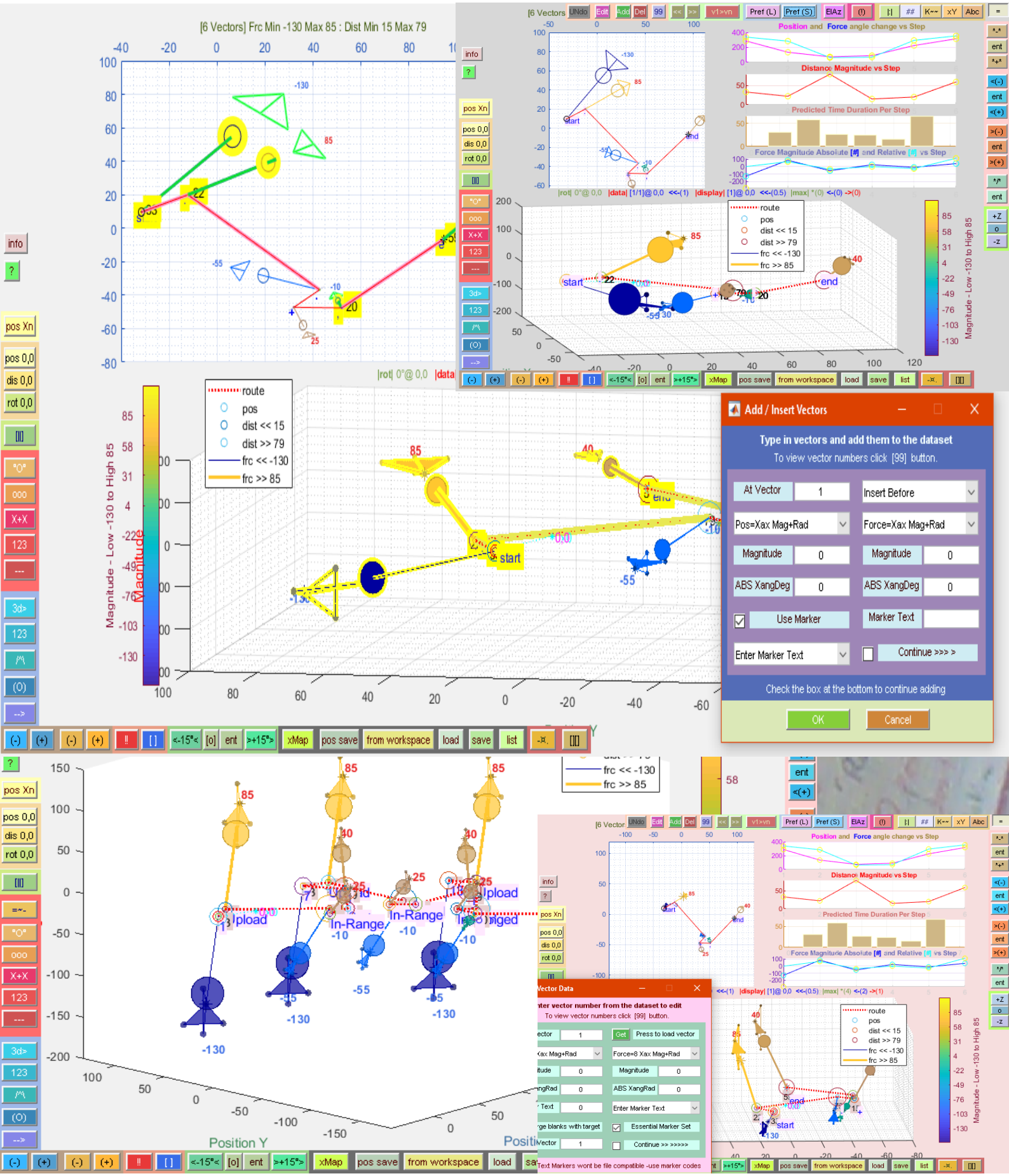
Lottie Vectors (manual for version 2.0)

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



« Manual For Version 2.0 »

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Cover Illustration – collage or screenshots taken from Lottie Vectors 2.0, some during development.

Preference

The use of vectors in mathematics spans the sciences including mechanics, fuild dynamics, electromagnetism and transportion. They find their uses as a clear way to describe many quantities and ideas such as fields that would otherwise perhaps lurk behind complicated obstuse equations. It's much easier to 'see' something visual like a vector field, or a map and different information can be discovered with the whole picture.

This software aims to provide a means to visualize vectors, both position vectors and force vectors in a clear and easy to manipulate way. It uses the MatLab(r) platform, and prodives it's main output through a figure window. Version 2.x takes on 2 dimensional vector datasets in a common simple format, that lends itself to be transfered over email or even text messages! You'll hopefully find that with 8 different types of 'vector' each of those 8 can be either a force or position vector, there are a good number of choices for your datasets.

With version 2.x you now also have the chance to add and edit vectors from within the window. Clicking on the buttons at the top of the screen open two different windows that allow you to input vectors from drop down boxes. The format they use is the same as the files and variables used by the software. It may take a little time to get used to the format, but you really need an understanding of it to make the most of the features.

The manual is being produced alongside the release of 2.x, as this is available online errors / additions will be made later and an expanded manual produced as time allows.

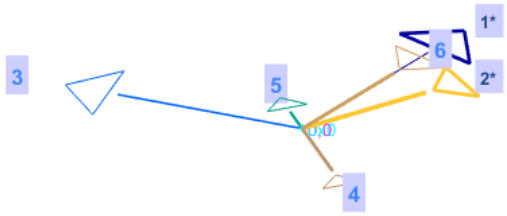
Thankyou for trying out Lottie Vectors, I hope you enjoy the sofware as much as I did in writing it. Which, by the way, I did!

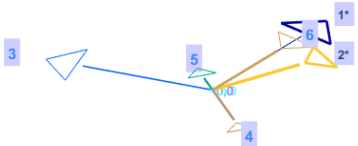
May the force vectors be with you!

Charlotte Élisabeth Ameil
October 17th 2018, UoE

Lottie Vectors 2.0 User Manual

Table of Contents





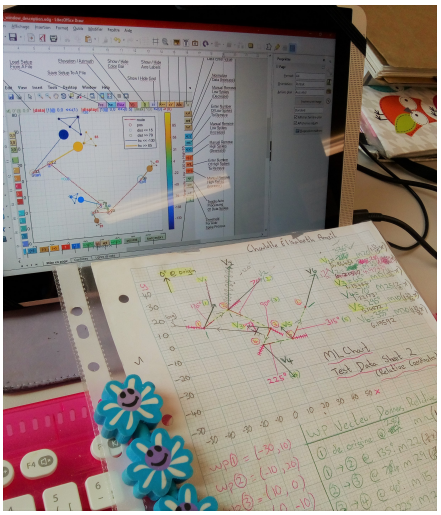
What Is Lottie Vectors?

Hello there and welcome to the Version 2.0 manual which at the moment is a work in progress but now that I have got 2.0 the program out there on the internet, I can get back to completing it's manual!

This manual though it has begun to have new content for 2.0 still has a few old screen shots and things from the 1.x versions. This will all get fixed soon. I'm going to focus though on adding the new sections for those features that weren't in the previous versions.

There's quite a lot to do ! I hope that the software is proving useful and thanks again for trying Lottie Vectors !

Charlotte Élisabeth Ameil – October 2018



twitter.com/mathlottie

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

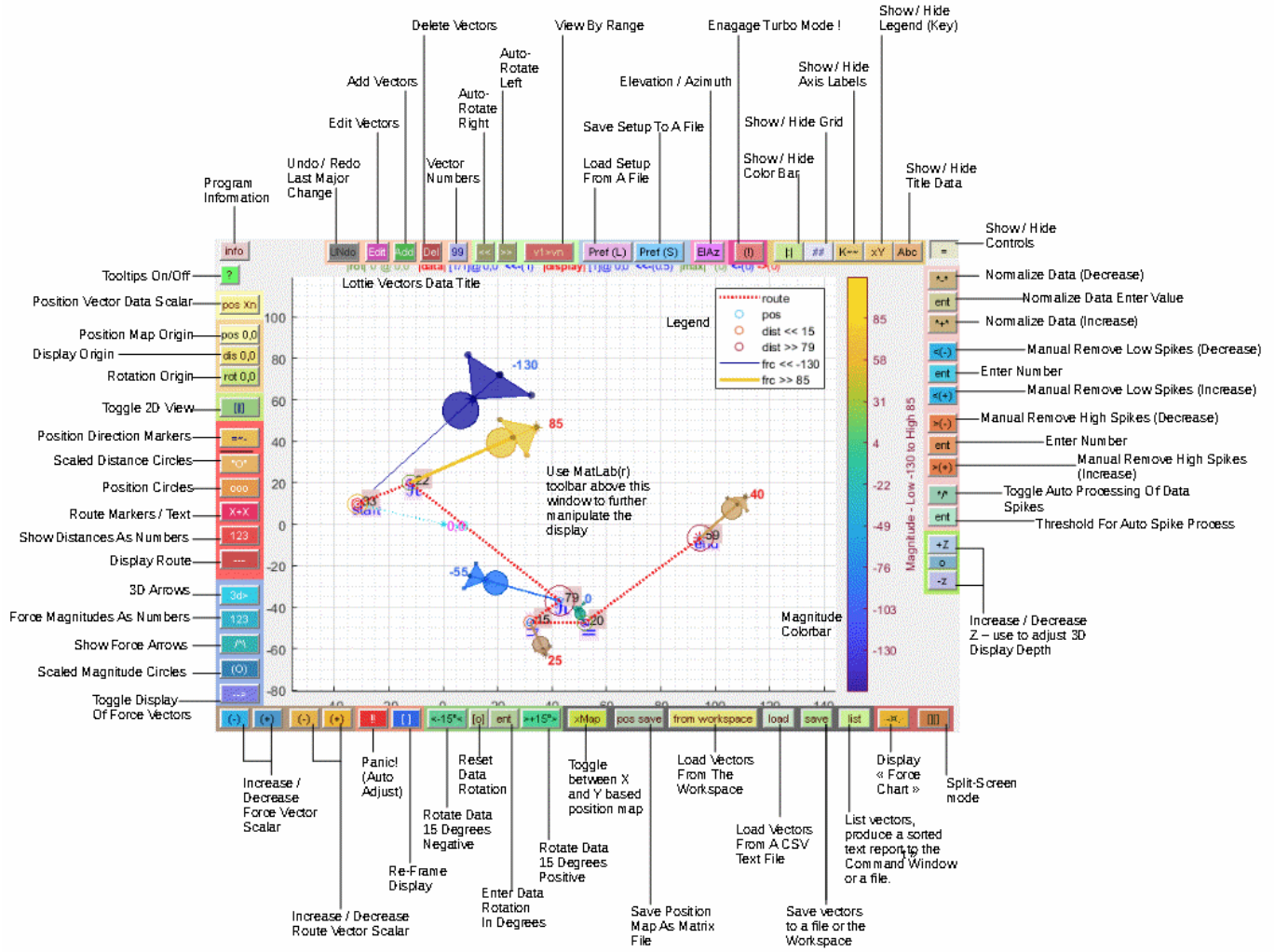
https://github.com/lottiemath/lottie_vectors

or

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

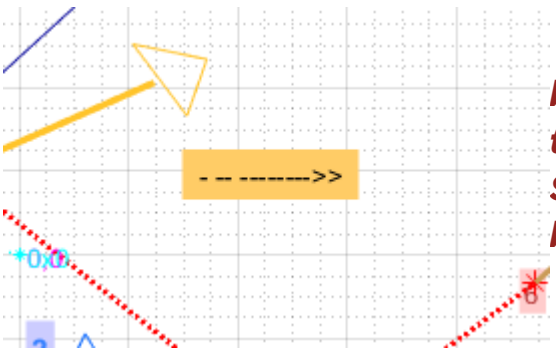
Lottie Vectors – Quick Tour Summary of Main Window Controls

The Main Window Buttons



Some buttons have changeable colors which become different when it's options are active. When a button is selected and it's window is displayed you must close that window before continuing in the main figure window.

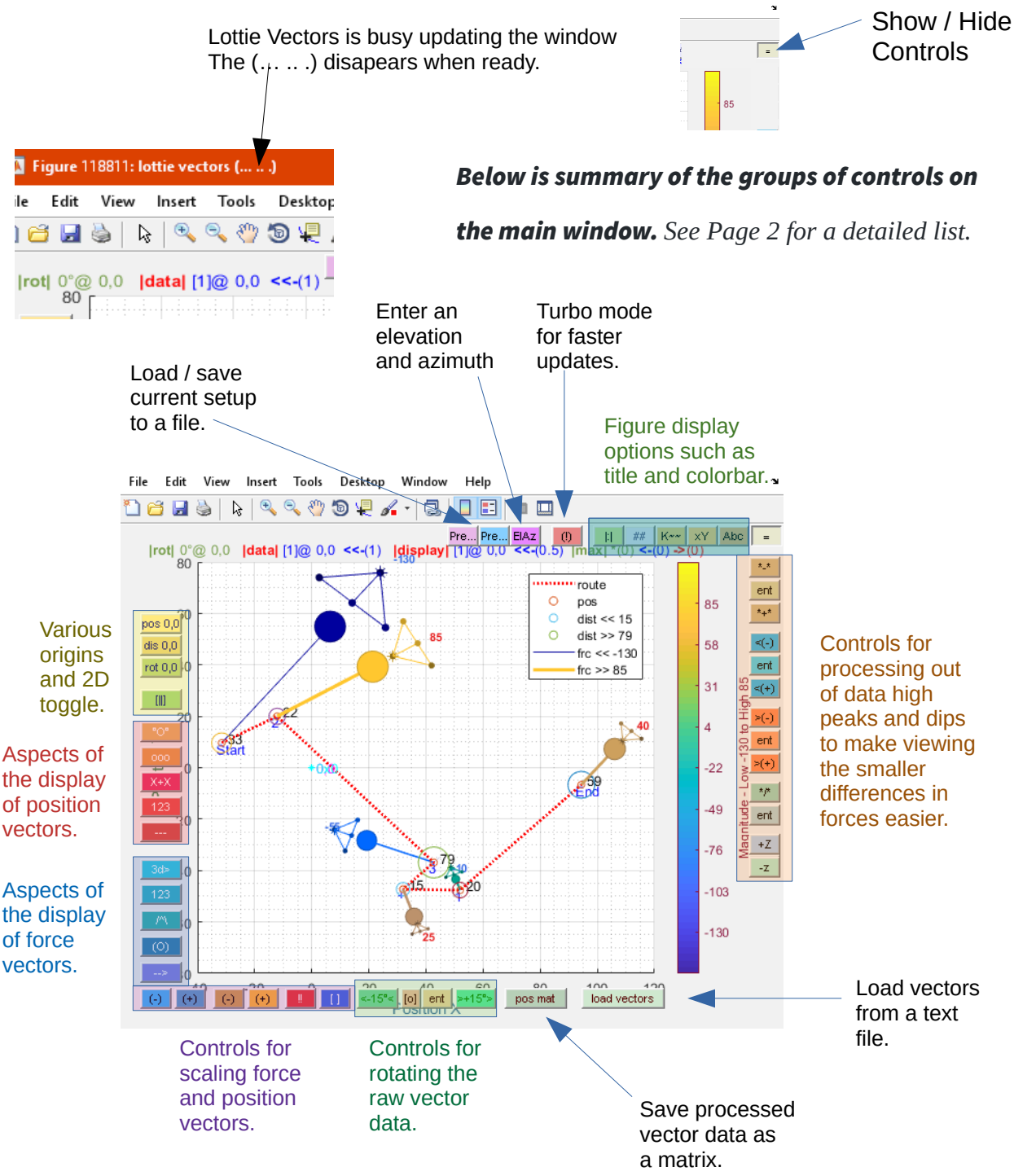
You may have to resize the figure window to see all the buttons.



Whenever Lottie Vecctors is busy the border of the window will change color and this arrow is displayed on the screen. TIP : Speed things up by clicking on the Turbo button.

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.

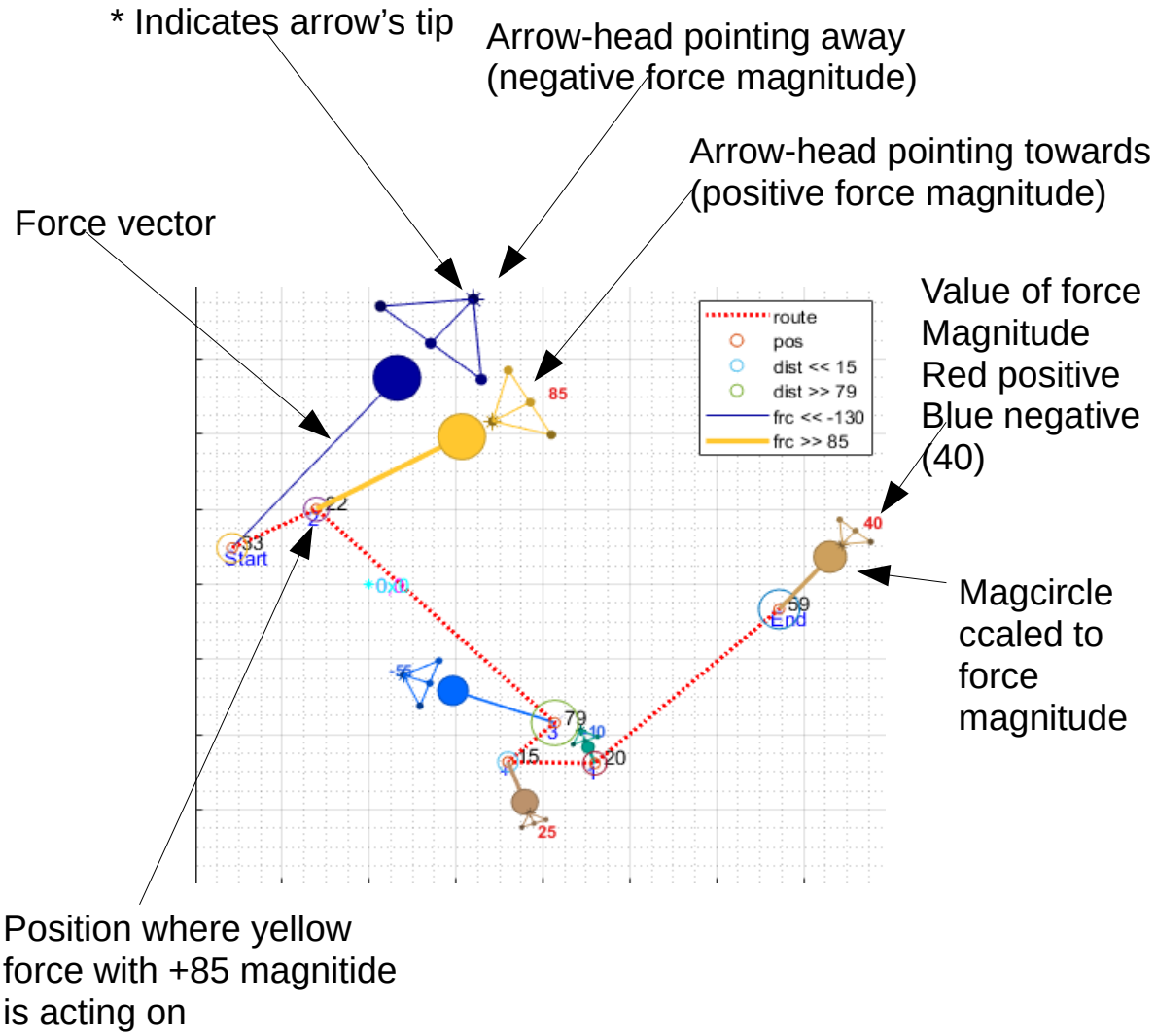


Lottie Vectors – Quick Tour Displaying Forces

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.

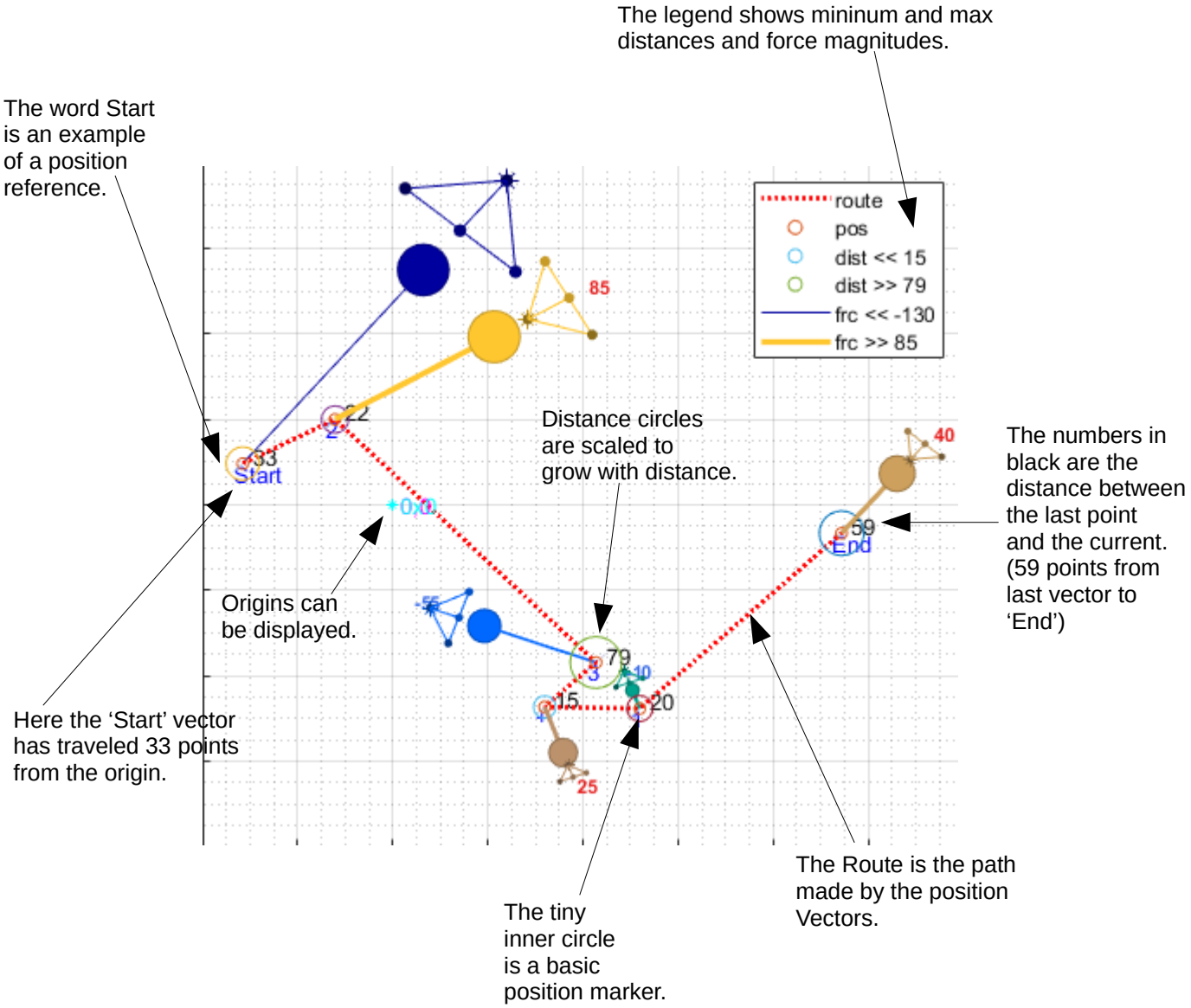
Below shows how force vectors are displayed



Lottie Vectors – Quick Tour Displaying Positions

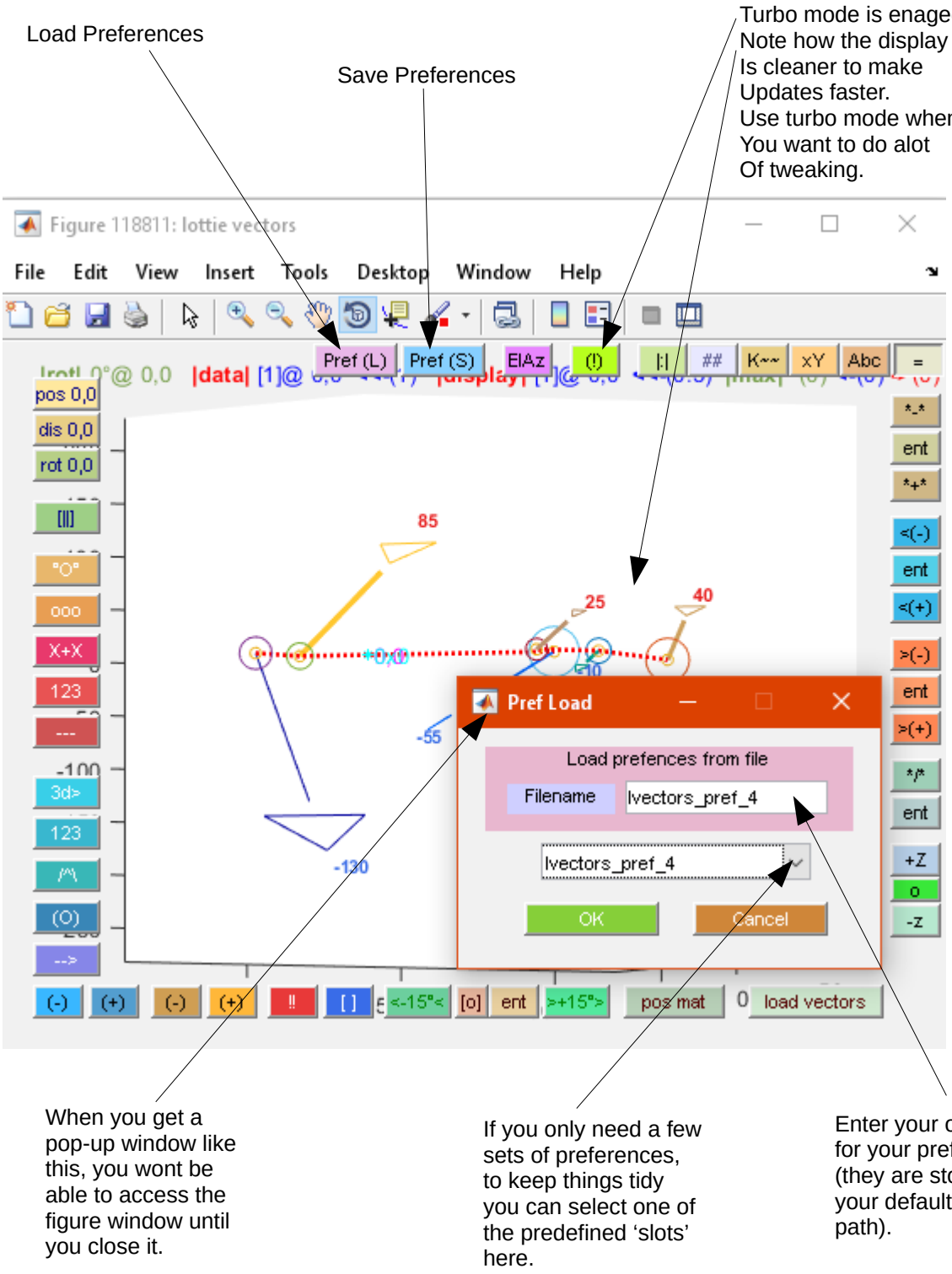
The positions can be displayed and a route mapped, or you can switch off the route leaving something like a vector field with only forces displayed from various positions. I tried to keep the program as flexible as possible so you could end up with some strange combinations !

Below shows how Positions are displayed in the figure window.



Lottie Vectors – Preferences

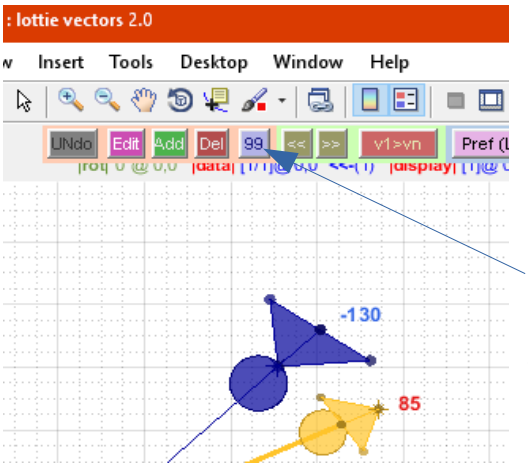
When you have tweaked the display for your vector data you can save the setup in a file and recall it later. You can have multple files with different preferences which can be loaded in on the main window.



Lottie Vectors – Some Ways Of Viewing Vectors

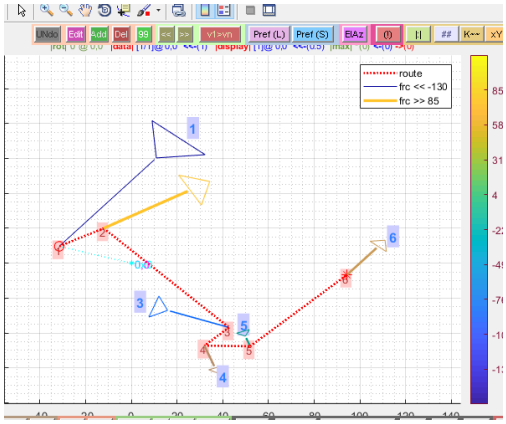
In this section I'll be giving you more of the quick tour of the buttons and features in Version 2.0 that affect the display of your datasets. We'll be using the built-in set throughout this.

Vectors are stored by their unique number, it's used to edit, delete, copy or view them within ranges. To their numbers will only change when you insert or delete. Simply they are numbered from 1 being the first, or start vector within a route through to the last one in the dataset. Each vector number is assigned to a unique combination of postition, force and marker. You can switch the view to show the vector numbers of the built-in dataset by pressing the 99 button.

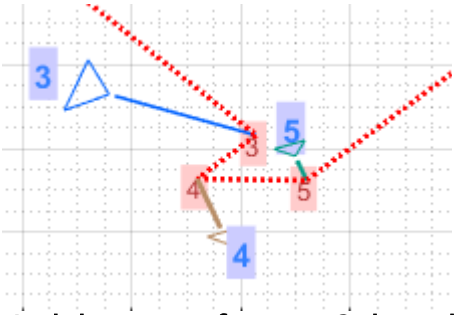


View vectors by their vector numbers (Green is active)

(2) Once pressed the window will update and you'll see the vector numbers, red for the positions, and blue for the forces.



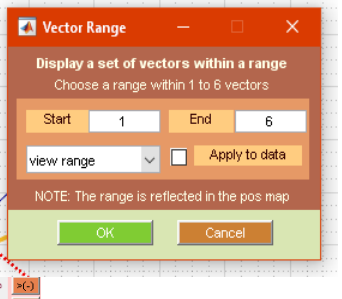
(3) Below we have forces (3,4,5) and positions (3,4,5). The vector number refers to the pair.



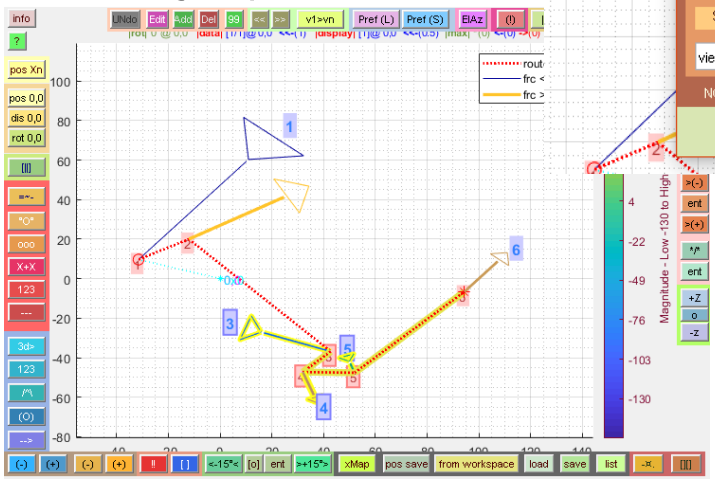
(4) Now that we have the vector numbers on the display we can use them to set a range, click on the range button below to bring it up.

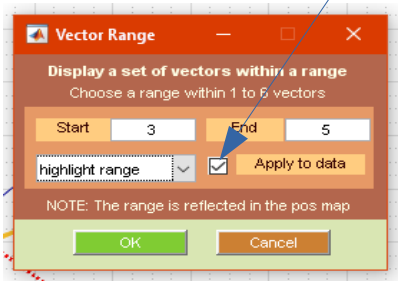
(5) Enter 3 in the Start box, 5 in the End box, and next click on the drop-down menu and scroll down to select 'highlight range'.

Don't forget to check the 'apply to data' box.



(6)... And the range of vectors 3 through 5 is highlighted. TIP : you can also use highlighting with text listings of your vectors.



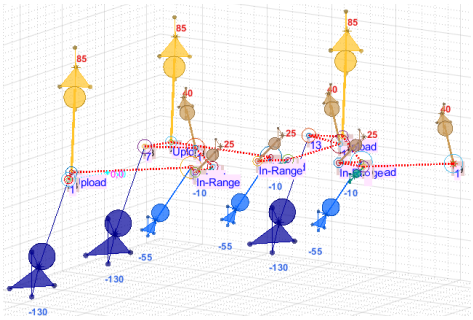


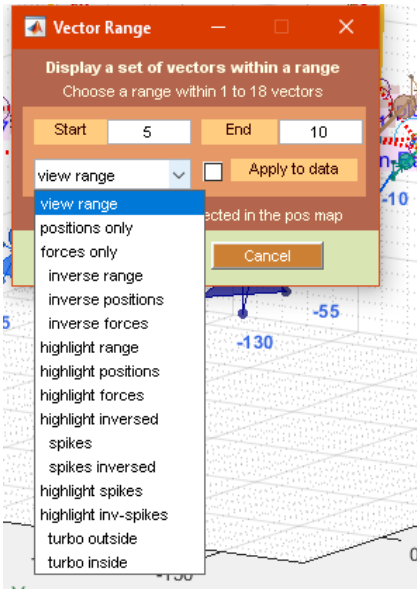
Lottie Vectors – Using Ranges

Now we've tried out the Range button, lets go further and see more about what it can do.

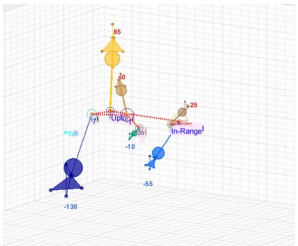
Ranges are great when you need to seperate certain vectors through highlighting or perhaps to only display a subset. There are ranges in other functions, but eah one is unique and Lottie Vectors remembers your settings (unless you want it to forget them, more on that in the expanded preferences section).

The original dataset with 18 vectors.
The dataset remains untouched throughout the following examples. Unhecking the 'apply to data' brings everything back.



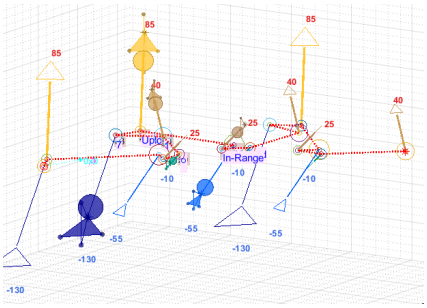


There are a number of different sort options for the Range function. The most simplest is shown below.

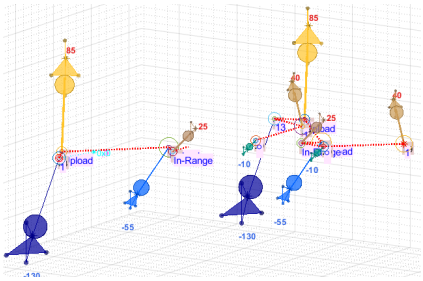


Only vectors 5 to 10 are displayed.

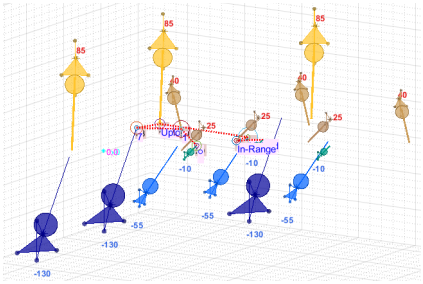
Right is an example of using Turbo in a range. Here of 18 vectors 5 to 10 where seleted as 'Turbo Outside', So vectors 1–4 and 11–18 were drawn with less detail. Use this function to speed up displays, but keep the data you're interested in fully drawn.



Again the same dataset and range setting (5 to 10), but this time the 'Inversed Range' was selected. Note how there is a gap in the middle, the dataset has been split effectively into two. Inversed range only drew the vectors outside, the entire dataset is still in place.



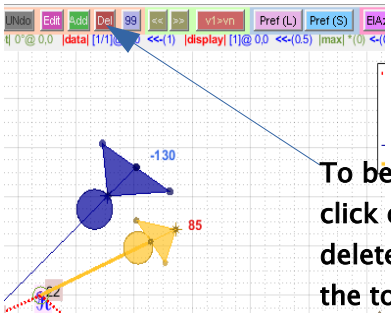
On the right shows the results of the range 'Inversed Forces'. This has only drawn the force vectors from 1 to 4 and 11 to 18, while in the center the red route can been seen where it's been drawn along with the force vectors from 5 to 10.



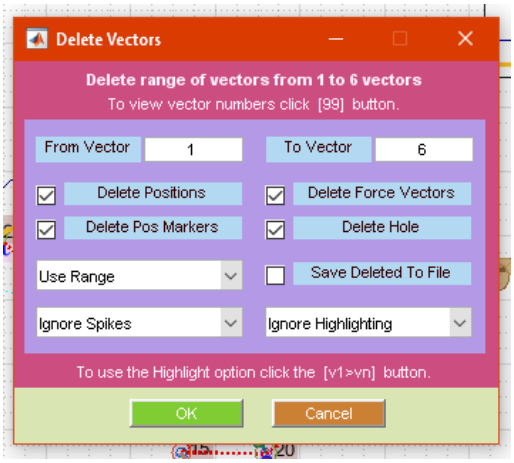
Lottie Vectors – Deleting Vectors

We're going to look at deleting vectors before we start to edit and add them, as you only need to know the vector's number to delete it. Also many of the principles of deleting are good for adding and editing vectors.

We're going to be using the built-in vector set in this example.



To begin with click on the 'del' delete button at the top of the window.



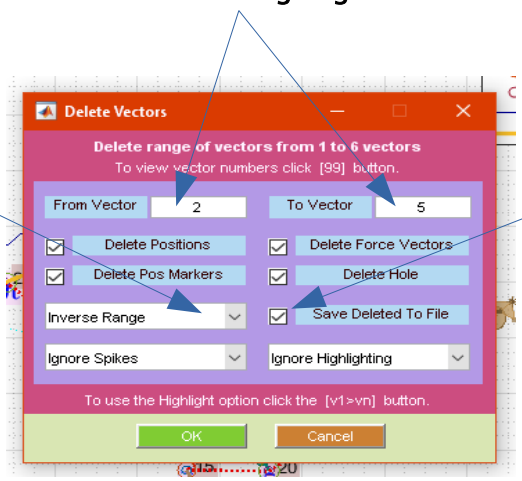
This brings up the Delete Vectors window. If you're using the default dataset, it should look pretty much the same.

It has a range, just like the Range function but like other's it's independent of it.

We'll be deleting the 1st and last vectors and then saving them to a file. Sounds complicated ? No it's all done in a single step with the use of the options in the Delete Vectors window.

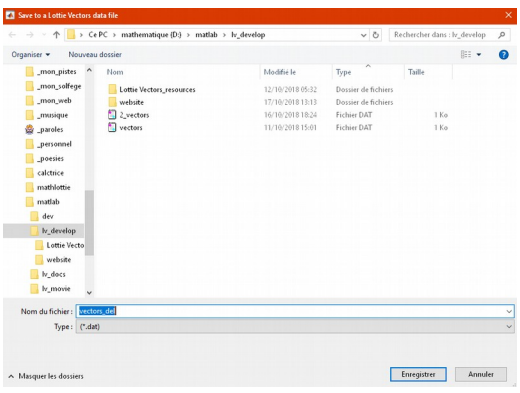
Normally we'd need to know the vector number, but the range is indicated on the top line as 1 to 6 and we only need to delete the 1st and Last. We going to use an Inverse Range so enter 2 and 5 in the boxes.

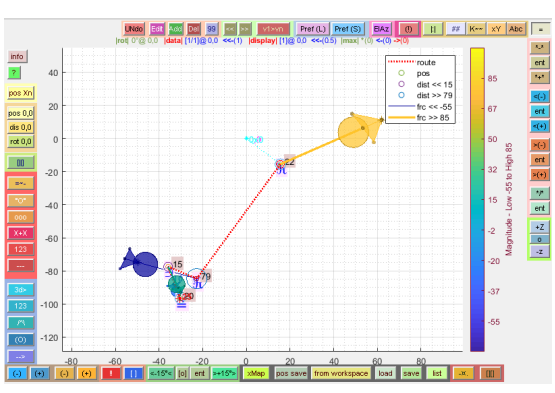
Open the dropdown menu and select 'Inverse Range'. Instead of deleting 2 to 5, this has selected 1 and 6 to be deleted.



Click on here and we'll have the chance to store the vectors we deleted to a file later.

After clicking on the OK button above, you'll see a save vectors file window pop up. Depending on your computer it may take a couple of seconds to appear. Choose a location and save the default file.





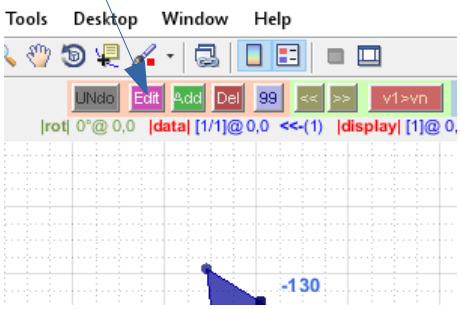
After you've saved your vector file the dataset is reloaded now with the first and last vectors gone.

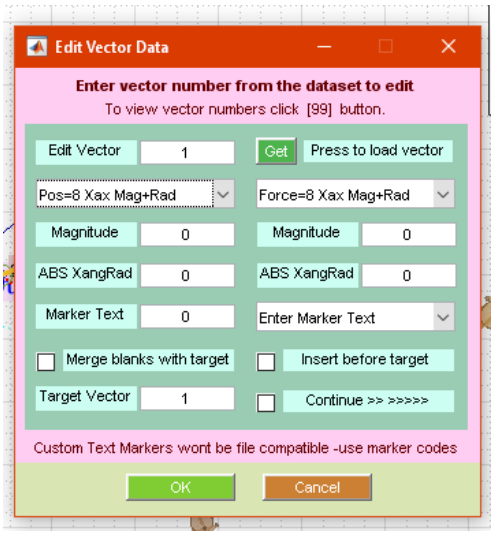
If you'd like to see the other vectors read the section on loading.

Lottie Vectors – Editing Vectors

Making changes to a dataset while loaded in Lottie Vectors is also new in version 2.x, here will be looking at the familiar default vector set, and making it less so by putting in some changes of our own !

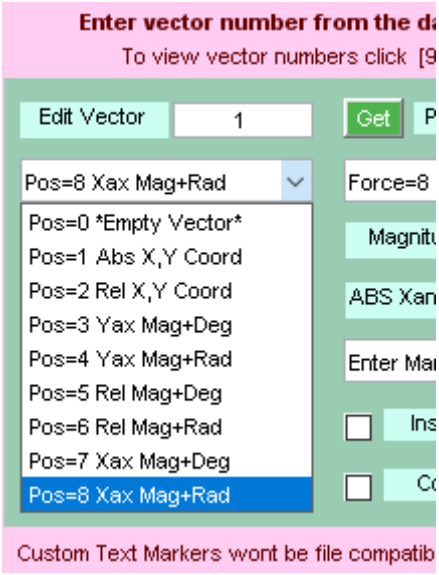
To get started, bring up the Edit Vectors window by clicking on it's button at the top of the window.





The Edit Vector Data window has a number of options and fields. Though it may look complicated, it's not much of a puzzle !

The 8 boxes in the middle are all just the same vector data as in a file. The top box is the vector you want to Get information from, the bottom is the Target you want to store to. By default it makes the Target the same.



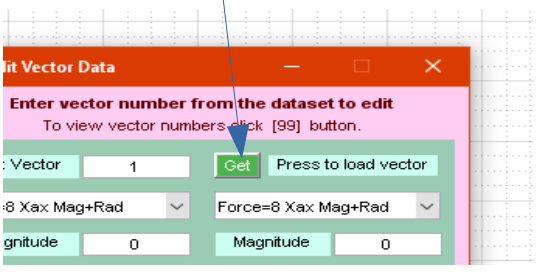
The two dropdown menus at the top have lists of all the possible vector types you can choose from. One set for the position vector on the left and the other for the force vector. You can also create an 'Empty vector', no forces, no position, or neither for that number. This is handy if you want to change a vector in a dataset a number of times in the same place. Leave it blank !

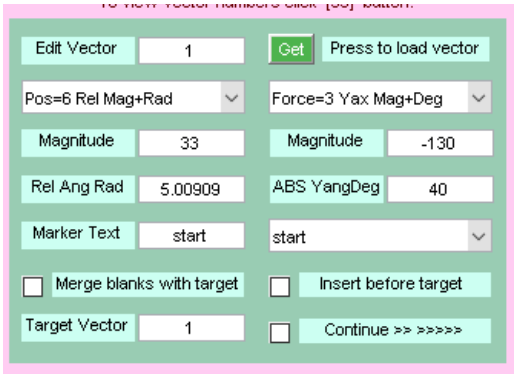
MEMO : (Vector Types)

0 = Empty
1 = Absolute Cart X/Y Co-ords
2 = Relative Cart X/Y Co-ords
3 =Absolute Y-Axis Degrees
4 =Absolute Y-Axis Radians
5 = Relative Degrees
6 = Relative Radians
7 =Absolute X-Axis Degrees
8 =Absolute X-Axis Radians

Tip : Use the preferences to save your favorite vector types in your startup preferences.

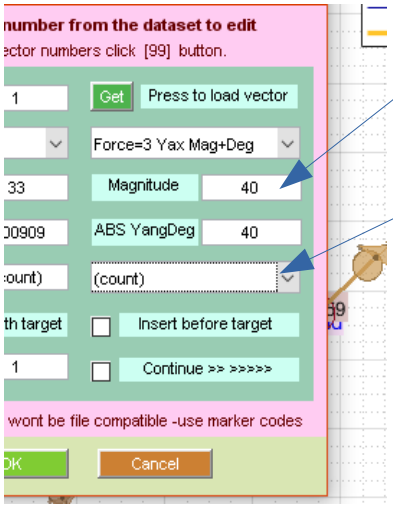
As 1 is in the top Vector box we can 'get' it's information by pressing the button. When you do all the boxes are filled out with it's data.





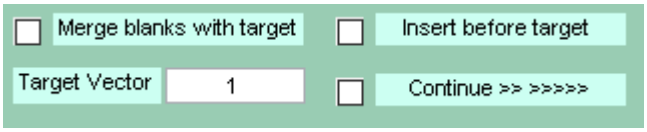
You can see now this vector's data. We're going to change the -130 force magnitude to 40 and change the marker text to a count. There are two types of count one that counts fom start to end, and count B which resets when you don't use it.

Lottie Vectors – Editing Vectors (continued)



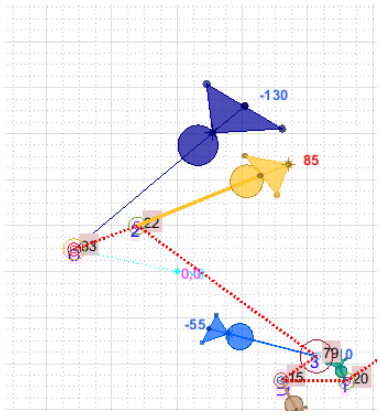
Enter the new 40 magnitude for the force vector here.

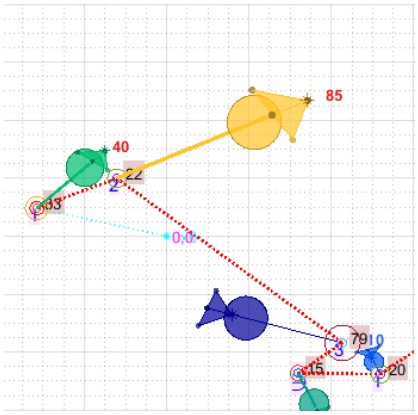
Click on the dropdown menu and select (count) from the list.



These options are all about where the vector will be stored. By default, the target is the same as the vector you Get. Inserting before the target will create a new vector adding it to the dataset. Merging will not overwrite any blank or '0' (zero) value fields with the target, keeping it's originals. While clicking on Continue will bring up a new window so you can go on editing after this one.

Here we have the dataset before the edit. The -130 is in blue.





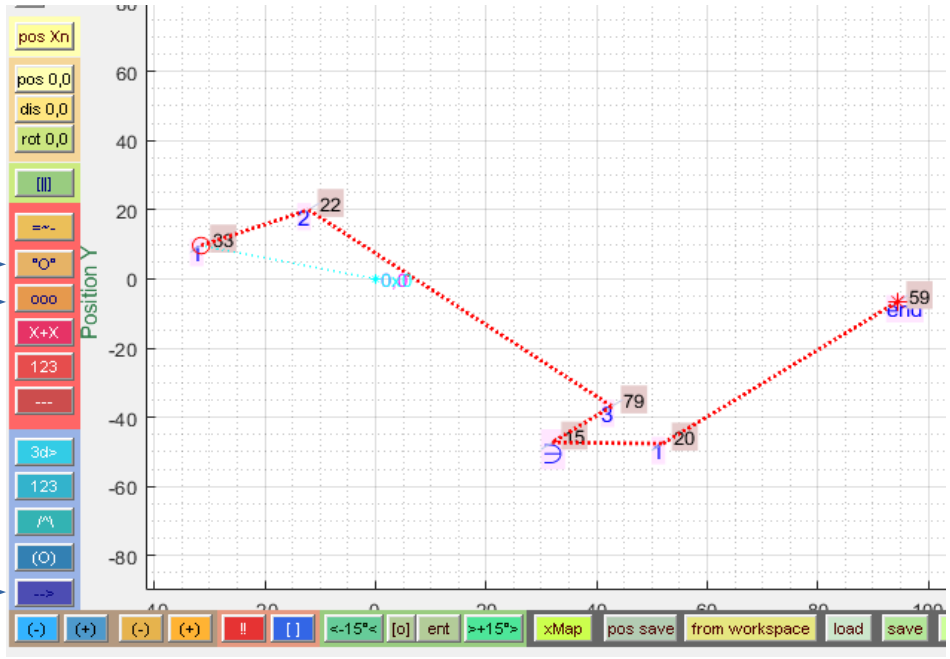
And this is the outcome to the dataset after the changes. Because of the reduction in the magnitude the force has now changed color from deep blue (because it was one of the lowest), to green. The arrow on it's end has also changed direction from pointing towards it, signifying a negative value, to pointing away because it is not positive 40.

The marker number '1' is just below the position circle in blue.

Here we have cleared away some of the clutter on the display so it's easier to view the position markers.

To do this we simply clicked on the 3 buttons with arrows.

Also shown on the display are the distance numbers in brown boxes. Remember they show the distance to their point. So the first vector's disctance is 33 from the origin.

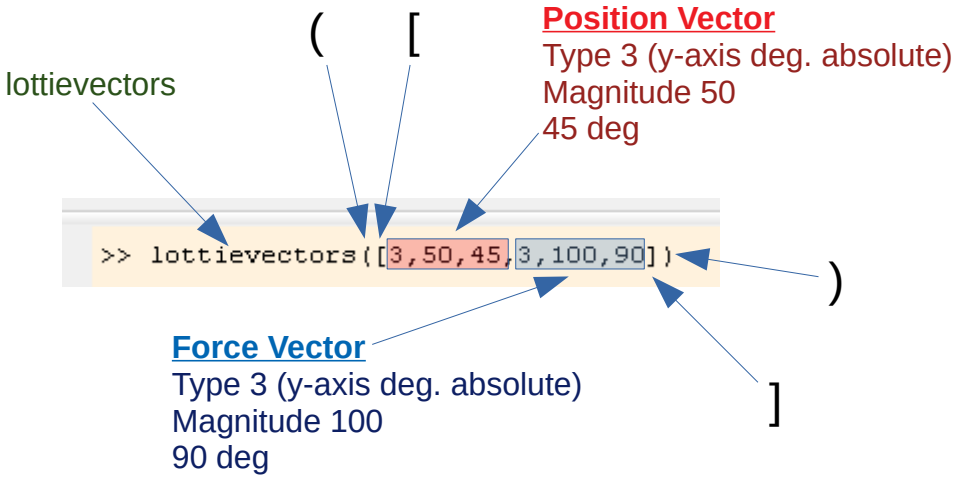


Lottie Vectors – Entering Vectors On The Command Line

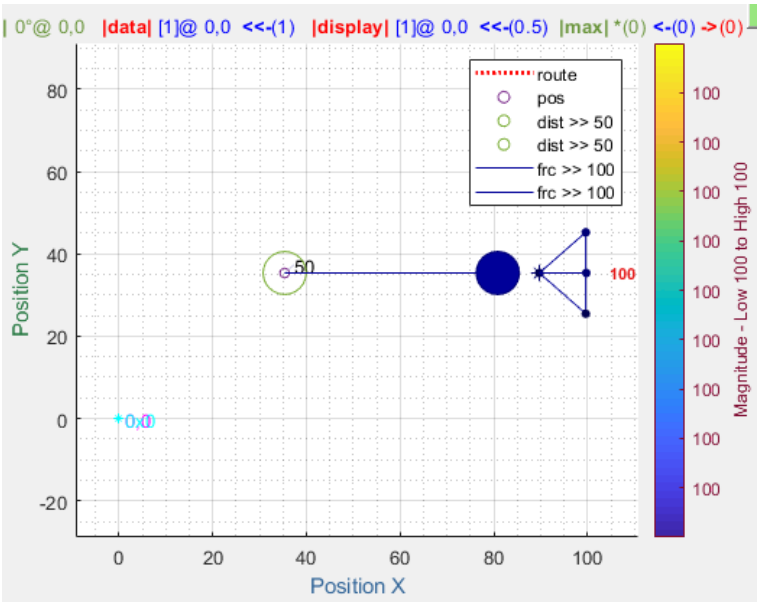
There are a few different ways to pass vectors to Lottie Vectors. You can do so at the command line, either as a variable or in [] notation. Or you can create a text file, give it a .dat extension and write your vectors in that.

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'

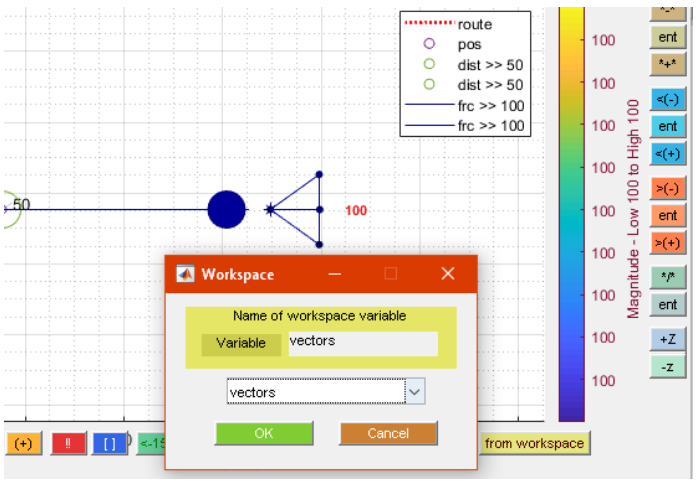
with the row 3,50,45,3,100,90

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.



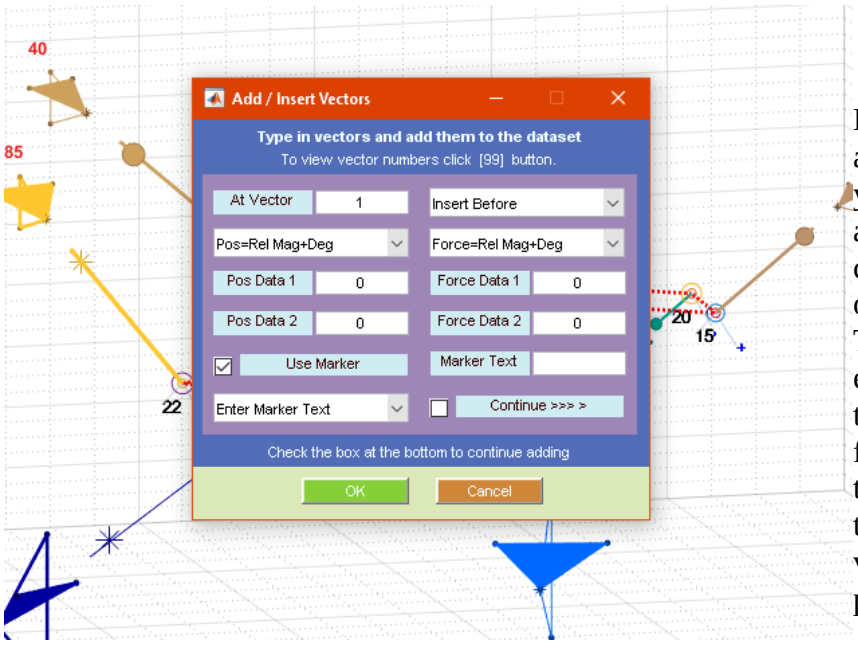
You can also load workspace variables from the main window by clicking on the 'from workspace ' button in mustard color at the bottom right of the display.

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 – Adding new vectors within the window

LottieVectors 2.0 represents a big improvement on the previous releases, with a lot more features and it being more stable. The largest change you'll notice though is the ability to add and edit vectors within the window.



By clicking on the buttons Edit and Add at the top of the display you can change current vectors, or add new ones to the dataset. This chapter is all about creating your own vectors and saving them. There are many different ways to enter vectors into the program, but they all have the same basic format and structure. This holds true if you are entering them on the command line, through a variable, a file, or within the program itself.

If you're not familiar with a lottie veector one is shown below

```
6  20  300  6  50  90
```

It's a repeating format that uses numbers and spaces within a text file. Each line is a new vector. A vector in LottieVectors can be a 3 part thing, and these are a position, a force and a marker. No text is allowed in the files, which are standard CSV format and are easy to transfer via email or messages. Don't get these files confused with Listings, those are looked at in another chapter.

When entering vectors within the program, the display will update on each vector you add or edit. It's recommended that you set Turbo mode to on for a faster responce. You might also like to click on the [99] 

button which enables you to see the vector numbers on screen. Use these vector numbers to choose either the vector to edit, or the point within the dataset you want to add new vectors at.

You can also make use of Ranges and Highlighting which you may find helpful in keeping track of where you are in the process of editing. Features such as the List button also give you more information in a text format about the dataset, as well as an easy to read table of whats currently there. You can save listings as a text file, use a notepad like utility to display the file onscreen while editing.

Finally make use of the display schnauzer buttons around the edge of the window to keep down the clutter on the display and show just what you need. Zooms are automatic when display within only a selected range, use this function to blow up a small area of your dataset to make viewing while editing easier.

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**

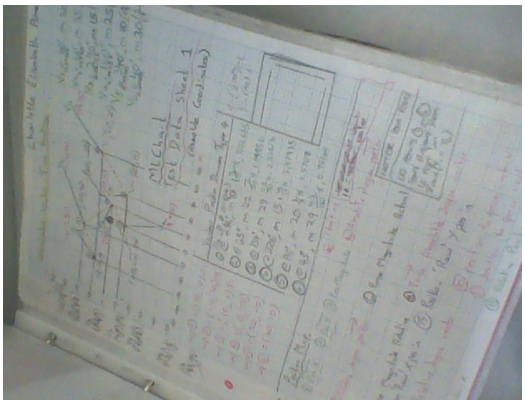
  1 Position vector type 2 Position vector data 1 3 Position vector data 2 4 Force vector type 5 Force vector data 1 6 Force vector data 2

- **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

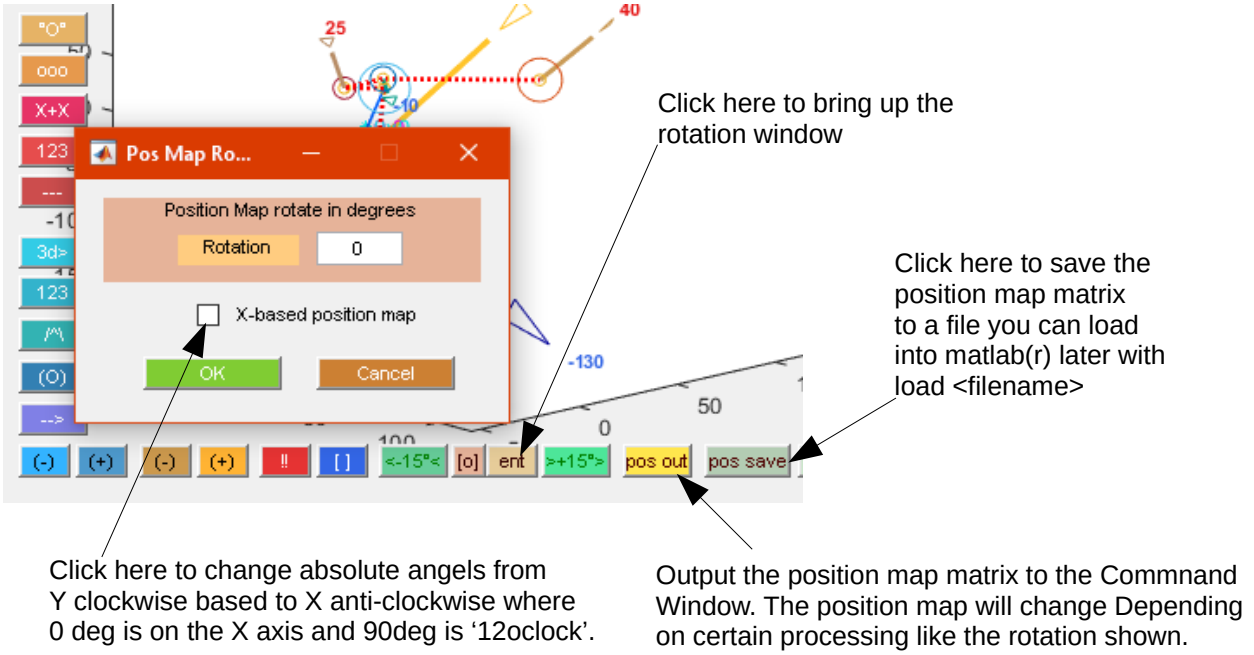
go to x=30, y=25
force of 100 points @ 90 deg
display the word 'Start'

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.

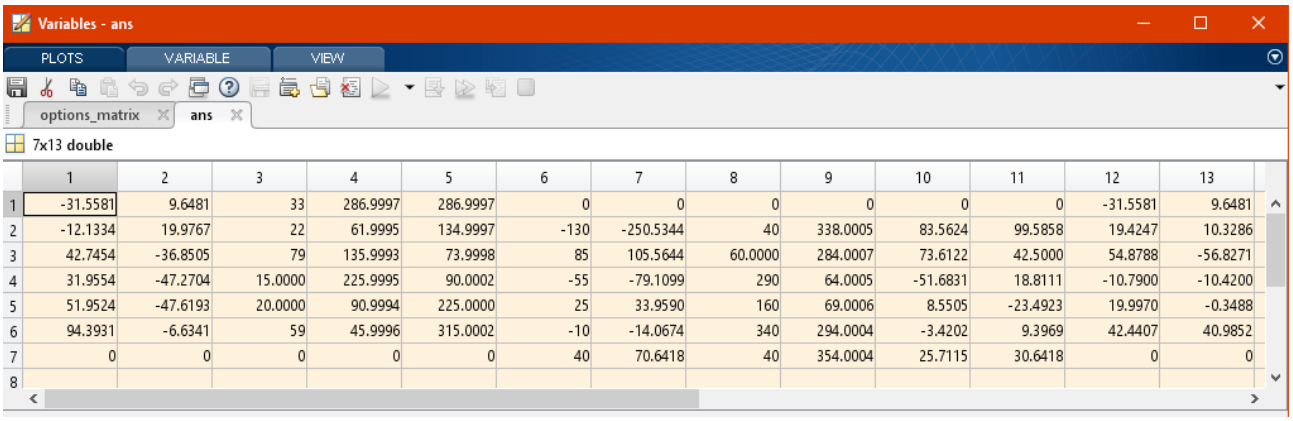
The data consists of cartesien coordinates of the vectors route, along with forces and copies of both sets of vectors magnitude and degrees. *The default for absolute angles is that they are read clockwise from the Y axis. You can change this by ticking the box on the rotate option.*



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

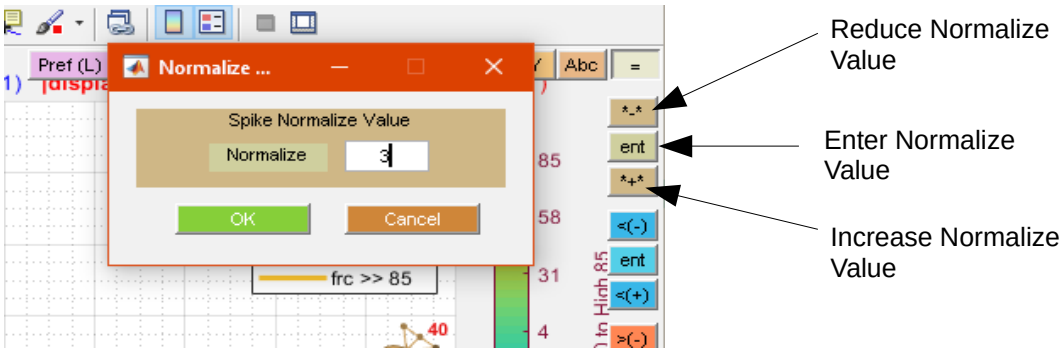
Column 12 : Position relative X Coordinate (relative from the last position)
Column 13 : Position relative Y Coordinate (relative from the last position)

Lottie Vectors – Data Processing / Smoothing Spikes

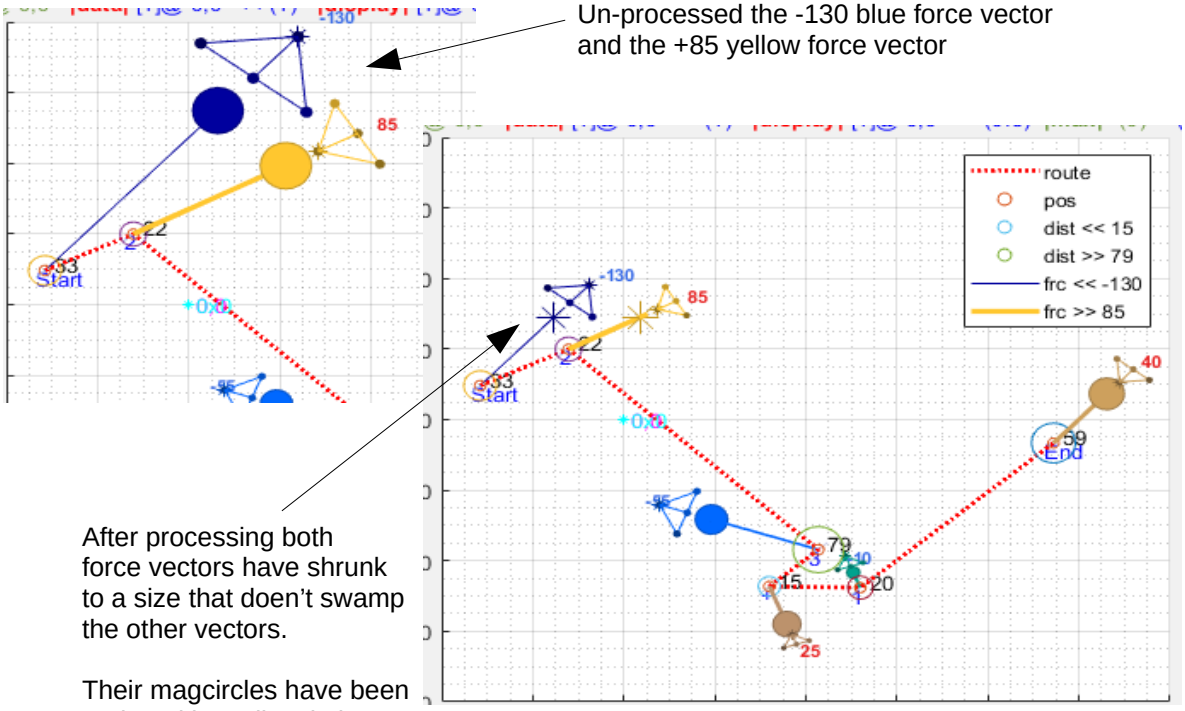
If you have a vector data where the majority of the force data is within a small range, but you have a few points where the magnitudes are much higher or lower. These kind forces can take up most of the display, making it harder to see trends in the rest of the data.

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.

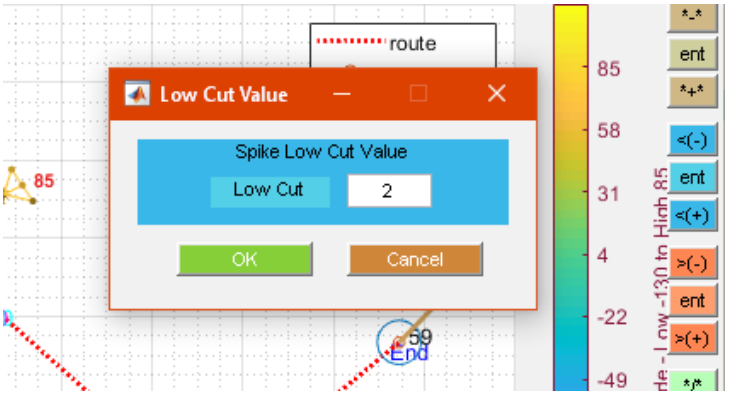


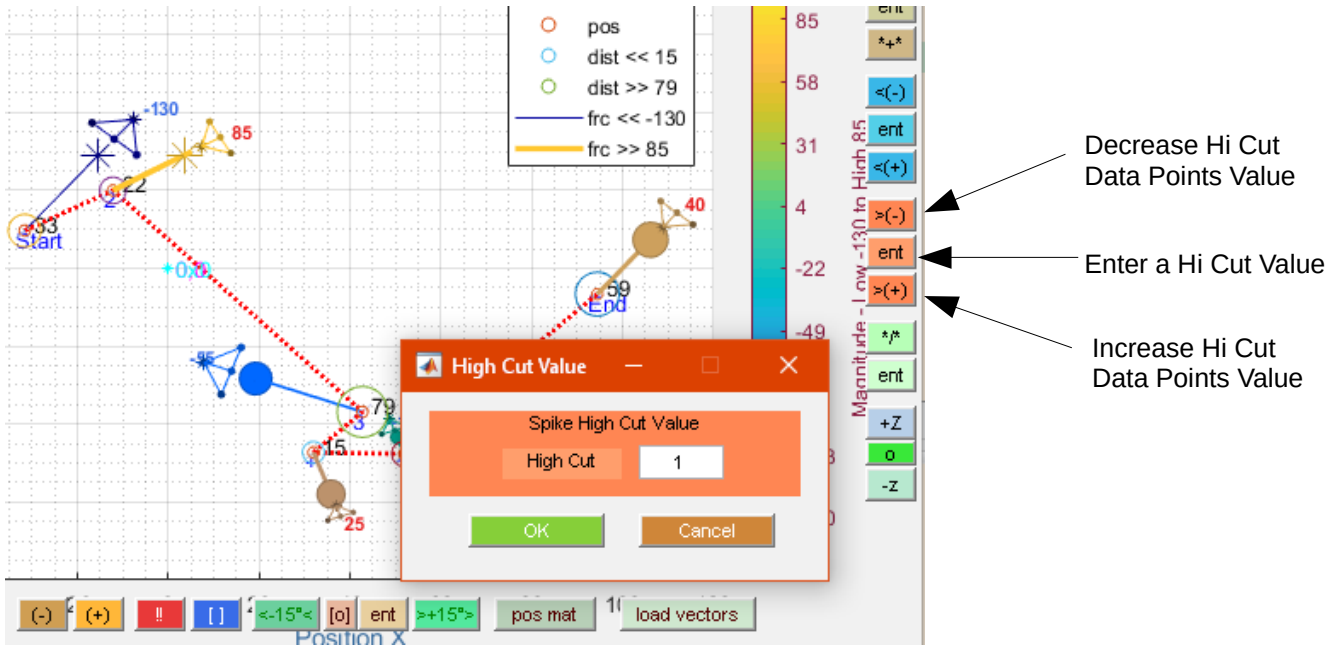
The results of methods of cutting is to remove the spike, keeping it's displayed magnitude, but giving it the length of the next greatest force vector.



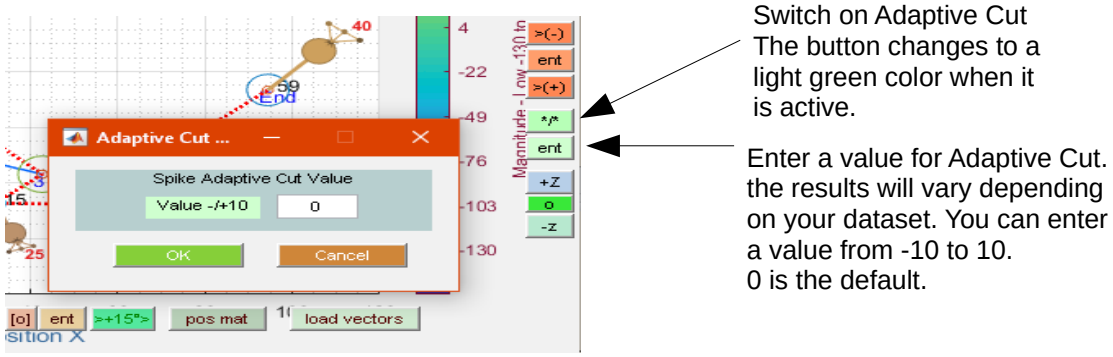
Lottie Vectors – Data Processing / Smoothing Spikes Continued

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.

Appendix 1 - Special characters datasheet

Lottie Vectors – Information document [Vector Reference Codes]

(Release 1.16) Fall 2018

This document describes the code numbers which relate to the position references that appear on screen when appended to a vector dataset. It covers releases from 1.16 onwards. Please go to the website at lottiemath.github.io and follow the links there to Lottie Vectors if you have a newer software version.

By Charlotte Élisabeth Ameil
UoE, September 2018
twitter.com/mathlottie

When entering vector datasets the final column is for position reference markers. This is an integer number greater than 0 which is mapped to one of the symbols listed below. If a zero is specified the program skips the marker, and nothing is displayed.

Provision is made for the user to define their own references, these are reserved as negative codes, beginning with (-1). As of release 1.16, 99 such codes can be defined within the program and stored along with setup data as a preference file. Such a file can be made portable and distributed to other uses with the vector file for display on their local machine. A symbol import function without affecting other local user preferences should be available.

Two special cases are also available. 1 displays the vector's number counted from the beginning, while 2 displays the vectors number counted from the first 2. If the dataset breaks a chain of 2's then this number is reset. The printed symbols below therefore start at 3.

```
 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)
39 = Upsilon
40 = Psi
41 = 'forall' symbol
42 = 'exists' symbol
43 =  ni
44 = cong
45 = 'approx' symbol
46 = Re
47 = 'oplus' symbol
48 = cup
49 = 'subset equals' symbol
50 = 'in' symbol
51 = lceil
52 = tau
53 = cappa
54 = 'super set' symbol
55 = varsigma
56 = Im"
57 = otimes
58 = nabla
59 = wp
60 = aleph
61 = neq
62 = equiv
63 = divide
64 = propto
65 = varpi
66 = left arrow
67 = left arrow bold
68 = up arrow
69 = right arrow
70 = right arrow bold
71 = down arrow
72 = infinity
73 = left and right arrow
74 = partial
75 = playing cards club
76 = playing cards diamond
77 = playing cards hearts
78 = playing cards spade
79 = circle
80 = pm
81 = "u"
82 = "U"
83 = "v"
84 = "V"
85 = "w"
86 = "W"
87 = "y"
88 = "Y"
89 = "z"
90 = "Z"
91 = f(x)
92 = g(x)
93 = h(x)
94 = "!"
95 = "#"
96 = "@"
97 = "HIT"
98 = "miss"
99 = "Aquired"
100 = "Lost"
101 = "Found"
102 = "Detect"
103 = "Fail"
104 = "Out"
105 = "In"
106 = "Target"
107 = "Error"
108 = "Success"
109 = "Win"
110 = "Down"
111 = "In-Range"
112 = "Out-Range"
113 = "Scan";
114 = "Wait"
115 = "Paused"
116 = "Continue"
117 = "Stop"
118 = "Go";
119 = "Download"
120 = "Upload"
121 = "Tracking";
122 = "Dive"
123 = "Flight"
124 = "Take Off"
125 = "Landing"
```

Appendix 2 - Special characters datasheet 2 (extended physics)

Lottie Vectors – Information document [Vector Reference Codes]

(Release 2.0) Fall 2018

This document describes the code numbers which relate to the position references that appear on screen when appended to a vector dataset. It covers releases from 2.0 onwards. Please go to the website at lottiemath.github.io and follow the links there to Lottie Vectors if you have a newer software version.

By Charlotte Élisabeth Ameil
UoE, Ocotober 2018
twitter.com/mathlottie

Supplementary datacodes for Lottie Vectors 2.0 and onwards.

Negative numbers are reserved for user use and there will be an in-program option to define a 'site set' of codes in a future release.

When entering vector datasets the final column is for position reference markers. This is an integer number greater than 0 which is mapped to one of the symbols listed below. If a zero is specified the program skips the marker, and nothing is displayed.

Provision is made for the user to define their own references, these are reserved as negative codes, beginning with (-1). As of release 2.1x, 99 such codes can be defined within the program and stored along with setup data as a preference file. As of 2.0 users can type in any text while in either Edit or Add vector windows. However the labels will not be stored outside of a Listing file.

```
126 = "+"
127 = "{}"
128 = "<>"
129 = "()"
130 = "Au"
131 = "Auv"
132 = "AFB"
133 = "B^u"
134 = "B^uv"
135 = "b,b"
136 = "d,d"
137 = "dk"
138 = "e,eL,eR"
139 = "F^uv"
140 = "Fabc"
141 = "G^u";
142 = "G^uv"
143 = "Gf"
144 = "gUV"
145 = "g1,g2"
146 = "J^u"
147 = "j^u"
148 = "l³"
149 = "Q²"
150 = "q^u"
151 = "Tv^u"
152 = "uk"
153 = "uL,uR"
154 = "u+,u-"
155 = "vL,vR"
156 = "v+,v-"
157 = "W^u"
158 = "W^uv"
159 = "Wu¹"
160 = "Wu²"
161 = "Wu⁺"
162 = "Wu⁻"
163 = "Zu"
164 = "alph(Q²)"
165 = "alph.s(Q^2)"
166 = "y^u"
167 = "u,uL,uR"
168 = "veL,vuL,vtL"
169 = "p(E)"
170 = "t,tL,tR"
```

Appendix 3 – Demonstration Vector Datasets

Data Set 1 (the built-in ectors)

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

Data Set 2 (Right Angle Return Path)

6,33,5.0091,3,-130,40,1
6,22,2.3562,3,85,60,5
6,79,1.2915,3,-55,290,5
6,15,1.5708,3,25,160,7
6,20,3.927,3,-10,340,8
6,59,5.4978,3,40,40,2
8,50,0,8,10,5,0
8,50,180,8,10,15,0
8,50,270,8,10,5,0

Data Set 3 (Single Vector)

6,79,1.2915,3,-55,290,0

Data Set 4 (Route Only)

33, 288, 1

22, 63, 0

29, 134, 0

15, 228, 3

20, 90, 4

29, 43, 2

Appendix 4 – Version 2.x Command Line Interface Options

If you have more than one option you'll need to put 'everything in quotes like this'. For example

lottievectors -help -bugs, wont work but

lottievectors '-help -bugs' will..

< path/filename > Load vector data file. (.dat default extension if none)

1 to 99 Load a preferences file with that number at start

0 Load the built in defaults, skipping preferences

[display options] :

-nodisplay	Don't use the figure window, text only
-nocontrols	Start with no controls around the border
-controls	Start with all controls on the window
-turbo	Begin in turbo, fast display mode
split	Begin in split screen mode

[vectors options] :

-noroute	Don't display red dotted route line
-noforce	Don't display any forces
-asnumbers	Show vector's index numbers (for editing)
-nonegz	Don't go below zero in 3D, -100 is as 100
-nofancyarrows	Display slightly simpler arrows for forces

[data options] :

-xposmap	Position map is X Based
-yposmap	Position map is Y based
-noposmap	Don't display the Postition map at startup
-posmap	Display the Position map when starting
-list	Display a list of vectors at the start
-nolist	Don't list vectors at the start

[program options] :

-about	General information about the software
-version	Actual version of your program
-bugs	Where to report bugs to

Appendix 5 - Built-In Dataset Synopsis

Lottie Vectors - Information document [Dataset Synopsis]

(Release 2.0) Fall 2018

This document contains an automated synopsis relating to the built-in dataset of my MatLab(r) program, Lottie Vectors. It can be used to help debug or test newer versions for valid results. The report can be verified against running a listing from a '0' (zero) start from the command window. Please go to the website at lottiemath.github.io and follow the links there for more information.

By Charlotte Élisabeth Ameil
UoE, Ocotober 2018
twitter.com/mathlottie

```
LottieVectors output on 17-Oct-2018 at 18:27. 6 vectors in list.


 -=Synopsis=-


 Force, Mag Nat MAX= 85.0000 (vector 2) MIN= -130.0000 (vector 1)
 Force, Mag Abs MAX= 130.0000 (vector 1) MIN= 10.0000 (vector 5)
 Force Total = 136.3333  : |Total| = 246.5399


 Position, Dist MAX= 79.0000 (vector 3) MIN= 15.0000 (vector 4)
 Position, Angle MAX= 315.0002 (vector 6) MIN= 73.9998 (vector 3)
 Position Distance Route = 228.0000 : Direct (1 to 6) = 126.9993
 Position Plane Dimensions = (-31.5581, -47.6193) to (94.3931, 19.9767)
 Position Plane Area = 8513.7912 : From vectors (1, 5) to (6, 2)


               Position Vectors [6](Rel Mag+Rad) = 6 : 100 %
               Force Vectors [3](Yax Mag+Deg) = 6 : 100 %


================================================================================
vnum    : Position (Type, Data, Data)     : Force (Type, Data, Data)   : Marker
================================================================================
1       : Rel Mag+Rad (33, 5.0091)        : Yax Mag+Deg (-130, 40)     : start
2       . Rel Mag+Rad  22, 2.3562         . Yax Mag+Deg  85, 60        . (count)
3       : Rel Mag+Rad (79, 1.2915)        : Yax Mag+Deg (-55, 290)     : (count)
4       . Rel Mag+Rad  15, 1.5708         . Yax Mag+Deg  25, 160       . ni
5       : Rel Mag+Rad (20, 3.927)         : Yax Mag+Deg (-10, 340)     : (count B)
6       . Rel Mag+Rad  59, 5.4978         . Yax Mag+Deg  40, 40        . end
================================================================================
```

Lottie **V**ectors **M**anual 2.**0**

Last revision **O**ctober 1**7** 2**0**1**8**