

**LAB 7 CHECKLIST**  
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**COURSE: INTRODUCTION TO ROBOTICS**  
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	TASKS	SIMULATION	REAL ROBOT
<b>WARM UP TASKS</b>			
1	Data pipeline manager	Run roscore	Run roscore
2	Get image/ video recordings	./play_data.sh	roslaunch realsense2_camera rs_rgbd.launch
3	Start digital visualizer	run rviz	run rviz
4	Load visualizer setup	load robot_ball.rviz from UR5e_control package	load robot_ball.rviz from UR5e_control package
5	Publish frames	roslaunch ur5e_control frame_publisher.launch	roslaunch ur5e_control frame_publisher.launch
6	Fire up UR5e robot	roslaunch ur_gazebo ur5e_bringup.launch	roslaunch ur5e_control ur5e_ros_connection.sh
<b>GET TENNIS BALL SPHERE POINT CLOUD FIT</b>			
7	Get filtered 2D tennis ball images	roslaunch ur5e_control detect_ball.py	roslaunch ur5e_control detect_ball.py
8	Get filtered 3D tennis ball image	roslaunch ur5e_control crop_visulaize_3d	roslaunch ur5e_control crop_visulaize_3d
9	Obtain estimated tennis ball point cloud data and parameters	roslaunch ur5e_control sphere_fit.py	roslaunch ur5e_control sphere_fit.py
<b>INITIALIZE ROBOT</b>			
10	Initialize UR5e robot to a safe position above checkerboard	roslaunch ur5e_control manual_initialization_real_robot.py	roslaunch ur5e_control manual_initialization_real_robot.py
11	Terminate UR5e robot initialization commands	roslaunch ur5e_control Stop_robotics_lab7_manual_initialization_real_robot.py	roslaunch ur5e_control Stop_robotics_lab7_manual_initialization_real_robot.py
<b>CONTROL ROBOT (FK &amp; IK)</b>			
12	Initiate robot driver with FK and IK	roslaunch ur5e_control ur5e_controller	roslaunch ur5e_control ur5e_controller.launch with <param name="sim" value="false"/>

13	Initiate smooth trajectory planning and motion	roslaunch ur5e_control task_space_traj	roslaunch ur5e_control task_space_traj
<b>HAND-AND-EYE COORDINATION</b>			
14	Get tennis ball point cloud fit co-ordinates w.r.t UR5e robot base frame	roslaunch robotics_lab7 hand_eye_coord_lab7.py	roslaunch robotics_lab7 hand_eye_coord_lab7.py
15	Perform pick-&-place tennis ball task i.e. planner	roslaunch robotics_lab7 hand_eye_coord_lab7.py	roslaunch robotics_lab7 hand_eye_coord_lab7.py
<b>MISCELLANEOUS</b>			
16	Pause feature for the target point defined by centre of the ball	<p>Included a while loop that continuously updates the ball's centre variables when the data stream stabilizes. This has been done through the same implementation as that used in the differentiation equations implemented for noise filtering. The while loop in <i>robotics_lab7's hand_eye_coord_lab.py call back function</i></p>	
17	Motion start trigger message for the robot	<p>Path plan implementation only initiates once correlation frames between the Intel sense color camera frames and the UR5e base robot frames can be extracted.</p> <p>Also, the second waypoint for pickup task receives its translational x, y and z values once the sphere fit has stabilized from the implementation above.</p>	