

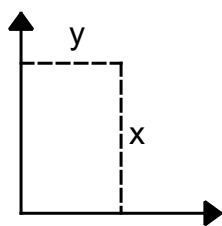
# MatDeck - Coordinate system conversion

The default settings in MatDeck is the Cartesian coordinate system and it is widely used for all calculations and in geometry in general. We have implemented conversion functions for four types of coordinate systems: Cartesian, polar, cylindrical and spherical coordinate system.

## Cartesian to polar

To transform cartesian coordinates to polar coordinates use the functions: cartesian2polar, cartesian2polar\_f, cartesian2polar\_r

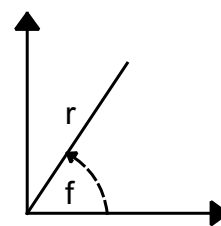
Cartesian



$$r = \sqrt{x^2 + y^2}$$

$$f = \arctan\left(\left|\frac{y}{x}\right|\right)$$

Polar



### Example

$$\text{cartesian2polar}(3, 4) = [5 \quad 0.927]$$

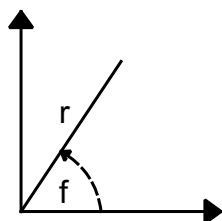
$$\text{cartesian2polar}_r(3, 4) = 5$$

$$\text{cartesian2polar}_f(3, 4) = 0.927$$

## Polar to cartesian

To transform polar coordinates to cartesian coordinates use the functions: polar2cartesian, polar2cartesian\_x, polar2cartesian\_y

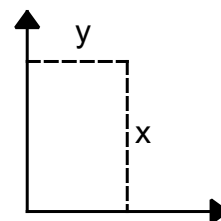
Polar



$$x = r \cdot \cos(f)$$

$$y = r \cdot \sin(f)$$

Cartesian



### Example

$$\text{polar2cartesian}(5, 1) = [2.702 \quad 4.207]$$

$$\text{polar2cartesian}_x(5, 1) = 2.702$$

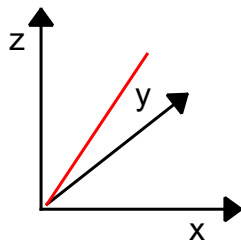
$$\text{polar2cartesian}_y(5, 1) = 4.207$$

When dealing with a coordinate system conversion in a 3D space, we have implemented the following transformations.

### Cartesian to cylindrical

To transform cartesian coordinates to cylindrical coordinates use the functions: cartesian2cylinder, cartesian2cylinder\_r, cartesian2cylinder\_f, cartesian2cylinder\_z

Cartesian

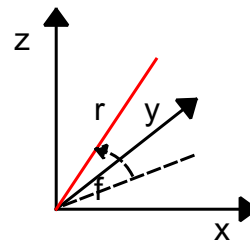


$$r = \sqrt{x^2 + y^2}$$

$$f = \arctan\left(\frac{y}{x}\right)$$

$$z = z$$

Cylinder



### Example

$$\text{cartesian2cylinder}(1, 2, 3) = [2.236 \ 1.107 \ 3]$$

$$\text{cartesian2cylinder}_r(1, 2, 3) = 2.236$$

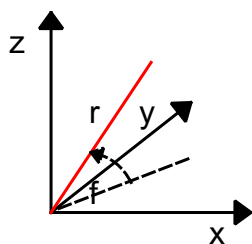
$$\text{cartesian2cylinder}_f(1, 2, 3) = 1.107$$

$$\text{cartesian2cylinder}_z(1, 2, 3) = 3$$

### Cylindrical to cartesian

To transform cylindrical coordinates to cartesian coordinates use the functions: cylinder2cartesian, cylinder2cartesian\_x, cylinder2cartesian\_y, cylinder2cartesian\_z

Cylinder

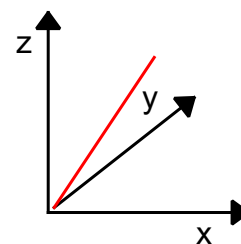


$$x = r \cdot \cos(f)$$

$$y = r \cdot \sin(f)$$

$$z = z$$

Cartesian



### Example

$$\text{cylinder2cartesian}(1, 2, 3) = [-0.416 \ 0.909 \ 3]$$

$$\text{cylinder2cartesian}_x(1, 2, 3) = -0.416$$

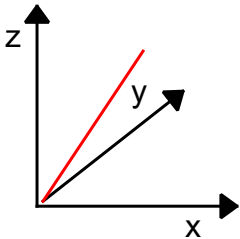
$$\text{cylinder2cartesian}_y(1, 2, 3) = 0.909$$

$$\text{cylinder2cartesian}_z(1, 2, 3) = 3$$

## Cartesian to spherical

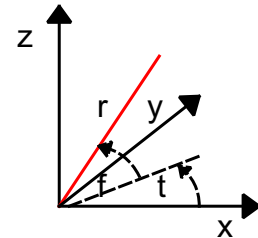
To transform cartesian coordinates to spherical coordinates use the functions: cartesian2sphere, cartesian2sphere\_r, cartesian2sphere\_f, cartesian2sphere\_t

Cartesian



$$r = \sqrt{x^2 + y^2 + z^2}$$
$$f = \arctan\left(\frac{\sqrt{x^2 + y^2}}{z}\right) \quad t = \arctan\left(\frac{y}{x}\right)$$

Spherical



### Example

$$\text{cartesian2sphere}(1, 2, 3) = [3.742 \quad 1.107 \quad 0.641]$$

$$\text{cartesian2sphere}_r(1, 2, 3) = 3.742$$

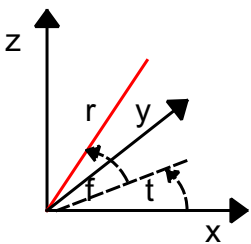
$$\text{cartesian2sphere}_f(1, 2, 3) = 1.107$$

$$\text{cartesian2sphere}_t(1, 2, 3) = 0.641$$

## Spherical to cartesian

To transform spherical coordinates to cartesian coordinates use the functions: sphere2cartesian, sphere2cartesian\_x, sphere2cartesian\_y, sphere2cartesian\_z

Spherical

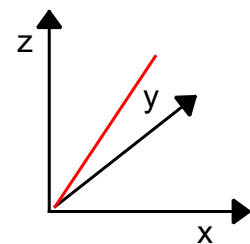


$$x = r \cdot \sin(f) \cdot \cos(t)$$

$$y = r \cdot \sin(f) \cdot \sin(t)$$

$$z = r \cdot \cos(f)$$

Cartesian



### Example

$$\text{sphere2cartesian}(1, 2, 3) = [-0.059 \quad 0.128 \quad -0.99]$$

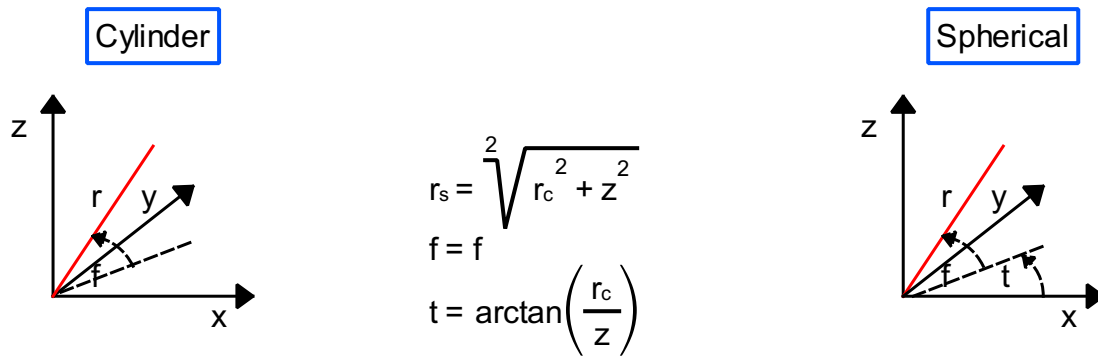
$$\text{sphere2cartesian}_x(1, 2, 3) = -0.059$$

$$\text{sphere2cartesian}_y(1, 2, 3) = 0.128$$

$$\text{sphere2cartesian}_z(1, 2, 3) = -0.99$$

## Cylindrical to spherical

To transform cylindrical coordinates to spherical coordinates use the functions: `cylinder2sphere`, `cylinder2sphere_r`, `cylinder2sphere_f`, `cylinder2sphere_t`



### Example

$$\text{cylinder2cartesian}(1, 2, 3) = [-0.416 \quad 0.909 \quad 3]$$

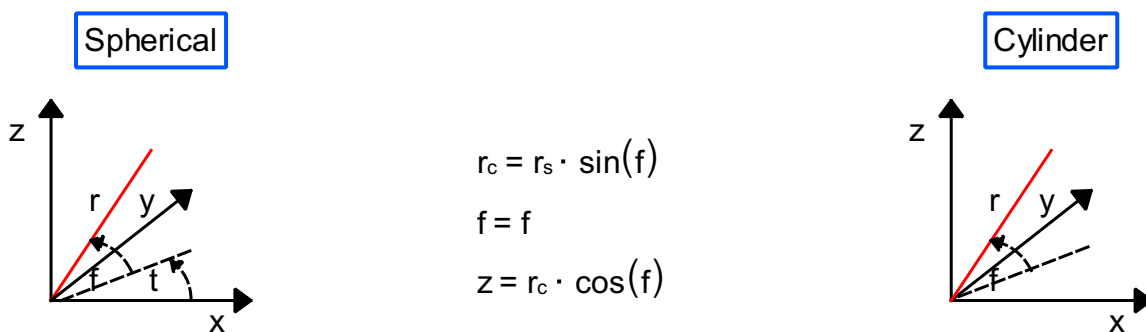
$$\text{cylinder2cartesian}_x(1, 2, 3) = -0.416$$

$$\text{cylinder2cartesian}_y(1, 2, 3) = 0.909$$

$$\text{cylinder2cartesian}_z(1, 2, 3) = 3$$

## Spherical to cylindrical

To transform spherical coordinates to cylindrical coordinates use the functions: `sphere2cylinder`, `sphere2cylinder_r`, `sphere2cylinder_f`, `sphere2cylinder_z`



### Example

$$\text{sphere2cylinder}(1, 2, 3) = [0.141 \quad 2 \quad -0.99]$$

$$\text{sphere2cylinder}_r(1, 2, 3) = 0.141$$

$$\text{sphere2cylinder}_f(1, 2, 3) = 2$$

$$\text{sphere2cylinder}_z(1, 2, 3) = -0.99$$