**MATLAB Report (Group – 49)- Dynamics of Crane**

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**Questions on the code:**

1. **What is the main goal of the experiment? What is ode45? What are the input arguments? What are the output arguments?**- In this experiment we look at the dynamics of the crane, specifically the compression and the tension forces experienced on the arm due to a point mass. By modelling the construction crane and numerically solving the differential equation in MATLAB, we can visualize the effects that the mass has under various scenarios. ODE 45 solver in MATBLAB is used to solve ordinary differential equations. The input arguments are the right side of the differential equation (ODEfun), time interval (t0, tEnd), the initial conditions (U0) for the point mass and the model parameters. The output arguments are the result at the given time point and the solution after the evaluation.
2. **What are the differences between scenarios ‘b’ and ‘c’? When answering to this question, please**

**take into account the following points.**

1. **What are the initial conditions φ and ˙φ for the point mass? What is the gravitational acceleration in both scenarios? In which file are the initial conditions specified?**

- ‘φ’ is the angular degree of freedom and ‘˙φ’ is the angular velocity for the point mass. The predefined values for case ‘b’ - ‘φ’=0, ‘˙φ’ =1 and for case ‘c’- ‘φ’=0.05, ‘˙φ’ =0.5. For the scenario ‘b’ there is no gravitational acceleration and in case ‘c’, we have standard gravitational acceleration (g=9.81m/s2). The initial conditions are mentioned in the file ‘parameter.m’.

**b) What are the resulting motions of the point mass in the two scenarios?**

- In case ‘b’ due to absence of gravitational acceleration we see a uniform circular motion. In case ‘c’ we have a pendulum motion due to presence of gravitational acceleration.

**c) Show and comment the differences in the results with the following MATLAB plots:**

• **solution in Cartesian coordinates.**

A graph of a graph

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Scenario c

Scenario b

We observe uniform circular motion due to

constant kinetic energy with respect to time.

Pendulum motion due to alternating between potential and kinetic energy

A graph of a function

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A graph on a graph

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Scenario c

Scenario b

Sinusoidal relationship between ‘φ’, ‘˙φ’ and time. ‘˙φ’ lags ‘φ’.

We see linear relationship due to absence of gravity and movement in the same direction.

A blue circle on a white grid

Description automatically generated• **φ˙ vs φ (phase space portrait).**

A graph of a graph

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Scenario c

Scenario b

The maximum and minimum value for ‘˙φ’ occurs at ‘φ’= 0, and the maximum and minimum value for ‘φ’ occurs at ‘˙φ’ = 0

‘˙φ’ is constant for every value of ‘φ’ due to the absence of acceleration due to gravity.

1. **Show the normal stresses distribution in scenation ‘c’ with a figure and reply to the following**

**questions.**

A colorful gradient on a white background

Description automatically generated

1. **Which part of the crane does the geometry show in the stress distribution?**

- The stress distribution for the beam (Arm) of the crane is shown.

**b) Which sections of the geometry have the maximum and minimum stresses in terms of magnitude? In other words, which sections have the highest tensile and compressive stresses? And which colours represent tensile and compressive stresses?**

- The section marked in red experiences the maximum stress and the section in blue is experiencing the minimum stress. The red colour represents tensile, and the blue represents compressive.

**c) Watch the video of the normal stress. Are the positions of the maximum and the minimum**

**stresses the same during the entire simulation time? Why or why not?**

- The position of the maximum and the minimum stresses during the simulation interval remain the same, we find the max stress to be at the same point due the support only on one end, hence the maximum bending forces exerted by the point mass due to gravity is found towards the support during the entire time interval.

1. **Explain the aim of exercise 7 by taking into account the following points in your answer.**
2. **Which two solvers are compared?**

- In task 7 we analyse two different solvers through the quality of their solution by comparing the solution at various tolerance. ODE 45 and ODE 23 are compared.

**b) In which scenario is the comparison carried out?**

- The comparison is run in scenario ‘c’.

**c) Which quantity (bar force, or energy, etc.) is compared?**

- We compare the total energy over time.

**d) Knowing the forces acting on the system, how should the amount behave in this scenario?**

- The total energy should be constant due to the pendulum motion as total energy is the addition of the kinetic and the potential energy.

**e) For which tolerances are the results the same? Show the comparison with the MATLAB plot.**

A graph of different colored lines

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* For the tolerance 10-7, 10-8 the results are almost identical.

**f) In your opinion, which of the two solvers is better suited for our application? Why?**

- ODE 45 is the better solver for our use case, as it provides a more accurate solution, and it can handle more dynamic step size/ interval. This allows us to interpret results for each of the cases in a better way.