Big HW 2

Dynamics

Outline

1. General ideas beside HW

2. Global task description

3. Detailed task description

4. What report should contain

5. Hints

General ideas beside HW

- It is a research homework, hence there is no unique right answer. Therefore, you have to prove your solution.

- The report should be unique, but you can do it in groups. But you must record who did what. Like, «Katya gathered a dataset, Ahmed measured a stand» and so on.

- You can read papers, use solutions from the internet, that's fine. But you have to mention it in the report.

Global task description

There is the cart pole system in the lab. Your global goal is to create a math model of it and prove that the model is really describes it.

Cart pole in the dungeon

Detailed task description

1. Obtain the required measurements of the stand (like needed masses, lengths and so on).

2. Gather the positions and velocities of the stand. You should run the same experiment 3 times each.

   Initial conditions:
   - $x = 0$, $\phi = 15°$, $\dot{x} = 0$, $\dot{\phi} = 0$, $t = 0$;
   - $x = 0.25\ m$, $\phi = 45°$, $\dot{x} = 0$, $\dot{\phi} = 0$, $t = 0$;
   - $x = 0.25\ m$, $\phi = -135°$, $\dot{x} = 0$, $\dot{\phi} = 0$, $t = 0$;

3. Substitute a real data to your math model from HW 7, 8 (you can choose any method your like) and compare the results (propose and justify the metric).

4. Explain, what affects the difference between math model and real data. Is it difference significant?

5. If so, change the model (add new forces, change the object representation), gather new needed data and compare it again.

6. Make a conclusion.

What report should contain

- The list of used tools and applications (I gathered a trajectory dataset using *x* tool), etc.

- The list of data you gathered from stand and how did you do it.

- Show how you conducted experiments. Is there any difference when you did the same experiment? Show it using plots and/or other metrics like *std, mse* and so on.

- Show the way how you chose the metrics for trajectory comparison, how you justify the answer.

- If the error is too large, explain how you wanted to change your model and why you chose such path.

- Summarize your experience.

Hints

- To determine inertia, you can create (or find) a CAD model and take data from it, or you can do an actual experiment to determine it.

- When you perform the experiment, you can make a template (for example, a piece of paper with a 10-degree angle).

- For choosing a metric for how to compare trajectories, you can start with the concept of least squares.

- Some of the data for the math model can be taken from the stand itself (e.g., friction).

- Feel free to do a literature review to find good ideas. But you must show exactly what you used.

Deserve "A" grade!

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🚪 Room 105 (Underground robotics lab)