Two Dimensional Plots

1. Plotting Functions and Equations
   - the graph of a function
   - equations in two variables

2. Curves in Parameter Form
   - rectangular coordinates
   - polar coordinates

MCS 320 Lecture 26
Introduction to Symbolic Computation
Jan Verschelde, 10 July 2024

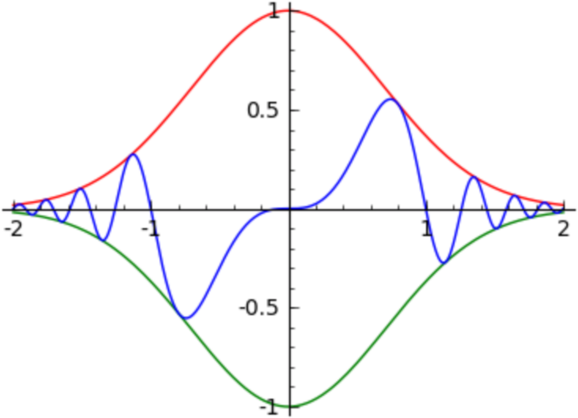
Two Dimensional Plots

1. Plotting Functions and Equations
   - the graph of a function
   - equations in two variables

2. Curves in Parameter Form
   - rectangular coordinates
   - polar coordinates

the Graph of a Function $y = f(x)$

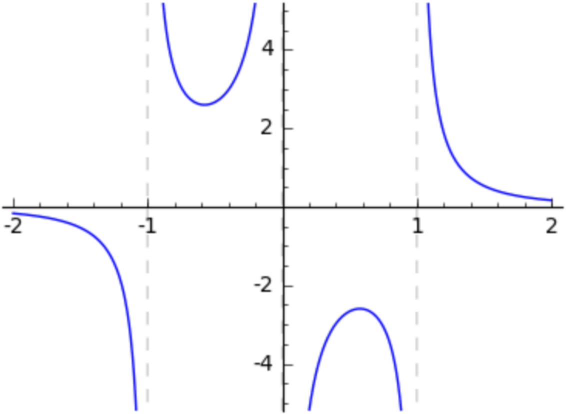
The function $f(x) = \exp(-x^2)\sin(\pi x^3)$ appears in blue below:



The plots of $\pm\exp(-x^2)$ show the decaying amplitude of $f(x)$.

Poles and Vertical Asymptotes

Plotting $f(x) = 1/(x^3 - x)$ requires some special care ...



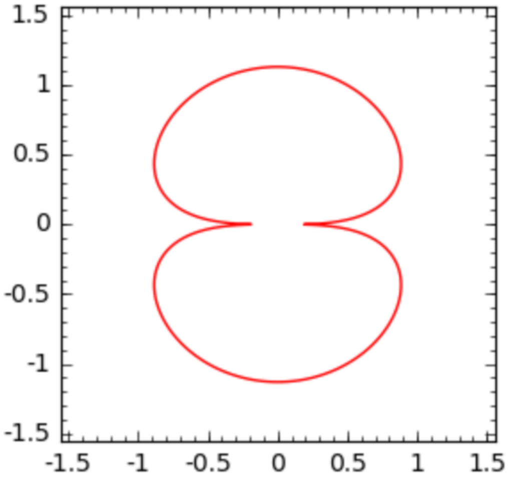
Two Dimensional Plots

1. Plotting Functions and Equations
   - the graph of a function
   - equations in two variables

2. Curves in Parameter Form
   - rectangular coordinates
   - polar coordinates

A Curve Invented by James Watt

$$f(x,y) = (x^2+y^2)^3 + 5.12(x^2+y^2)^2 - 5.15(x^4-y^4) - 14.7456y^2 = 0$$

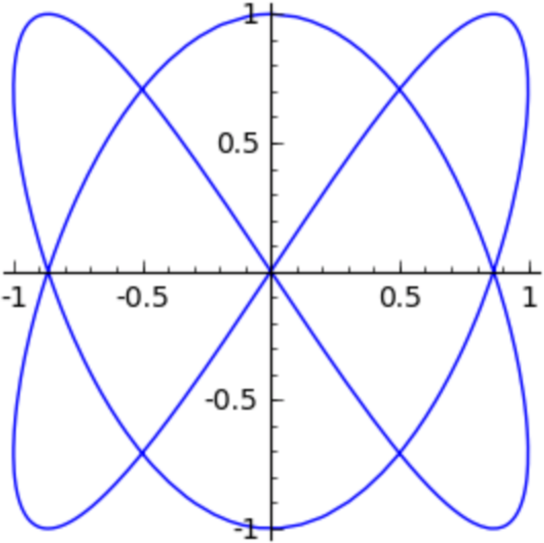


Two Dimensional Plots

1. Plotting Functions and Equations
   - the graph of a function
   - equations in two variables

2. Curves in Parameter Form
   - rectangular coordinates
   - polar coordinates

A Lissajous Curve $(x(t) = \sin(2t), y(t) = \sin(3t))$



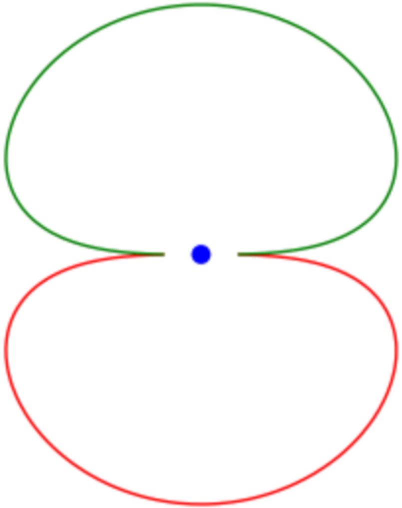
Two Dimensional Plots

1. Plotting Functions and Equations
   - the graph of a function
   - equations in two variables

2. Curves in Parameter Form
   - rectangular coordinates
   - polar coordinates

Polar Coordinates $r = f(t)$, $t \in [0, 2\pi]$

The curve invented by James Watt in polar coordinates:



from rectangular to polar coordinates

Given is an equation $f(x, y) = 0$.

A polar representation can be obtained as follows:

1. For radius r and angle t, compute

$$g(r, t) = f(x = r\cos(t), y = r\sin(t)).$$

2. Simplify g using trigonometric identities.
3. Solve $g(r, t) = 0$ for r.

The solutions of $g(r, t) = 0$ define the components of the curve.

If the curve passes several times through the origin,
then the polar representation may greatly simplify the plotting.