

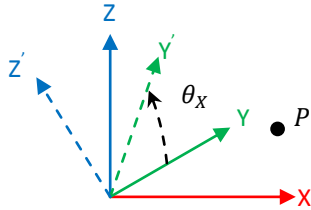
## Coordinate System Rotation Matrices

---

The standard coordinate system rotation matrices can be applied in the opposite direction to rotate the coordinate system instead of the point. This is done by swapping the sign of the sine components of each of the rotation matrices.

### Coordinate System Rotation about X-Axis

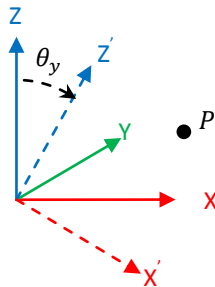
Description: The x-axis coordinate system rotation is similar to the standard x-axis rotation, except this rotation matrix rotates the coordinate system instead of the point about the current x-axis by an angle  $\theta_x$ .



$$\begin{bmatrix} P'_x \\ P'_y \\ P'_z \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(\theta_x) & \sin(\theta_x) & 0 \\ 0 & -\sin(\theta_x) & \cos(\theta_x) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} P_x \\ P_y \\ P_z \\ 1 \end{bmatrix}$$

### Coordinate System Rotation about Y-Axis

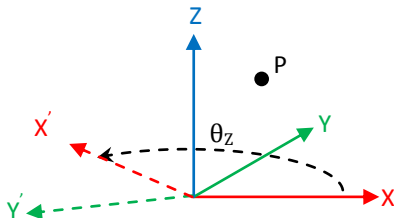
Description: The y-axis coordinate system rotation is similar to the standard y-axis rotation, except this rotation matrix rotates the coordinate system instead of the point about the current y-axis by an angle  $\theta_y$ .



$$\begin{bmatrix} P'_x \\ P'_y \\ P'_z \\ 1 \end{bmatrix} = \begin{bmatrix} \cos(\theta_y) & 0 & -\sin(\theta_y) & 0 \\ 0 & 1 & 0 & 0 \\ \sin(\theta_y) & 0 & \cos(\theta_y) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} P_x \\ P_y \\ P_z \\ 1 \end{bmatrix}$$

### Coordinate System Rotation about Z-Axis

Description: The z-axis coordinate system rotation is similar to the standard z-axis rotation, except this rotation matrix rotates the coordinate system instead of the point about the current z-axis by an angle  $\theta_z$ .



$$\begin{bmatrix} P'_x \\ P'_y \\ P'_z \\ 1 \end{bmatrix} = \begin{bmatrix} \cos(\theta_z) & \sin(\theta_z) & 0 & 0 \\ -\sin(\theta_z) & \cos(\theta_z) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} P_x \\ P_y \\ P_z \\ 1 \end{bmatrix}$$

