restart

#Initialize linear algebra
with(*LinearAlgebra*) :
with(*CodeGeneration*) :

#Import expressions from other worksheets:

read "../Equations_of_motion/eom.m";

#Inserting for virtual holonomic constraint

$E := K0 + P0$:

$$Ev := E0 = collect\left(subs(q1 = \mathrm{theta}(t), q2 = \mathrm{phi}(\mathrm{theta}(t)), Dq1 = diff(\mathrm{theta}(t), t), Dq2 = diff(\mathrm{phi}(\mathrm{theta}(t)), t), E), \left[\left(\frac{\mathrm{d}}{\mathrm{d}t} \theta(t) \right)^2 \right] \right);$$

$$eom := M.Vector([DDq1, DDq2]) + Cc.Vector([Dq1, Dq2]) + G :$$

$$aby1 := collect\left(subs(q1 = \mathrm{theta}(t), q2 = \mathrm{phi}(\mathrm{theta}(t)), Dq1 = diff(\mathrm{theta}(t), t), Dq2 = diff(\mathrm{phi}(\mathrm{theta}(t)), t), DDq1 = diff(diff(\mathrm{theta}(t), t), t), DDq2 = diff(diff(\mathrm{phi}(\mathrm{theta}(t)), t), t), eom(1)), \left[\frac{\mathrm{d}^2}{\mathrm{d}t^2} \theta(t), \left(\frac{\mathrm{d}}{\mathrm{d}t} \theta(t) \right)^2 \right] \right);$$

$$aby2 := collect\left(subs(q1 = \mathrm{theta}(t), q2 = \mathrm{phi}(\mathrm{theta}(t)), Dq1 = diff(\mathrm{theta}(t), t), Dq2 = diff(\mathrm{phi}(\mathrm{theta}(t)), t), DDq1 = diff(diff(\mathrm{theta}(t), t), t), DDq2 = diff(diff(\mathrm{phi}(\mathrm{theta}(t)), t), t), eom(2)), \left[\frac{\mathrm{d}^2}{\mathrm{d}t^2} \theta(t), \left(\frac{\mathrm{d}}{\mathrm{d}t} \theta(t) \right)^2 \right] \right);$$

$$aby1 := collect\left(aby1, \left[\frac{\mathrm{d}^2}{\mathrm{d}t^2} \theta(t), \left(\frac{\mathrm{d}}{\mathrm{d}t} \theta(t) \right)^2 \right] \right) :$$

$$aby2 := collect\left(aby2, \left[\frac{\mathrm{d}^2}{\mathrm{d}t^2} \theta(t), \left(\frac{\mathrm{d}}{\mathrm{d}t} \theta(t) \right)^2 \right] \right) :$$

$$alpha1 := coeff\left(aby1, \frac{d^2}{dt^2}\,\theta(t)\right);$$

$$alpha2 := coeff\left(aby2, \frac{d^2}{dt^2}\,\theta(t)\right);$$

$$gamma1 := subs\left(\left(\frac{d}{dt}\,\theta(t)\right)^2 = 0, \frac{d^2}{dt^2}\,\theta(t) = 0, aby1\right);$$

$$gamma2 := subs\left(\left(\frac{d}{dt}\,\theta(t)\right)^2 = 0, \frac{d^2}{dt^2}\,\theta(t) = 0, aby2\right);$$

$$beta1 := subs\left(\frac{d^2}{dt^2}\,\theta(t) = 0, \left(\frac{d}{dt}\,\theta(t)\right)^2 = 1, aby1\right) - gamma1;$$

$$\beta 2 := subs\left(\frac{d^2}{dt^2}\,\theta(t) = 0, \left(\frac{d}{dt}\,\theta(t)\right)^2 = 1, aby2\right) - \gamma 2;$$

$$abyEq := collect\left(solve\left(subs\left(\left(\frac{d}{dt}\,\theta(t)\right)^2 = placeholder, diff(\mathrm{theta}(t), t)^2 = \frac{\alpha 2\cdot\gamma 1 - \alpha 1\cdot\gamma 2}{\alpha 1\cdot\beta 2 - \alpha 2\cdot\beta 1}\right),\ \mathrm{D}^{(2)}(\phi)(\theta(t))\right), placeholder\right);$$

$$energyEq := solve\left(subs\left(\left(\frac{d}{dt}\,\theta(t)\right)^2 = placeholder, Ev\right), placeholder\right);$$

$$f := subs(placeholder = energyEq, abyEq);$$

#Creating Matlab code

$$f0 := algsubs\left(\mathrm{D}(\phi)(\theta(t)) = Dphi, f\right):$$
$$f0 := algsubs(\mathrm{phi}(\mathrm{theta}(t)) = \mathrm{phi}, f0):$$
$$f0 := algsubs(\mathrm{theta}(t) = \mathrm{theta}, f0):$$

$$Matlab(f0, resultname = 'f0');$$

save *f*, "diff_eq_phi.m";