Week HW 7, KIN ENERGY NEWTON EULER

Theorem on the Change of Kinetic Energy of a System

Newton-Euler equation

INNOPOLIS UNIVERSITY

Task 1

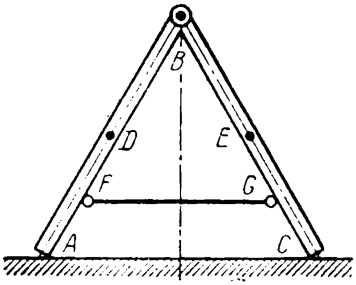
A step ladder ABC, hinged at B, rests on a smooth horizontal floor, as shown on the figure. $AB = BC = 2l$.

The centres of gravity are at the midpoints D and E of the rods. The radius of gyration of each part of the ladder about the axis passing through the center of gravity is p.

The distance between B and the floor is h. At the certain moment the ladder collapses due to the rupture of a ling FG between the two halves of the ladder. Neglecting the effect of friction in the hinge, determine:

1. the velocity v_1 of the point B at the moment, when it hits the floor;
2. the velocity v_2 of point B at the moment, when it is at a distance $\frac{1}{2}h$ from the floor.

Answer: $v_1 = 2l\sqrt{\dfrac{gh}{l^2 + p^2}}$, $v_2 = \dfrac{1}{2}\sqrt{gh\dfrac{16l^2 - h^2}{2(l^2 + p^2)}}$.



Task 1

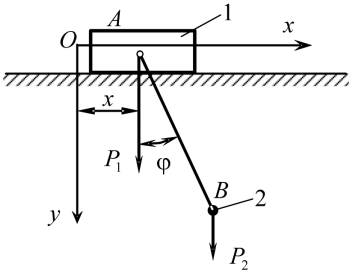
Task 2 (Coding)

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:

1. **Newton-Euler** method;
2. Model-oriented design applications (*SimInTech*, or MATLAB Simulink).

Tasks

1. To derive a differential equation of the motion, using **Newton-Euler** 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).

Artifacts

1. Report in *.pdf* or in *.md*.
2. For **Newton-Euler** method — code, GIFs, plots.
3. For **SimInTech** — *.prt*, for **Simulink** — *.slx* file which contains a description of the system, GIFs, plots.

Deserve “A” grade!

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Room 105 (Underground robotics lab)