Graphs of Functions, Graphs of Planar Curves*

1-dimensional functions are always visualized by drawing their graphs $\{(x, f(x)\}$, while planar curves, although usually described as maps: $t \in [t_0, t_1] \mapsto c(t) \in \mathbb{R}^2$, are nevertheless visualized by their image, the set of their values: $\{c(t) \in \mathbb{R}^2; t \in [t_0, t_1]\}$. The graph allows to see, for each argument x, the value $f(x)$; the image shows no connection between the points of the curve and the arguments $t \in [t_0, t_1]$. This leads to difficulties if one wants to visualize the connection between a curve and "its" component functions, because the image of a curve does not show traces of the map that was used to draw it. Therefore, strictly speaking, the image of a curve does not have "its" component functions. We need to have some specific parametrization $t \mapsto c(t)$ of the curve in mind before we can speak of "the" component functions of the curve, or better of its representing map $t \mapsto c(t)$.

In `3D-XplorMath` many planar curves have an Action Menu entry: `Project Curve to x-y-Axes`. The resulting demo shows the curve and the graphs of the component functions of the curve that the program uses for drawing the image of the curve. A moving point on the curve and corresponding moving points on the graphs are shown. The moving point on the curve demonstrates the parametrization that is employed by the program.

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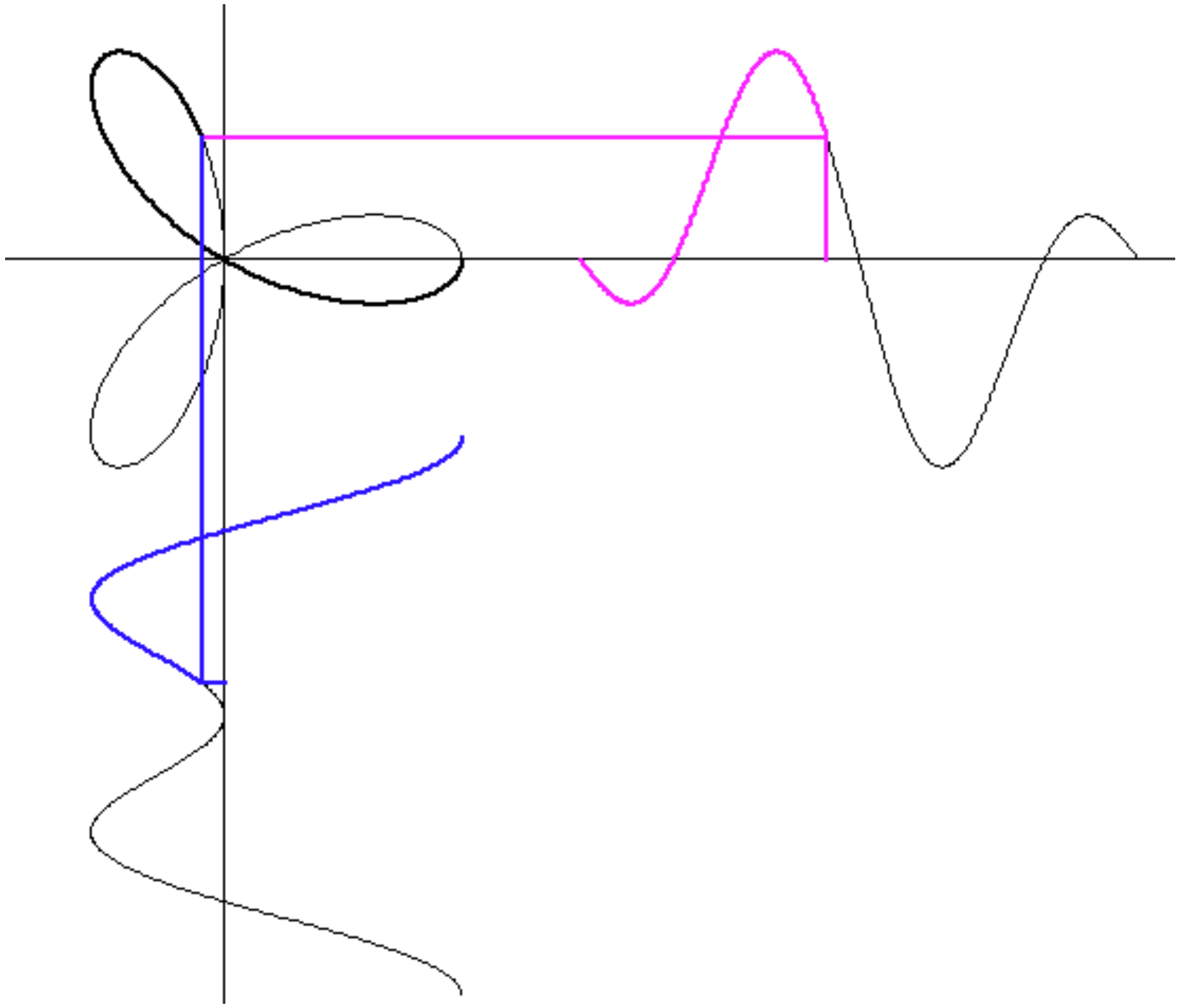
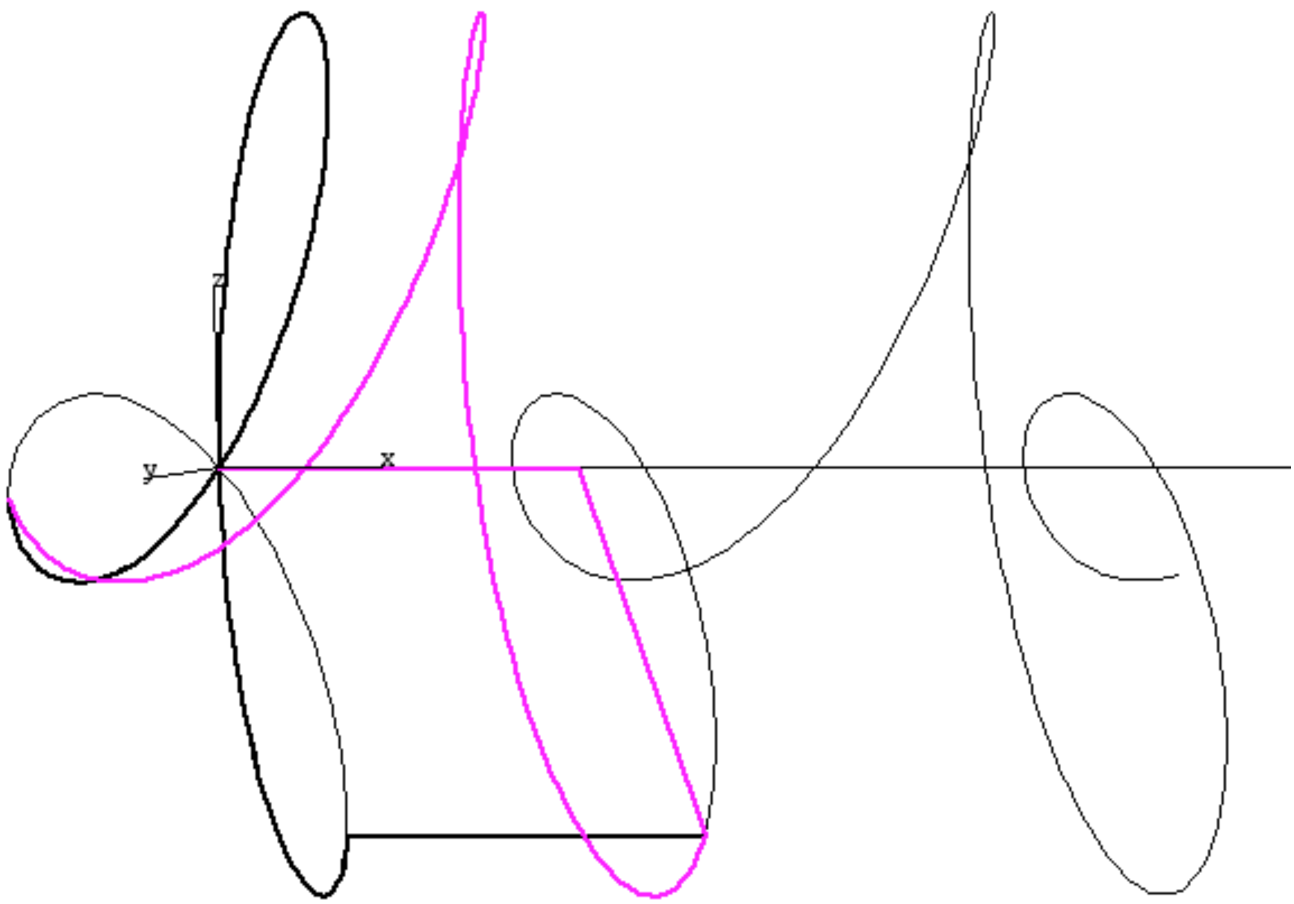
* This file is from the 3D-XplorMath project. Please see:

http://3D-XplorMath.org/



Epicycloid with graphs of component functions.

We have enough dimensions to also show the graph of a parametrized planar curve, $\{(t, c(t)); t \in [t_0, t_1]\} \subset \mathbb{R}^3$. This is not used much, except for world lines in Relativity Theory. However, the graphs of the component functions of the curve are just orthogonal projections of the graph of the curve! So, after getting used to the unusual sight of the graph of a curve, see in `3D-XplorMath` the Action Menu entry `Show Planar Curve as Graph`, such a demo may help to bridge the gap between the graph representation of 1-dim functions and the image representation of higher dimensional maps. Actually, in $\mathbb{R}^3$ there are only two more cases for which the dimensions fit, the frequently used graphs of real valued "height" functions h from $\mathbb{R}^2$: $\{(x, y, h(x, y)); (x, y) \in \mathbb{R}^2,\ h(x, y) \in \mathbb{R}\}$ (think of "mountains") and the mentioned graphs of planar curves: $\{(t, c(t)) \in \mathbb{R}^3;\ t \in [t_0, t_1]\}$, which are curves in $\mathbb{R}^3$ that frequently look like deformed helices.



Epicycloid in y-z-plane and its graph in $\mathbb{R}^3$.

This image is easier to interpret when the point of the curve moves and when the visualization is in stereo.