

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

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

VR toolbox and wrl
file

- ✓ 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:** DA IMPLEMENTARE IN MACCHINA A STATI, FILE "Reaching".
 - 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
condizioni!

➤ 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!