1 Vector basics

Magnitude of a vector v is denoted $|v|$. It is the square root of the sum of the squares of a vector

$$v = x, y \tag{1}$$
$$|v| = \sqrt{x^2 + y^2} \tag{2}$$

The magnitude $|v|$ of a one element vector is the square root of the square. It is therefore the same as the absolute value.

The magnitude $|v|$ = norm = modulus = length of a vector.

A unit vector is a vector with magnitude = 1. To obtain a unit vector in the direction of a vector v we divide each element in the vector by the magnitude/length/modulus of the vector. The unit vector is denoted with a "hat"

$$v = \frac{v}{|v|}$$

2 Polar Coordinates and complex numbers

Complex numbers have two components, a real and imaginary. The imaginary part is denoted i. Just like the "unit" of real numbers is 1, the unit of imaginary numbers is the square root of -1.

$$i = \sqrt{-1} \tag{3}$$

The way complex numbers are often represented is $z = a + bi$. However you can also represent them in polar coordinates

$$z = r \cdot \cos(\theta) + ir \cdot \sin(\theta) = r \cdot (\cos(\theta) + i \sin(\theta))$$

The abbeviated form is

$$z = r \cdot cis(\theta)$$

where

- r = radius = $\sqrt{x^2 + y^2}$, where x = width and y = height.
- θ = angle $\tan^{-1}(\frac{y}{x})$

3 Exponential form of a complex number

If a complex number z has modulus r and argument θ, then

$$z = r(\cos(\theta) + i \sin(\theta))$$

4 Fourier transformation