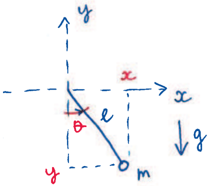
Homework 2: Task 1



Consider the point-mass system moving in the vertical plane (x, y) in presence of the gravity assuming that any of its motions is consistent with the constraint: $x(t)^2 + y(t)^2 - l^2 \equiv 0$.

The dynamics of the system written in excessive coordinates (x, y) are

$$\begin{aligned} m \cdot \ddot{x} &= \tfrac{m}{l^2}\left(y \cdot g - \dot{x}^2 - \dot{y}^2\right) \cdot x \\ m \cdot \ddot{y} &= \tfrac{m}{l^2}\left(y \cdot g - \dot{x}^2 - \dot{y}^2\right) \cdot y - m \cdot g \end{aligned} \qquad (1)$$

and the dynamics written in generalized coordinate θ

$$\ddot{\theta} + \tfrac{g}{l} \cdot \sin\theta = 0 \qquad (2)$$

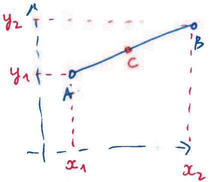
Check that a solution of (1) given by

$$x(t) = l \cdot \sin\theta(t), \quad y(t) = -l \cdot \cos\theta(t)$$

is determined by the system (2).

Homework 2: Task 2

Consider two point masses of $m = 1$ [kg] each connected by massless rod of length l and moving in the vertical plane.



Constraint No. 1: $\left(x_1(t) - x_2(t)\right)^2 + \left(y_1(t) - y_2(t)\right)^2 = l^2, \; \forall \, t$

Constraint No. 2: Assume that the velocity of the center of the rod – point C on the plot

$$\vec{v}_C = \left[\tfrac{1}{2}(\dot{x}_1 + \dot{x}_2); \; \tfrac{1}{2}(\dot{y}_1 + \dot{y}_2)\right]$$

always aligned with the rod written as the identity

$$\left(x_2(t) - x_1(t)\right)\left(\dot{y}_1(t) + \dot{y}_2(t)\right) - \left(y_2(t) - y_1(t)\right)\left(\dot{x}_1(t) + \dot{x}_2(t)\right) \equiv 0$$

Homework 2: Task 2

Assignments:

- Write the dynamics of the system
- Integrate the dynamics, i.e. given initial conditions, find the corresponding solution of the system as a function of time

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If necessary, use the (hand written) materials provided for solving the task ☺