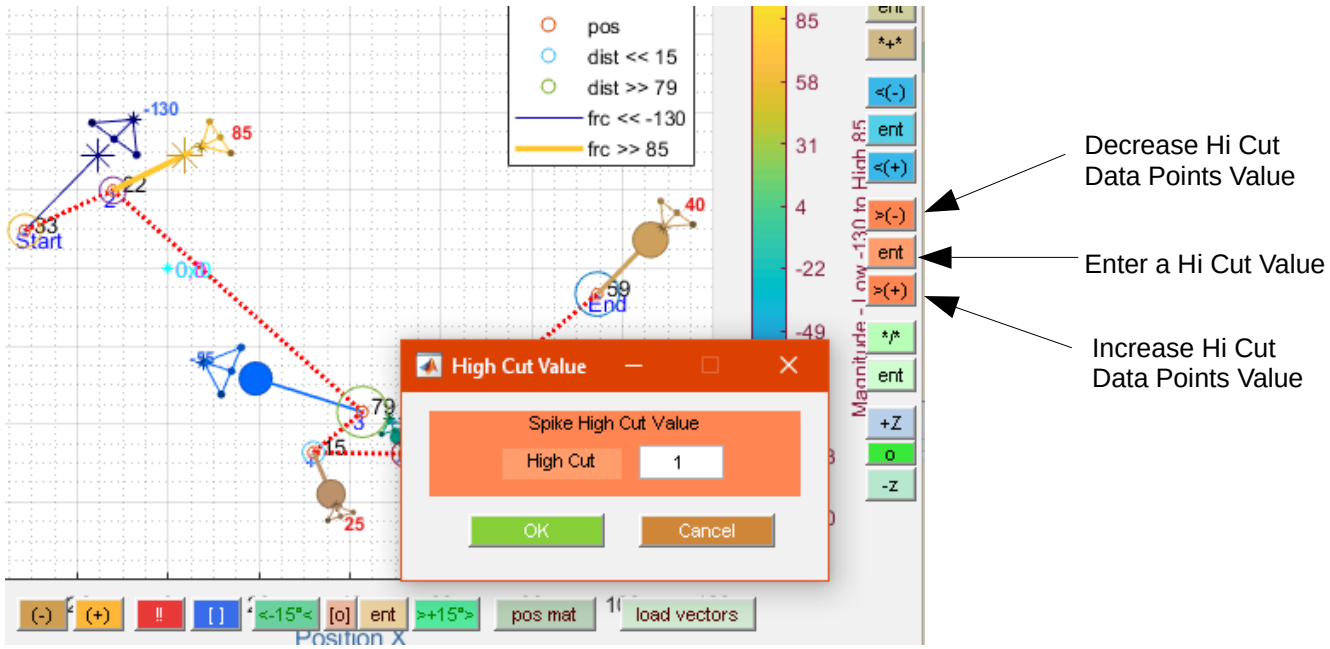
The results of methods of cutting is to remove the spike, keeping it's displayed magnitude, but giving it the length of the next greatest force vector.



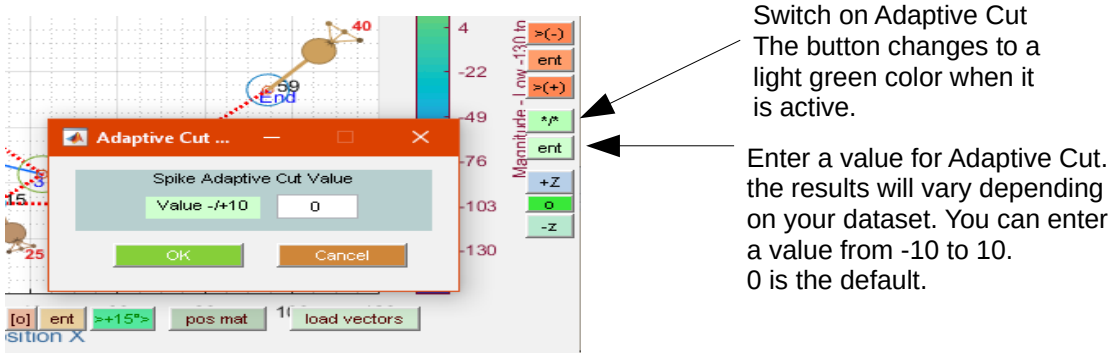
Lottie Vectors – Data Processing / Smoothing Spikes Continued

Hi and Low cutting removes data points 'manually' from the top end (Hi) or the low end (Low) of the dataset.





You can combine all of the methods together. The order of processing is Normalize, Low Cut, High Cut and then the final Adaptive Cut, which is a more automatic method shown next.



Adaptive tries to 'guess' where the spikes are in your dataset. It's in it's first version here, but it can still be useful and is included in this version.

Lottie Vectors – That's NOT All Folks !

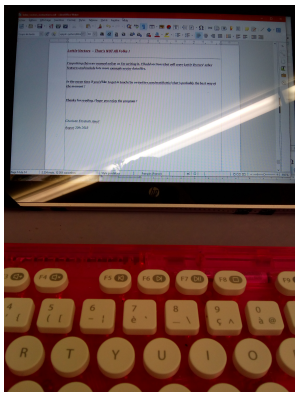
(Written for version 1.12 of the program)

I'm putting this user manual online as I'm writing it. I'll add sections that will cover Lottie Vectors' other features and include lots more example vector data files.

There is a wiki at github.com/lottiemath/lottie_vectors/wiki I'm keeping that up to date with things which are more release / bugs (bugs?! I feel now for people writing programs as now I realize the effort it takes between adding things / making more problems and figuring when to release . With version 1.12 however if you don't have it or at least that version if this is an old PDF then download a new version now. The first ones had more bugs than… somewhere with a lot of bugs :)

In the mean time if you'd like to get in touch I'm on twitter.com/mathlottie/ that's probably the best way at the moment !

Thanks for reading, I hope you enjoy the program !



Charlotte Élisabeth Ameil

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