**EE 547 (PMP): Homework 1**

Assigned: Thursday January 8, 2015. Due: Wednesday January 14, 2015.

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**Problem** **1** Consider a MinSeg model as below. The geometric parameters and some constants are labeled on the figure. A system of equations is derived as (1) to describe the movement and angle of rotation of MinSeg body.

1. Let’s focus on the translation of MinSeg wheel (x) and rotation of MinSeg pendulum (α). Please linearize (1) around equilibrium point . (Hint: high order terms shall be ignored.)

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| Figure 1 MinSeg system |

|  |  |
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|  | (1) |

where Tm is the torque from the DC motor, which is not explicitly demonstrated in Figure 1.

1. A torque equation is given as (2). Please rewrite the derived linear model with (2).

|  |  |
| --- | --- |
|  | (2) |

where V is applied voltage, R is the resistance of DC motor, kt is torque constant and kb is back-EMF constant.

1. If state variables are defined as and input variable is, please derive state space matrices A and B. Now we are interested in and there is no disturbance over the system. Please derive matrices C and D.

HW hint:

|  |  |
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|  | (3) |

|  |  |
| --- | --- |
|  | (4) |