Week HW 8, EULER LAGRANGE

Euler-Lagrange equation

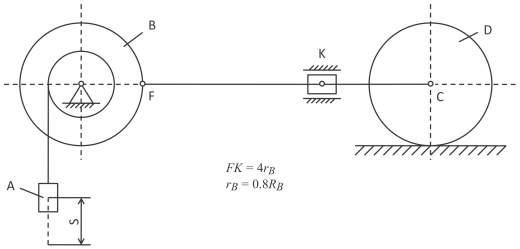
INNOPOLIS UNIVERSITY

Task 1 (Coding)

A mechanical system under the gravity force moves from the rest. Define the velocity of object *A* if it travels distance *s* from the rest. The masses of the non-deformable ropes are ignored. Neglect the masses of links *FK*, *KC* and the piston *K*.
The task is to:

1. make a plot $v_A(s)$;
2. What will change if we omit the last sentence (Neglect …). (Explain it and show on equations). Why Yablonskii made these constraints?

Needed variables:
$m_A = 1,\ m_B = 3,\ m_D = 20$ (kg);
$R_B = 20,\ R_D = 20,\ i_{Bx} = 18$ (cm), i_{Bx} – radii of gyration of the body;
$\psi = 0.6$ (cm), where ψ is rolling friction.



Task 1
(Yablonskii (eng) D6)

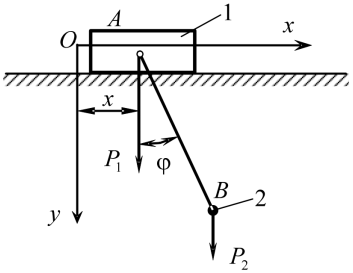
Task 2 (Coding)

System description

You have a a cart pole. Body 1 is a slider, mass m_1, it moves without friction.

AB is a massless rod with length *l*. Body 2 with mass m_2 is connected to *AB* in point *B*.

It's a 2 DoF system. You should take x and ϕ as a representation of this system. The origin of each coordinate should be the same as on the picture.



Task 2

Initial conditions:

1. $x = 0,\ \phi = 10°,\ \dot{x} = 0,\ \dot{\phi} = 0,\ t = 0;$
2. $x = 0.5,\ \phi = 45°,\ \dot{x} = 0,\ \dot{\phi} = 0,\ t = 0;$
3. $x = 0.5,\ \phi = -135°,\ \dot{x} = 0,\ \dot{\phi} = 0,\ t = 0;$

Parameters: $m_1 = 5\ kg,\ m_2 = 1\ kg,\ l = 1\ m.$

Task 2 (Coding)

Tasks description

You should solve this problem using **Euler-Lagrange** method;

Tasks

1. To derive a differential equation of the motion, using **Euler-Lagrange** approach.
2. To create plots $x(t)$, $\phi(t)$, $\dot{x}(t)$, $\dot{\phi}(t)$.
3. To make a simulation of this system. Show velocities and accelerations for 1, 2 bodies (coding approach).
4. Compare the obtained results from previous lab (*Newton-Euler* and *Model-oriented design*).

Deserve “A” grade!

– Oleg Bulichev

o.bulichev@innopolis.ru

@Lupasic

Room 105 (Underground robotics lab)