

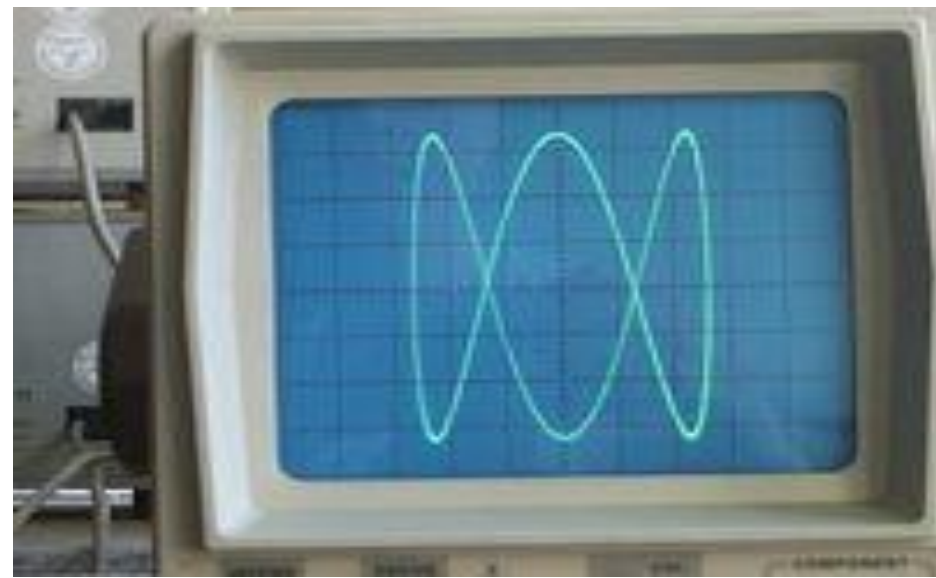
A Lissajous emulator in Excel (by George Lungu @ excelunusual.com)

Jules A. Lissajous was a French mathematician from the 19th century

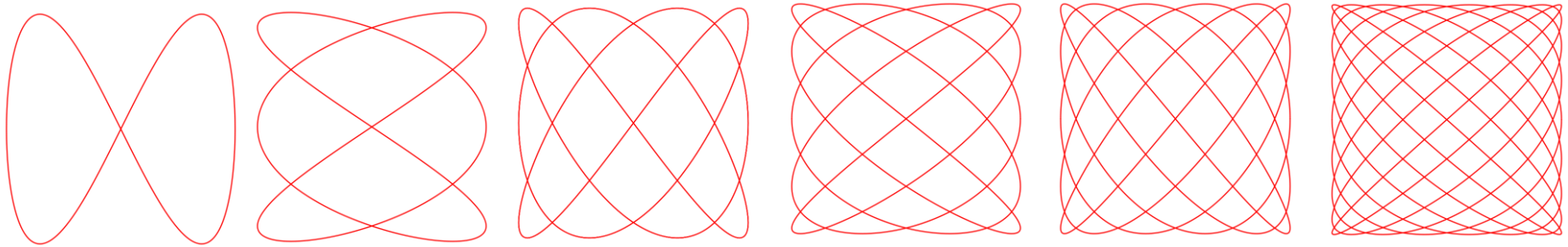
- He wanted to visualize waves.
- He started by using tuning forks resonating in the water in order to create standing waves.
- Eventually he settled for bouncing a beam of light off two small mirrors each connected to a different tuning fork. After that, the beam was projected on a wall.



- Nowadays the Lissajous figures are commonly generated using oscilloscopes by driving both the X and Y axes with sinusoidal signals
- An example of an application is measuring the phase difference between two signals



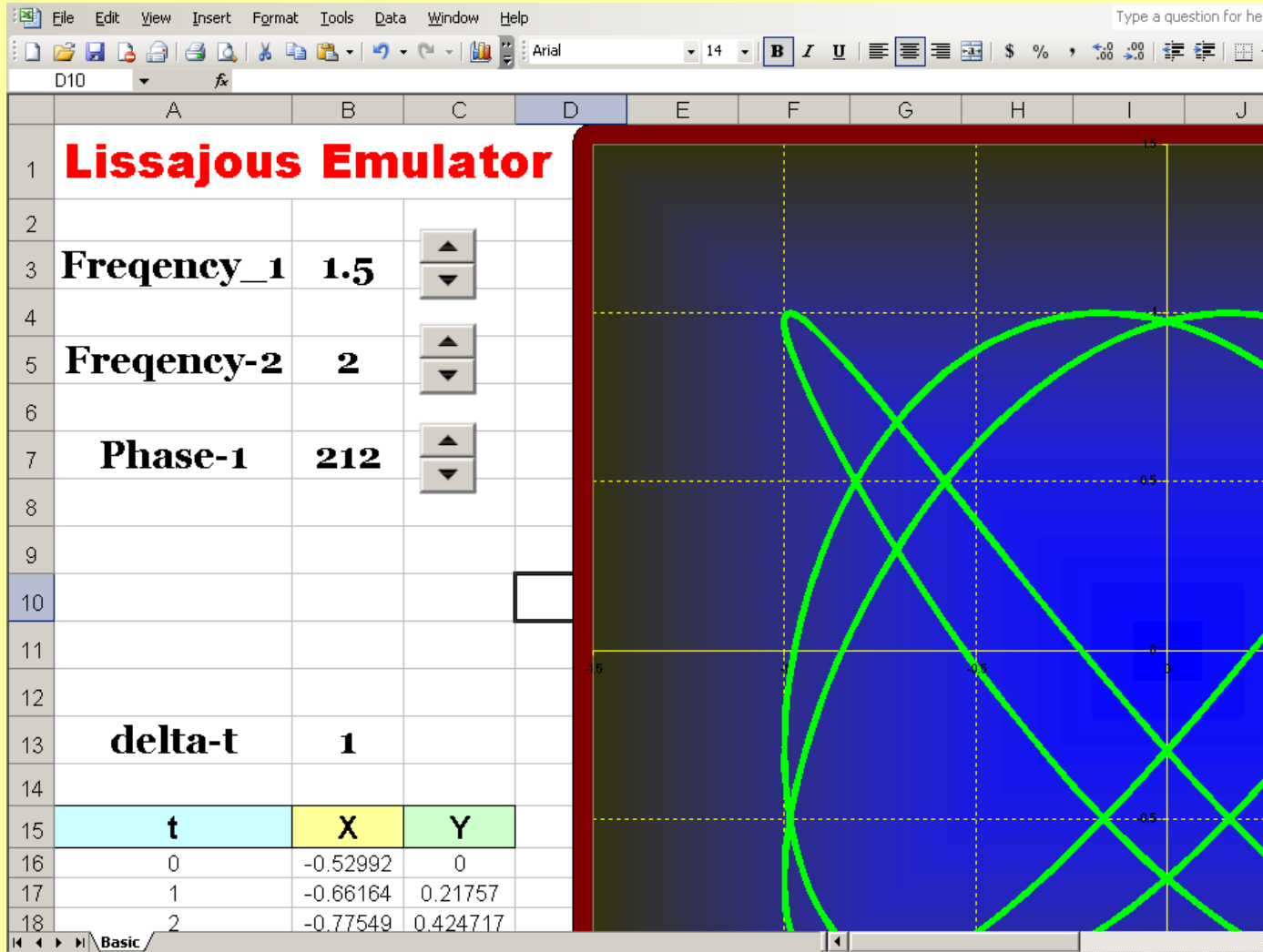
- Below is a series of Lissajous figures from **Wikipedia** for sinusoidal signals having the following ratios of frequencies: 1:2, 3:2, 3:4, 5:4, 5:6, 9:8 and a difference in phase of $\pi/4$



How is this done in Excel?

-The two waves are expressed as:

$$\left\{ \begin{array}{l} \mathbf{A} = \sin(2\pi\nu_1 t + \phi_1) \\ \mathbf{B} = \sin(2\pi\nu_2 t) \end{array} \right.$$



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The time column (column "A"):

- $A16 = 0$
- $A17 = A16 + B\$13$
- Copy down A17 to A18, A19, ..., A700

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X column (column "B") – first wave:

- $B16 = \text{SIN}(\text{RADIANS}(2 * \text{PI}() * B\$3 * A16 + B\$7))$
- Copy down B16 to B17, B18, ..., B700

Y column (column "C") – second wave:

- $C16 = \text{SIN}(\text{RADIANS}(2 * \text{PI}() * B\$5 * A16))$
- Copy down C16 to C17, C18, ..., C700

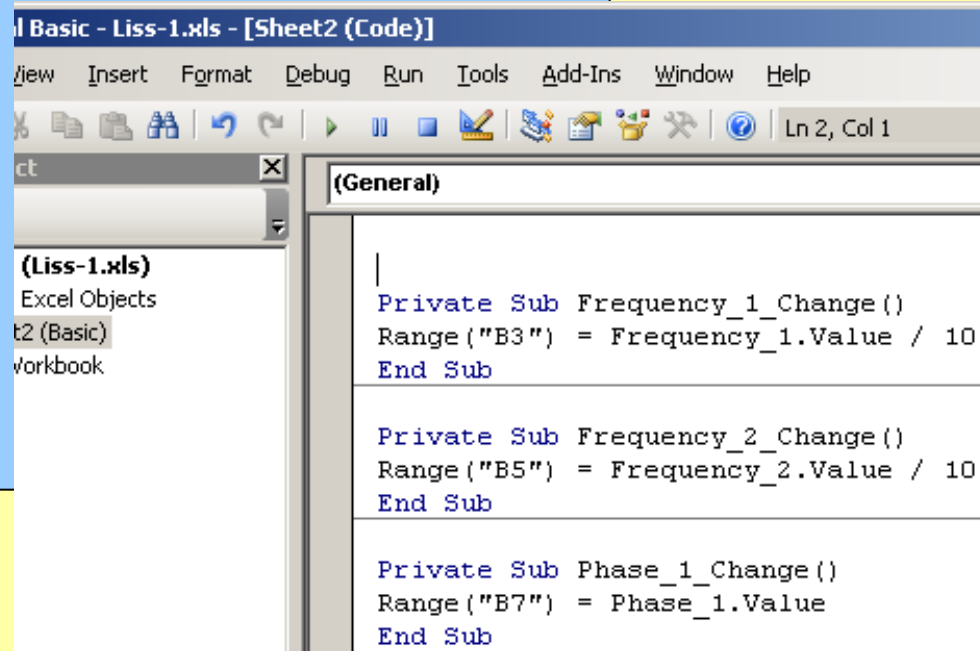
Let's chart the following data on a 2D scatter plot: X as B16:B700
Y as C16:C700

Create the following macros for controlling the frequencies and difference in phase between the two waves:

```
Private Sub Frequency_1_Change()  
Range("B3") = Frequency_1.Value / 10  
End Sub
```

```
Private Sub Frequency_2_Change()  
Range("B5") = Frequency_2.Value / 10  
End Sub
```

```
Private Sub Phase_1_Change()  
Range("B7") = Phase_1.Value  
End Sub
```



The screenshot shows the VBA editor for a workbook named "Liss-1.xls". The code editor contains the following macros:

```
Private Sub Frequency_1_Change()  
Range("B3") = Frequency_1.Value / 10  
End Sub  
  
Private Sub Frequency_2_Change()  
Range("B5") = Frequency_2.Value / 10  
End Sub  
  
Private Sub Phase_1_Change()  
Range("B7") = Phase_1.Value  
End Sub
```

A Few Screenshots:

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