IP[y]: Notebook ee547_hw1 Last Checkpoint: Jan 14 17:50 (unsaved changes)

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- Python
- Markdown
- NumPy
- SciPy
- Matplotlib
- SymPy
- pandas

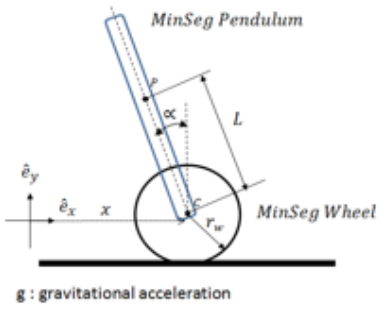
Code Cell Toolbar: None

In [3]:
```
import warnings
warnings.filterwarnings('ignore')
from IPython.display import Image
Image(filename="C:\cygwin64\home\lq561d\ee547_hw1_img1.png")
```

Out[3]:

Problem 1 Consider a MinSeg model as below. The geometric parameters and some constants are labeled on the figure. A system of equations is derived as (1) to describe the movement and angle of rotation of MinSeg body.

a) Let's focus on the translation of MinSeg wheel (x) and rotation of MinSeg pendulum (α). Please linearize (1) around equilibrium point $x^{eq} = \alpha^{eq} = 0$. (Hint: high order terms shall be ignored.)



α : angle between of MinSeg Pendulum and vertical axis;
L : distance between wheel center and reference point over pendulum;
m_p : mass of pendulum;
I_p : moment of inertia at reference point of pendulum;

x : traveling distance of wheel;
c : center of wheel;
m_w : mass of wheel;
r_w : radius of wheel;
$I_{cm,w}$: moment of inertia at center of mass of wheel;

Figure 1 MinSeg system

$$\begin{bmatrix} -(I_p + m_p L^2) & m_p L \cos\alpha \\ m_p L\, r_w^2 \cos\alpha & -(I_{cm,w} + m_w r_w^2 + m_p r_w^2) \end{bmatrix} \begin{bmatrix} \ddot{\alpha} \\ \ddot{x} \end{bmatrix} = \begin{bmatrix} T_m - m_p L g \sin\alpha \\ T_m r_w + m_p L\, r_w^2 \dot{\alpha}^2 \cos\alpha \end{bmatrix} \quad (1)$$

where T_m is the torque from the DC motor, which is not explicitly demonstrated in Figure 1.