

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

January 7, 2020

Name: \_\_\_\_\_

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

1. At the same level of resolution, the cost of incremental encoders is usually less than that of absolute encoders because . . .

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2. What is the purpose of using Wheatstone bridge configurations in the electronics of strain gages?

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3. Compare the link position resolution of an incremental encoder with 600 pulses per revolution (PPR) mounted on the motor having a transmission of reduction ratio  $n_r = 30$ , with that of an incremental encoder with 4000 PPR and quadrature electronics mounted directly on the link. Which is better?

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4. Given a desired end-effector position of a planar 3R robot, the iterative Newton method can find all solutions to the inverse kinematics problem out of singularities. True or false? Why?

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5. Which is the relation between the second derivative  $\ddot{\mathbf{R}}$  of a time-varying rotation matrix  $\mathbf{R}(t)$  and the associated angular velocity  $\boldsymbol{\omega}$  and acceleration  $\dot{\boldsymbol{\omega}}$ ?

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6. For a joint that needs to move by  $\Delta q > 0$ , if the bounds on maximum absolute velocity and acceleration are related by  $A_{max} = V_{max}^2/\Delta q$ , is the minimum time acceleration profile always bang-coast-bang?

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7. The uniform time scaling procedure allows to obtain the minimum motion time along a parametrized path under maximum velocity and acceleration constraints. True or false? Why?

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8. Kinematic control laws designed at the Cartesian level are better than those designed at the joint level because . . . , and are worse because . . .

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