Assignment 3
Phantom Robot
Biomedical Robotics

Phantom Omni Robot

- ➢ Serial architecture
- ➢ Force feedback
- ➢ Feel sense of touch during manipulation of virtual objects

Phantom Robot Assignment

1 Reaching Task

2 Force Fields

Reaching Task - Design

Phantom Simulink block

VR toolbox and wrl file

✓ Read encoders
✓ Read end effector's Cartesian position (x, y, z)

✓ Display cursor and target on the screen:
   a. **Cursor**: It allows the user to visualize the position of the end effector → smaller circle
   b. **Target**: its position is displayed through a bigger circle

Feel free to modify the wrl file!

Reaching Task – State Machine

❖ Definition of the state machine of the reaching task:

- **Starting setting:**
    - ○ home target → at the center of the screen
    - ○ 8 equi-spaced possible targets on a circle (radius: 10 cm) → centered on the home target (see wrl file)

- **Iterative process:**
    1) when the cursor reaches the central target, the target changes color to give a feedback to the user;
    2) when the cursor stays in this position for 1 s, the target disappears and the home target appears;
    3) the cursor returns to the home target and holds the position for 2 s;
    4) iterate the process from 1).

    Repetition : **10 times** (reaching the 8 targets in random order).

Reaching Task - Hints

➢ Set a **threshold** → to assess if the cursor has reached the target

➢ Robot's end effector moves in the space

VS

The reaching task is implemented on a plane

Force Fields - Design

Creation of the new model

- Phantom will apply force fields related to:
  1) the position of the end effector;
  2) the velocity of the end effector.

- Robot's characteristics :
  1) impedance controller → definition of a force field (3x3 matrix)
  2) The 3x3 matrix will multiply the end-effector's position vectors and/or velocity

Force Fields - Questions

Q1: Define how to compute (and comment) a field that attracts the end effector toward the target. How to have a field that rejects from the target instead?

Q2: Define how to compute (and comment) a viscous field that is opposed to the velocity of the end effector.

a. Write the matrix for each case and test it on the Simulink Model
b. Remember that the Phantom block in Simulink requires the **torque**, not the force!