How to Create a Chaos Ring of Sinewave Spheres

Follow this article to learn how to create a Chaos Ring of Sinewave Spheres in Microsoft Excel and to make this image and many more like it, but different. Become familiar with the basic image to be created: === The Tutorial ===

Part 1 of 3:

The Tutorial

1. **Open a new Excel workbook and create 3 worksheets (except Chart if you are using Chart Wizard).** Name them Data, Chart and Saves. If you have completed the Article and workbook How to Acquire a Ring of Sinewave Spheres, we'll be using that article for our model and quite a bit of time can be saved by looking for **MODIFIED** or **NEW** sections after doing a SAVE AS of the first workbook under a name appropriate to the present project. The workbook being used for this article is titled *Chaos Sinewave On Sphere NO X.xlsx* Otherwise, simply follow the steps in order. #* As a warning note that this process uses the RandBetween function with over 34,0000 cells involved and can take large amounts of processing time. Please set the Calculation setting to Manual and carefully follow the instructions to PASTE VALUES as given.
2. **Set Your Preferences:** Open Preferences in the Excel menu and follow the directions below for each tab/icon.
    1. In General, set *R1C1* to Off and select *Show the 10 Most Recent Documents* .
    2. In Edit, set all the first options to checked except *Automatically Convert Date System*. Set *Display number of decimal places* to blank(as integers are preferred). Preserve the display of dates and set 30 for 21st century cutoff.
    3. In View, click on show *Formula Bar* and *Status Bar* and hover for *comments of all Objects* . Check *Show gridlines* and set all boxes below that to auto or checked.
    4. In Chart, allow *show chart names* and set *data markers* on hover and leave the rest unchecked for now.
    5. In Calculation, Make sure *Manually* and *calculate before save* are checked. Set max change to .000,000,000,000,01 without commas as goal-seeking is done a lot. Check *save external link values* and *use 1904 system*
    6. In Error checking, check all the options.
    7. In Save, select *save preview picture with new files* and *Save Autorecover* after 5 minutes
    8. In Ribbon, keep all of them checked except *Hide group titles* and *Developer* .
3. **It helps by placing the cursor at cell A16 and doing Freeze Panes.** Edit Go To cell range A1:N17288 and Format Cells Number Number Decimal Places 4, Font Size 9 or 10, Fill (from the color wheel) a nice fuchsia and make the Border Dark Blue bold Outline.

4. 

Sinewave Spheres in a Chaos Ring_				AYE	10.00000	Stretch_y1	Stretch_x1	ROWS	17280.00000				
Pasted	Values			BEE	0.50000	4.25000	4.25000	MAGIC	720.00000				
				CEE	0.50000	SHRINKER	0.05000	SPHERES	24.00000				
			=RANDBETWEEN(4,7)/100					Charting	Charting			Charting	Charting
Adj Cos	Adj Sin	Indicator	Randy	t: 0 to n	z1_	Adj_x1	Adj_y1	x: No z	y: With z	Adj_x2	Adj_y2	x2: No z	y2: With z
17.0000	17.0000	1.00000	0.0600	0.00000	0.5000	17.0000	17.0000	0.0425	0.0478		0.0600		0.0866
17.0000	17.0062	1.0000	0.0400	0.00873	0.4981	17.0000	17.0062	0.0430	0.0478		0.0400		0.0666
17.0000	17.0124	0.0000	0.0500	0.0175	0.4924	17.0000	17.0062	0.0434	0.0478		0.0400		0.0665
17.0000	17.0185	0.0000	0.0400	0.0262	0.4830	17.0000	17.0062	0.0439	0.0477		0.0400		0.0664
17.0000	17.0247	0.0000	0.0500	0.0349	0.4698	17.0000	17.0062	0.0443	0.0476		0.0400		0.0663
17.0000	17.0309	0.0000	0.0500	0.0436	0.4532	17.0000	17.0062	0.0447	0.0474		0.0400		0.0662
17.0000	17.0371	0.0000	0.0600	0.0524	0.4330	17.0000	17.0062	0.0452	0.0473		0.0400		0.0660
16.9999	17.0433	0.0000	0.0600	0.0611	0.4096	17.0000	17.0062	0.0455	0.0471		0.0400		0.0658
16.9999	17.0495	0.0000	0.0500	0.0698	0.3830	17.0000	17.0062	0.0459	0.0468		0.0400		0.0656
16.9999	17.0556	0.0000	0.0600	0.0785	0.3536	17.0000	17.0062	0.0462	0.0466		0.0400		0.0653

Enter the upper Defined Name Variables Section (here's a picture):

1. Cell A1: Enter Sinewave Spheres in a Chaos Ring
2. B2: Enter Pasted and C2: Enter Values. Format Fill Red and Font White.
3. E1: AYE
4. E2: BEE
5. E3: CEE
6. F1: 10
7. F2: .50
8. F3: .50
9. Select cell range E1:F3 and Insert Name Create Names in Left Column, OK.
10. G1: Stretch_y1
11. H1: Stretch_x1
12. G3: Shrinker
13. H3: Enter "=0.1*12/SPHERES" and Insert Name Define Name Shrinker to cell $H$3.
14. I3: SPHERES
15. J3: 24
16. I1: ROWS
17. I2: MAGIC
18. Select cell range I1:J3 and Insert Name Create Names in Left Column, OK.
19. J1: Enter "=17285-5"
20. J2: Enter "=ROWS/SPHERES"
21. G2: Enter "=(8.5*(SHRINKER*10))"
22. H2: Enter "=(8.5*(SHRINKER*10))"
23. Select cell range G1:H2 and Insert Name Create Names in Top Rows, OK.

5. **MODIFIED:** Enter the column heading of rows 4 and 5:
    1. A5: Adj Cos (for Adjusted Cosine)
    2. B5: Adj Sin
    3. C5: Indicator
    4. NEW: D4: Enter .=RANDBETWEEN(4,7)/100 where if the period is deleted the formula becomes active.
    5. D5: Randy (for RandBetween)
    6. E5: t: 0 to n?
    7. F5: z1_
    8. G5: Adj_x1
    9. H5: Adj_y1
    10. I4 and J4: Charting
    11. I5: x: No z
    12. J5: y: With z

13. NEW: K5: Adj_x2 (not used but conceivably could be in future; if so the formula would be "=IF(C6=1,D6,K5)"
14. NEW: L5: Adj_y2
15. NEW: M4 and N4: Charting
16. NEW: M5: x2: No Z (not used but conceivably could be in future; if so the formula would be "=SHRINKER^2*(Stretch_y1*(((BEE^2-CEE^2*COS(AYE*E6)*COS(AYE*E6))^0.5* SIN(E6))+z1_)+Adj_x1*0.5)+Adj_x2"
17. NEW: N5: y2: With z.
18. Command+Select cells F1:F3 and I3 and Format Fill yellow.
19. Select cell J3 and Format Fill sky blue from the color wheel.
20. Select cell range I4:J5 and Format Font italic.
21. NEW: Select cell range M4:N5 and Format Font italic.
22. NEW: Command+Select cells A1:D1, A2, A3:D3, D2, G1:N2, G3:H3, M3:N3 and Format Fill White.

6. **Enter the column formulas - BE VERY CAREFUL TO COPY AND PASTE VALUES as specified please.**
    1. Adj Cos: Edit Go To cell range A6:A17285 and enter into A6 w/o quotes the following formula, "=17*COS((ROW()-6)*0.25/12*PI()/180)" and Edit Fill Down. The .25 is for 1440*.25 = 360. 17280/12=1440. So we are taking 1/12th of 1/4 or 1/48th of 17280 = 360, the degrees of the trig function cosine for a circle. PI()/180 converts radians to degrees. (ROW()-6) in row 6 = 0, so we start off taking the cosine of 0, which is 1, and multiplying it by 17. 17 is twice the Stretch factor, and if I recall rightly, is 1/2 the radius of the ring (the Stretch factor operates from each sphere's center). However, Shrinker is also involved, as you'll see later.
    2. Adj Sin: Edit Go To cell range B6:B17285 and enter into B6 w/o quotes the following formula,"=17*SIN((ROW()-6)*0.25/12*PI()/180)+17"and Edit Fill Down, which is different than the above one for cosine by the addition of 17 to it. All in all, that give us 4*8.5, and that is the radius, as I recall.
    3. Indicator: Select cell C6 and enter 1. Edit Go To cell range C7:C17286 and enter w/o quote the formula, "=IF((ROW()-7)/MAGIC=INT((ROW()-7)/MAGIC),1,IF((ROW()-7)=0,1,0))" and Edit Fill Down. This formula says, 'Take a look at the row I'm in, divide it by the number of rows per sphere (MAGIC) and if that number is an integer, return a 1, otherwise if I'm in the next-to-top row also return a 1, otherwise, return a 0.' So now there is an indicator of where 1 sphere ends and the next one begins, no matter how many spheres the user selects to chart.
    4. MODIFIED: Randy: Edit Go To cell range D6:D17286 and enter into D6 w/o quotes the following formula,"=RANDBETWEEN(4,7)/100" and Edit Fill Down. Warning: Make calculation Manual before adding this variable or column into your formulas, especially as a factor, as it can take 20 minutes to calculate and draw the new chart. It is not currently employed, but a copy of its formula has been saved at the bottom of the x and y formulas. Edit Go To cell range D6:D17285 and Insert Name Define Name Randy to cell range $D$6:$D$17285. Also, Edit Go To cell range D6:D17286 and Copy, then Paste Values right back to cell D6:D17286.
    5. t: 0 to n?: Select cell E6 and enter 0. Select cell E7 and enter the formula "=(2*PI()/MAGIC)". Edit Go To cell range E8:E17285 and enter w/o quotes into E8 the formula "=IF(C8=1,2*PI(),2*PI()/MAGIC+E7)" and Edit Fill Down.
    6. z1_: Edit Go To cell range F6:F17285 and enter w/o quotes into F6 the formula "=CEE*COS(AYE*E6)" and Edit Fill Down. Edit Go To cell range F6:F17285 and Insert Name Define Name z1_ to cell range $F$6:$F$17285.
    7. Adj_x1: Edit Go To cell range G6:G17285 and enter w/o quotes into G6 the formula "=IF(C6=1,A6,G5)" and Edit Fill Down. Edit Go To cell range G6:G17285 and Insert Name Define

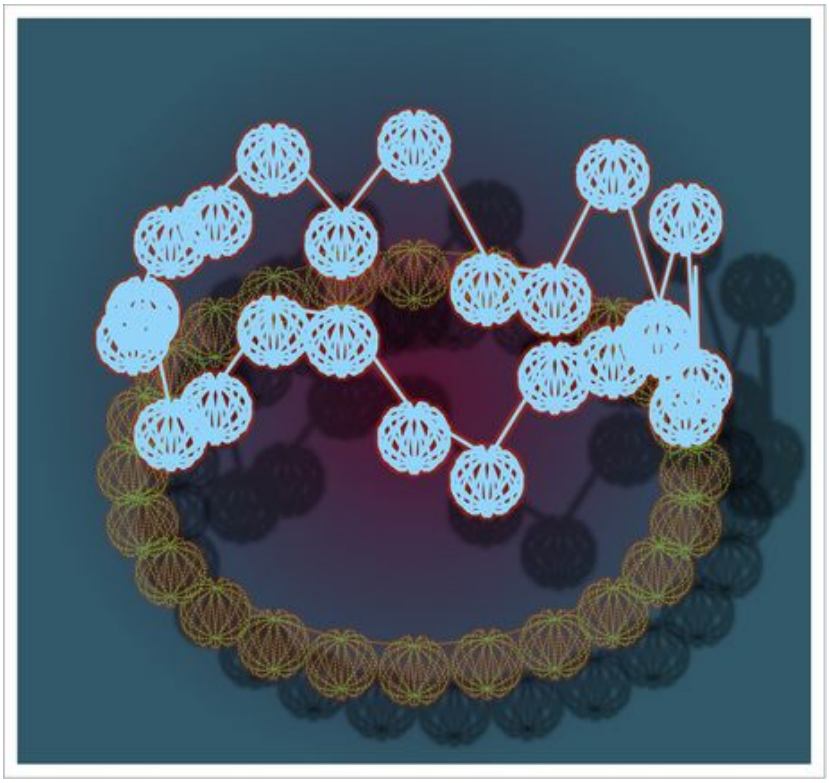
Name Adj_x1 to cell range $G$6:$G$17285. This makes a constant adjustment as if one were referencing a new center of every new sphere from Adj Cos, else it takes the value just above itself.

8. Adj_y1: Edit Go To cell range H6:H17285 and enter w/o quotes into H6 the formula "=IF(C6=1,B6,H5)" and Edit Fill Down. Edit Go To cell range H6:H17285 and Insert Name Define Name Adj_y1 to cell range $H$6:$H$17285. This makes a constant adjustment as if one were referencing a new center of every new sphere from Adj Sin, else it takes the value just above itself.
9. x: No z: Edit Go To cell range I6:I17285 and enter w/o quotes into I6 the formula "=SHRINKER^2*(Stretch_x1*(((BEE^2-CEE^2*COS(AYE*E6)*COS(AYE*E6))^0.5 *COS(E6)))+Adj_x1)" and Edit Fill Down. This is the x part of the heart of the sinewave sphere formula from the text, without the z dimension added or multiplied in, which is why it took me so long to discover how to make it work.
10. y: With z: Edit Go To cell range J6:J17285 and enter w/o quotes into J6 the formula "=SHRINKER^2*(Stretch_y1*(((BEE^2-CEE^2*COS(AYE*E6)*COS(AYE*E6))^0.5* SIN(E6))+z1_)+Adj_y1)" and Edit Fill Down. This is the y part of the heart of the sinewave sphere formula from the text, with the z dimension added in, which is why it took me so long to discover how to make it work. In the spirallic spheroids Garthwaite Curve, the z-dimension is multiplied into both x and y parts. Furthermore, there was no adjustment for the GOLDEN MEAN Long Leg, which was expected all along, until it worked without it. The other curve doesn't.
11. Select cell I17286 and enter the formula w/o quotes "=I6" and select cell J17286 and enter the formula w/o quotes "=J6". This makes the top connecting line from the last sphere to the first.
12. Edit Go To cell range I6:J17288 and do Format Fill sky blue. Edit Go To cell range M6:N17288 and Format Fill sky blue.
13. Select cell D5 and Format Fill light sea green, font red, Border navy blue outline bold. Copy this cell to H17287. Then do Edit Paste Special Format of this cell to cell C6, E6, E7, I17286, J17286, M17286 and N17286 to make distinct the format of those cell's formulas/values.
14. NEW: COPY CELL RANGE A11:J17285 and then PASTE SPECIAL VALUES right back atop the same cell range. Format Fill Red and Font White. This means that the top Variables section is no longer operative in any useful way until you Edit Fill Down the formulas from row 10, which may mean having to wait a considerable length of time, as in 25 - 40 minutes. It can also take that long to save the workbook, so ...
15. NEW: Save the workbook.
16. NEW: Adj_y2: Edit Go To cell range L6:L17285 and enter w/o quotes into L6 the formula "=IF(C6=1,Randy,L5)" and Edit Fill Down. COPY CELL RANGE L11:L17285 and then PASTE SPECIAL VALUES right back atop the same cell range. Format Fill Red and Font White.
17. NEW: y2: With z: Edit Go To cell range M6:M17285 and enter w/o quotes into M6 the formula "=SHRINKER^2*(Stretch_y1*(((BEE^2-CEE^2*COS(AYE*E6)*COS(AYE*E6))^0.5* SIN(E6))+z1_)+Adj_y1*0.5)+Adj_y2" and Edit Fill Down. COPY CELL RANGE M11:M17285 and then PASTE SPECIAL VALUES right back atop the same cell range. Format Fill Red and Font White.
18. Select cell N17286 and enter "=N6", w/o quotes.
19. Hopefully, that avoided all the waiting and waiting for processing time to pass. We'll see.

Part 2 of 3:

Explanatory Charts, Diagrams, Photos

1. (dependent upon the tutorial data above)

1. 

Create the chart.

1. Edit Go To cell range I6:J17286 and from the Ribbon or Chart Wizard select Charts All/Other Scatter Smoothed Line Scatter and Copy or Cut the chart that is atop the data worksheet and paste it to the top left of the Chart worksheet. Hover over the lower right corner until the cursor becomes a double-headed arrow and pull it open to become a large approximate square.
2. Click in the Plot Area and select Chart Layout from the ribbon and at far left under Current Selection select Series 1, then under that, Format Selection. Set Line to Kelly Green, Smoothed line, Transparency 27%, Weight = 1 pt. and Dashed = Heavy Dashed Dots. Set Shadow to checked Outer 315 degrees, black, Size 100%, Blur 4 pt, Distance 54 pt, Transparency 2 %. Set Glow to fire engine red Size = 4 pt. 74% transparency, Soft Edges 0 pt. Then click on OK.
3. Do Current Selection under Chart Layout as Plot Area, Format Selection. No Line, No Glow and No Shadow. Set Fill to Gradient to Aubergine left 0% and Foresty Blue Green at 70%; Radial Centered and Rotate gradient with shape check-box in lower left checked. Then click on OK.
4. Do menuitem Chart Add Data and respond to the range query by selecting M6:N17286 on the Data worksheet. This you will want to edit in the Chart worksheet formula bar until it becomes "=SERIES(,'DATA 01'!$I$6:$I$17286,'DATA 01'!$N$6:$N$17286,2)", w/o quotes.
5. Click in the Plot Area and select Chart Layout from the ribbon and at far left under Current Selection select Series 2 (or 3, whatever), then under that, Format Selection. Set Line to Bright Sky Blue, Smoothed line, Transparency 0%, Weight = 2 pt. (see TIPS below -- the example above is 3.75 tho) and Style Dashed is Solid. Set Shadow to checked Outer 315 degrees, black, Size 100%, Blur 4 pt, Distance 96 pt, Transparency 57 %. Set Glow to fire engine red Size = 4 pt. 50% transparency, Soft Edges 0 pt. OK - done ?

Part 3 of 3:

Helpful Guidance

1. **Make use of helper articles when proceeding through this tutorial:**
    1. See the article How to Create a Spirallic Spin Particle Path or Necklace Form or Spherical Border for a list of articles related to Excel, Geometric and/or Trigonometric Art, Charting/Diagramming and Algebraic Formulation.
    2. For more art charts and graphs, you might also want to click on Category:Microsoft Excel Imagery, Category:Mathematics, Category:Spreadsheets or Category:Graphics to view many Excel worksheets and charts where Trigonometry, Geometry and Calculus have been turned into Art, or simply click on the category as appears in the upper right white portion of this page, or at the bottom left of the page.