Introduction to Curves in Mathematica

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Summer 2018

1 Plotting Curves

Use the function ParametricPlot to graph the following curves:

1. $c(t) = (\cos(t), \sin(t))$ where $0 \leq t \leq 2\pi$
2. $\alpha(t) = (2\cos(t), \sin(2t))$ where $0 \leq t \leq 2\pi$
3. $\alpha(t) = (t\sin(t), t\cos(t))$ where $0 \leq t \leq 6\pi$
4. $\alpha(t) = (t, \sin(t))$ where $-2\pi \leq t \leq 2\pi$
5. $\alpha(t) = (3\cos(t), 2\sin(t))$, $0 \leq t \leq 2\pi$
6. $\alpha(t) = (t^3 - t, t^2)$, $-5 \leq t \leq 5$

Challenge: Plot 3 circles all centered at 0 and of radii 1, 2, and 3 in the same image. Don't forget to add a key to your graphic!

2 Manipulate

Use the Manipulate function to create an interactive graph of the curve $\alpha(t) = (t, af(pt))$ where a, p and f are all variables to be manipulated and $-2\pi \leq t \leq 2\pi$. Set a to go between -2 and 2. Set p to go between -10 and 10. Set f to be either sin, cos, or tan.

3 Curvature

Create a function called circlecurvature[t] to calculate the curvature of the unit circle $c(t) = (\cos(t), \sin(t))$ at a point t.

Compute the curvature at $t = 0$, $t = \pi/2$, and at any other point of your choice.

Challenge: Create two input function $f1$ and $f2$. Start by setting these equal to cos and sin, respectively. Then, use Dynamic to create a function which computes the curvature of the curve $\alpha(t) = (f1(t), f2(t))$ and updates automatically as you update the functions f_1 and f_2.

4 Curves in 3D

In this course, we will focus on curves in the 2-dimensional plane, but curves that move in 3 dimensions are also interesting to look at. Try plotting the following 3-dimensional curves:

1. $\alpha(t) = (t, \cos(t), \sin(t))$, $0 \leq t \leq 4\pi$
2. $\alpha(t) = (\sin(t), \cos(t), \cos(8t))$, $0 \leq t \leq 4\pi$
3. $\alpha(t) = (t\cos(t), t\sin(t), t)$, $0 \leq t \leq 4\pi$
4. $\alpha(t) = (t, t^2, \cos(t))$, $0 \leq t \leq 2\pi$