A picture containing fireworks, dark, water, flying

Description automatically generated

College of Engineering

School of Aeronautics and Astronautics

AAE 564

System Analysis and Synthesis

Homework 6

System and Matrices

*Author:*

Tomoki Koike

*Supervisor:*

Martin Corless

October 9th, 2020 Friday

Purdue University

West Lafayette, Indiana

**Exercise 1**

Consider a mechanical/aerospace system described by

where is an -vector and *M*, *C*, and *K* are square matrices. Suppose is a complex number which satisfies

Show that the above system has a solution of the form

where is a constant -vector.

From what we are given,

Plug these into the equation

This becomes

Since, is a non-zero vector and cannot be zero. Thus, the matrix is equal to zero and makes it singular.

Then,

Thus, have proven that

is a solution of .

**Exercise 2**

Suppose is a 3 x 3 matrix and

1. Express in terms of .
2. Express in terms of .
3. Express in terms of .

(a).

The roots of the polynomial are

From Cayley-Hamilton Theorem

Thus,

(b).

From the result of part (a),

Then,

(c).

From the result of part (a),

**Exercise 3**

Without doing any matrix multiplications, compute for

Justify your answer.

Looking at the matrix, we can tell that the matrix is a companion matrix. Thus, the characteristic polynomial is going to be

Using the Cayley-Hamilton Theorem, we have