

EE 547 (PMP): Homework 4

Assigned: Thursday, January 29, 2015. Due: Wednesday, February 4, 2015.

Professor Linda Bushnell, UW EE

Problem 1 (Compare Different Methods to Solve State Transition Matrix) Consider matrix A as in equation (1) below. Up to this week, we learned different methods to evaluate the state-transition matrix, including the fundamental matrix, inverse Laplace Transform, Jordon Form, \exp^{At} direct method via **expm**, and function of a square matrix.

$$A = \begin{bmatrix} 14 & -75 & 190 & -224 & 96 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix} \quad (1)$$

- a) Use MATLAB to implement inverse Laplace Transform, Jordon Form, function of a square matrix, and **expm** to evaluate the state-transition matrix. Then, compare the computation time of each method.

(Hint 1: $\exp^{At} = \exp[(Q\bar{A}Q^{-1})t] = Q \exp^{\bar{A}t} Q^{-1}$, where \bar{A} is the Jordon Form and Q is the transformation matrix.)

(Hint 2: use the **tic toc** function in MATLAB to compute the computation time.)

Problem 2 (Matrix Function by Jordon Form) Consider a system as follows:

$$\dot{x} = \begin{bmatrix} -12 & -55 & -120 & -124 & -48 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} \quad (2)$$

Use MATLAB to:

- Evaluate the eigenvalues and characteristic polynomial of matrix A.
- Evaluate the Jordon Form and transformation matrix Q of matrix A.
- Evaluate a function $f(A,t) = \exp(At) + At$ by the Jordon Form method.