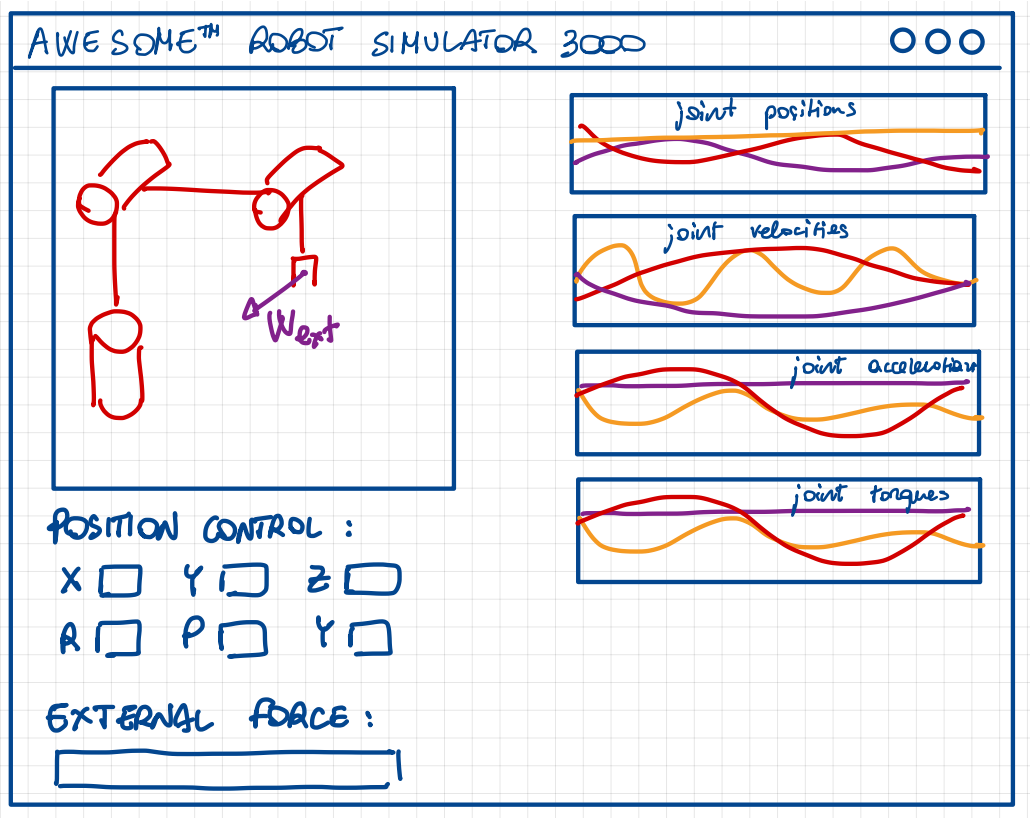
Worcester Polytechnic Institute

RBE/ME 501 – ROBOT DYNAMICS
MINI-PROJECT 2
Spring 2024 – Instructor: L. Fichera

PROBLEM STATEMENT

Your goal in this mini project is to develop a robot dynamics simulator in MATLAB. The application must include a Graphical User Interface (GUI) that displays (a) the kinematic chain of the robot, (b) plots that display the state of the robot in real time, and (c) controls to interact with the robot. A wireframe sketch of the GUI is included below:



You are welcome to simulate any commercially-avilable robot arm you like, but bear in mind the following:

- The robot must have at least 6 degrees of freedom.
- It cannot be any of the robots you have encountered in this course until now.
- The robot's inertial properties (mass, rotational inertia tensor) should be retrieved from the robot's URDF file – include a reference to it (URL) in your code.

To a minimum, the application should implement the following functionalities:

- **Online Simulation**: The forward dynamics engine should be on at all times, and the plots of joint varialbes (position, velocity, acceleration, torque) should be updated accordingly in real-time. To

prevent the robot from falling down under its own weight, gravity compensation must be performed at all times.

- **Position Control**: It must be possible for a user to specify a target configuration (in task space) for the robot to move to. The application should solve the inverse kinematics in the background, then run the Recursive Newton Euler algorithm to make the robot move to the target. The GUI should animate the robot to display its movement, and the plots of joint variables (position, velocity, acceleration, torque) should be updated accordingly in real-time.
- **Application of an External Force**: It must be possible for a user to specify an external wrench that acts on the robot. This could be used, for instance, to simulate a payload.

Grading Rubric: The grading scheme for this mini project is a simple Satisfactory/Unsatisfactory. To make the determination, the following factors will be considered:

- Is the software of professional quality?
  - Does the application run without errors?
  - Does it produce minimal warnings? Are the warnings explainable?
  - Is the code well organized into functions/classes?
  - Is the software well documented?
  - Is a user manual/tutorial provided?
- Does the application offer the minimum set of functionalities described earlier?
- Did all team members contribute equally to the work?