Week HW 1, KIN PART ROT PLANE1

Particle kinematics

Rotational motion

Plane motion, simple

Week HWs formal rules

Grading

1. HW costs 5 point max.
2. Not late policy. If you submit it later, 0 points.
3. Score distribution:
   - Correct formal criteria and document structure — 1 score.
   - Correct algorithm and idea — 2 out of 5 for sure.
   - Correct plots and simulation — 2 out of 5.

Week HWs formal rules

Tasks and formal reporting

Tasks

1. If task has label ”coding”, it should be not only solved, but also coded.
2. It’s a good practice to code not coding task, for checking your calculations (not obligatory).
3. Consider, that this report you are making for yourself to use it in future. I mean, it can be helpful sometimes to put full solution, not like ”(1) eqn -> after trivial magical passes (2)”. It’s recommended to explain each step (it helps you and me to find mistakes and typos).
4. Each HW is a report. It consists of a solution (don’t forget about formal criteria), info about tools which were used, link to the code.

Formal reporting

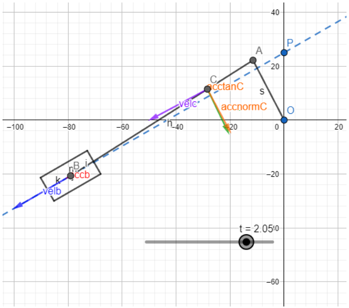
1. In Moodle you are sending only a report (other stuff are links). **IN PDF**, *txt* files won’t be opened.
2. We are in IT university, hence it’s obligatory that your code should work on other computers.

Week HWs formal rules

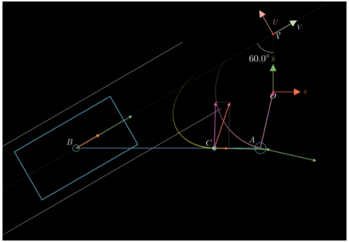
Report template

1. **Tools**. Write, what tools did you use for solving task (Python/Matlab ..., Latex/Markdown ...)
2. **Link to the simulation.** If you put report together with the code, then the path is needed.
3. **Task description.** Retype or put a screenshot of the task.
4. **Task explanation.** It can be typed or be handwritten, or mixed. The goal, to explain step by step, how did you solve the task. You should explain your formulas too.
   I'd like to highlight, that the way how do you make a simulation is also worthy for be explained. Assume, that you are writing it for yourself, and you will read it later.
5. **Plots**. Put needed plots. Don't forget to make an appropriate title, legend, and axes description.
6. **Screenshots from simulation**. Several screenshots, in some interesting positions. Example: parabola — midway of left branch, root, somewhere in right branch.
7. **Meme (optional)**. Put funny picture/video))

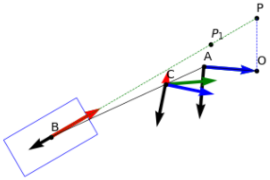
Simulation examples



(a) Geogebra app



(b) Manim library



(c) Matplotlib animations

Code samples: Here

Task 1 (Coding)

You should find:

1. simulate the move of $\vec{O}$ for $t = [0..10]$;
2. find and draw plots $v,\ a,\ a_n,\ a_\tau,\ \kappa$ (Osculating circle) respect to t;
3. find $y(x)$, $\vec{v}$, $\vec{a}$, $\vec{a}_n$, $\vec{a}_\tau$ and show it on the simulation.

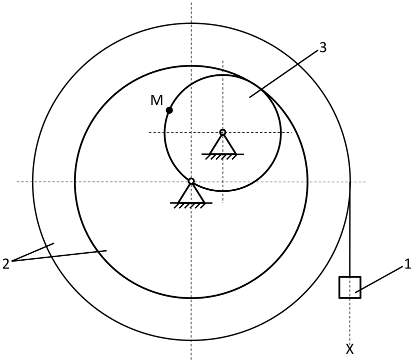
$$\vec{O} = \begin{cases} x = 3\cos(2t)\cos(t) + 0.82 \\ y = 3\cos(2t)\sin(t) + 0.82 \end{cases}$$

Task 2 (Coding)

You should solve the task, till the *M* point travels *s*:

1. simulate this mechanism (obtain all positions of bodies 1, 2, 3)
2. velocity for *M*(draw plots for magnitudes and show vectors on simulation);
3. accelerations (tangent, normal, overall) for *M*(draw plots for magnitudes and show vectors on simulation);
4. draw plots of angular velocities for 2, 3 bodies.

If $R_2 = 40,\ r_2 = 30,\ R_3 = 15$
$x = x(t) = 3 + 80t^2,\ s_M = 0,5.$



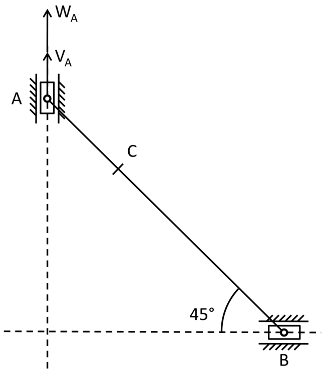
Task 2
(Yablonskii (eng) K2

Task 3 (Coding)

You should find:

1. simulate this mechanism (obtain all positions.) $(x_i(t),\ y_i(t)$, where i is $A,\ B,\ C$ point)
2. velocities for $B,\ C$ (draw plots for magnitudes and show vectors on simulation);
3. accelerations for B and C (draw plots for magnitudes and show vectors on simulation);
4. draw a plot of angular velocity of body BA.

If $y_A(t) = 22.5 + 10sin(\frac{\pi}{5}t);\ t = [0..10]\ sec.;$
$AB = 45,\ BC = 30.$



Task 3
(Yablonskii (rus) K3)

Deserve “A” grade!

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Room 105 (Underground robotics lab)