UNIVERSITÄT ZU LÜBECK
INSTITUTE FOR ROBOTICS
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Humanoid Robotics
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Exercise sheet 0 - Matlab and V-rep

Please prepare the following exercises for the upcoming tutorial.

Task 1: Pendulum

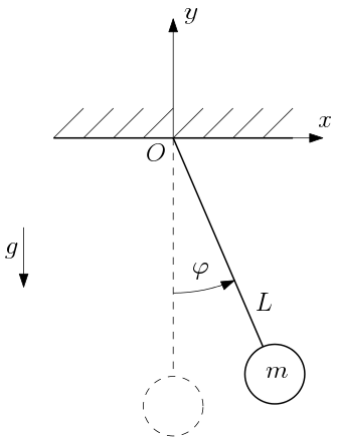

Figure 1 Pendulum

The pendulum, which is shown in Figure 1, shall be analyzed given the following specifications,

$$\begin{aligned} L &= 1.0\,\mathrm{m} \\ m &= 0.5\,\mathrm{kg} \\ g &= 9.81\,\mathrm{m/s^2} \\ \varphi(t=0) &= 0.1\,\mathrm{rad} \\ \dot{\varphi}(t=0) &= 0\,\mathrm{rad/s} \end{aligned} \tag{1}$$

(a) Determine the response of the pendulum $\varphi(t)$ for the time interval $t \in [0\,\mathrm{s} \quad 10\,\mathrm{s}]$ assuming $\varphi << 1 \quad \forall t$ in order to linearize the differential equation. Plot the answer using Matlab. Label all axes and add a legend.

(b) Determine the response of the pendulum $\varphi(t)$ for the non-linearized differential equation using Matlab's ODE solver, e. g., with the function ode45. Plot $\varphi(t)$ for $t \in [0\,\mathrm{s} \quad 10\,\mathrm{s}]$.

(c) Do (a) and (b) again with $\varphi(t=0) = 3$ and compare the results.

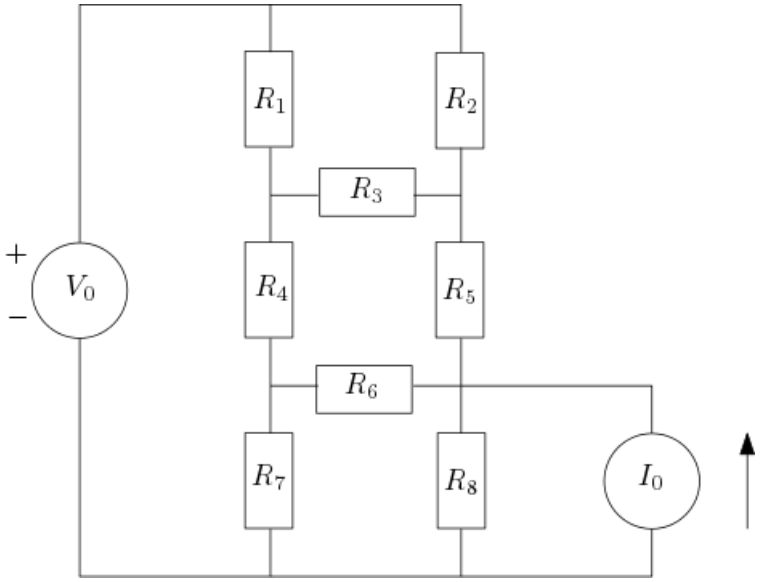

Figure 2 Electric Circuit

Task 2: Electric Circuit

The electric circuit, which is shown in Figure 2, shall be analyzed given the following specifications,

$$\begin{aligned} V_0 &= 5.0\,\mathrm{V} \\ I_0 &= 2.0\,\mathrm{A} \\ R_1 &= 1.0\,\Omega \\ R_2 &= 1.0\,\Omega \\ R_3 &= 2.0\,\Omega \\ R_4 &= 2.0\,\Omega \\ R_5 &= 3.0\,\Omega \\ R_6 &= 3.0\,\Omega \\ R_7 &= 4.0\,\Omega \\ R_8 &= 4.0\,\Omega \end{aligned} \tag{2}$$

(a) Compute all voltages and currents across all resistors using the node analysis method. For this computation, write the equations in matrix from and use Matlab for the calculation.

Task 3: V-REP Introdcution

In the tutorial we go through a V-REP (virtual robot experimentation platform) introduction. Please download and install V-REP educational from `http://www.coppeliarobotics.com/downloads.html`. You can start to get an overview over V-REP by following the tutorials from `http://www.coppeliarobotics.com/helpFiles/en/tutorials.htm`. In the introduction, we start with a short overview of V-REP and show how to connect and steer a robot in V-REP via Matlab. V-Rep will be used in the upcoming exercises, so if you have any questions or problems please get in touch in time.

Additional important links:

- `http://www.coppeliarobotics.com/helpFiles/en/remoteApiFunctionsMatlab.htm`
- `https://www.youtube.com/watch?v=piI5wYEXUms`
- `https://www.youtube.com/watch?v=mal48Vd-DQY`

Graded Assignment

There will be no graded assignment this week.