Robotics I - Extra Sheet #2 (for Exercise 4)

February 12, 2020

Name: ____

Answer to the questions or reply/comment on/complete the statements, providing a *short* motivation/explanation (within the given lines of text) for each of the following 8 items.

1. Order the three classes of infrared, laser, and ultrasound proximity sensors in terms of their typical range of measurement.

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2. Order infrared, laser, and ultrasound sensors in terms of their typical angular resolution.

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3. Compare the motor-side position resolution of an incremental encoder with 512 pulses per revolution (PPR) and quadrature electronics mounted on the motor with that of an absolute encoder with 16 bits mounted on the link, when the transmission has reduction ratio $n_r = 20$, Which one is better?

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4. Given a desired end-effector position for a planar PPR robot, the gradient method will always provide a solution to the inverse kinematics problem without need of restarting procedures. True or false? Why?

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5. What is the so-called overfly in trajectory planning and which are its pros and cons? Can this concept be applied equally well at the joint level and at the Cartesian level or not? Why?

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6. We have four positional knots to be interpolated in the 3D Cartesian space, plus a number of boundary conditions and continuity requirements. Should we use 4-3-4 polynomials or cubic splines? If both can be used, which choice is better and why?

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7. For a single robot joint, we have computed a spline trajectory interpolating $n = 10$ given knots at some assigned instants of time $t_1 < t_2 < \cdots < t_{10}$. If we modify only one of such time instants, but still satisfying the sequential order —e.g., the kth instant t_k becomes a new $t'_k \in (t_{k-1}, t_{k+1})$, and then redo the computations, will the trajectory change or not? Why?

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8. A robot commanded at the joint velocity level has initially zero position and orientation errors with respect to a desired end-effector trajectory, except along the $\boldsymbol{z}$-component in position. If we apply a Cartesian kinematic control law, the robot will move so that ...

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