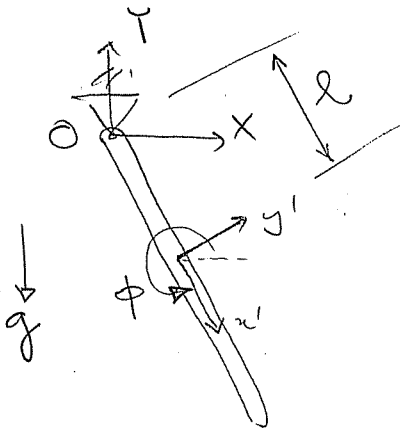
Example 6.3.6.

~ Simple Pendulum IC's ~



To establish a set of consistent IC one has only to consider the constraints associated with the model.

For our model we have a revolute joint between pendulum and ground at point O.

$$r^O = r + A\begin{bmatrix} -l \\ 0 \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} c\phi & -s\phi \\ s\phi & c\phi \end{bmatrix}\begin{bmatrix} -l \\ 0 \end{bmatrix}$$

$$= \begin{bmatrix} x - l c\phi \\ y - l s\phi \end{bmatrix}$$

The constraints read:

$$\phi(q) = \begin{bmatrix} x - l c\phi \\ y - l s\phi \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

At time $t=0$ I want the mechanism to start from a vertical configuration hanging down. I also want it to have an initial angular velocity of $\omega = \dot{\phi} = 2\pi$. These conditions translate at time $t=0$

$$\begin{cases} \dot{\phi} - \frac{3\pi}{2} = 0 \\ \dot{\phi} - 2\pi = 0 \end{cases}$$

The position ICs are going then to be the solution of the following set of nonlinear equations:

$$\begin{cases} x_0 - l c\phi_0 = 0 \\ y - l s\phi_0 = 0 \\ \phi_0 - \frac{3\pi}{2} = 0 \end{cases} \Rightarrow \boxed{\begin{aligned} x_0 &= 0 \\ y_0 &= -l \\ \phi_0 &= \frac{3\pi}{2} \end{aligned}}$$

As far as the velocity is concerned,

$$\dot{\phi} = \begin{bmatrix} \dot{x} + \dot{\phi} l s\phi \\ \dot{y} - \dot{\phi} l c\phi \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\dot{\phi}^{IC} = \dot{\phi} - 2\pi = 0$$

Then $\dot{x}, \dot{y}, \dot{\phi}$ is the solution of the following linear system of equations:

$$\begin{cases} \dot{x}_0 + \dot{\phi}_0 l s\phi_0 = 0 \\ \dot{y}_0 - \dot{\phi}_0 l c\phi_0 = 0 \\ \dot{\phi}_0 - 2\pi = 0 \end{cases}$$

Since $\phi_0 = \frac{3\pi}{2} \Rightarrow$

$$\boxed{\begin{aligned} \dot{x}_0 &= l\dot{\phi}_0 \\ \dot{y}_0 &= 0 \\ \dot{\phi}_0 &= 2\pi \end{aligned}}$$

Since $l = 0.2$ m, we end up with

$$q_0 = \begin{bmatrix} 0 \\ -0.2 \\ \frac{3\pi}{2} \end{bmatrix} \qquad \dot{q}_0 = \begin{bmatrix} 0.4\cdot\pi \\ 0 \\ 2\pi \end{bmatrix}$$

These are the values that you should enter in the adm file associated with this mechanism.