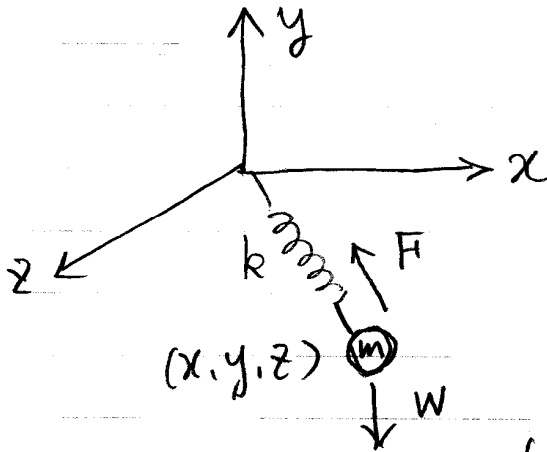


PSIO Formulation



Two forces to consider:

W: gravity

F: spring

Gravity $W = \begin{Bmatrix} W_x \\ W_y \\ W_z \end{Bmatrix} = \begin{Bmatrix} \\ \\ \end{Bmatrix}$

Spring force

$$\|F\| = k(l - l_0) = k(\quad)$$

$$F = \begin{Bmatrix} F_x \\ F_y \\ F_z \end{Bmatrix} = \begin{Bmatrix} \|F\| \cdot \underline{\hspace{2cm}} \\ \|F\| \cdot \underline{\hspace{2cm}} \\ \|F\| \cdot \underline{\hspace{2cm}} \end{Bmatrix}$$

$f = ma$ in x , y , and z -directions

$$x'' = \frac{F_x + W_x}{m} =$$

$$\leftarrow \textcircled{f_x}$$

$$y'' = \frac{F_y + W_y}{m} =$$

$$\leftarrow \textcircled{f_y}$$

$$z'' = \frac{F_z + W_z}{m} =$$

$$\leftarrow \textcircled{f_z}$$

Original indep. variables : x, y, z



New state variables : x, y, z, v_x, v_y, v_z

$$\begin{Bmatrix} x \\ y \\ z \end{Bmatrix} \longrightarrow \begin{Bmatrix} x \\ y \\ z \\ v_x \\ v_y \\ v_z \end{Bmatrix}$$

vector form

$$\begin{Bmatrix} x \\ y \\ z \\ v_x \\ v_y \\ v_z \end{Bmatrix} = \begin{Bmatrix} \leftarrow f_1 \\ \leftarrow f_2 \\ \leftarrow f_3 \\ \leftarrow f_4 \\ \leftarrow f_5 \\ \leftarrow f_6 \end{Bmatrix}$$