COE 352 Project 1

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SVD Function

Explaining the SVD Function

The SVD.m file contains the SVD function, as well as a comparison between the function and the blackbox SVD. Given a NXM matrix A, the function svdd returns a U, S, and V transpose matrix as parts of the SVD. It also returns the condition number c and inverse matrix of A.

Using the SVD Function

In order to solve for a user's matrix, enter the desired matrix values for A. Both the written function and the blackbox will use matrix A for their calculations.

Written Function vs. Blackbox Results

For a matrix A using the written function:

```
A =

     1     2     3
     0     1     4
     5     6     0
```

```
U =

    0.3378    0.5132    0.7890
    0.1989    0.7804   -0.5928
    0.9200   -0.3571   -0.1616

S =

    8.2788         0         0
         0    4.8436         0
         0         0    0.0249
```

```
Vt =

    0.5964    0.7724    0.2185
    0.2627    0.0694   -0.9624
    0.7585   -0.6314    0.1615

c =

  331.9745

I =

   24.0487  -17.9713   -4.8674
  -19.9370   15.0371    4.1717
    5.0178   -3.9895   -0.9514
```

For the same matrix A using the blackbox function:

```
U1 =

   -0.3378   -0.5132   -0.7890
   -0.1989   -0.7804    0.5928
   -0.9200    0.3571    0.1616

S1 =

    8.2788         0         0
         0    4.8436         0
         0         0    0.0249
```

```
VT =

   -0.5964   -0.7724   -0.2185
    0.2627    0.0694   -0.9624
    0.7585   -0.6314    0.1615

AI =

  -24.0000   18.0000    5.0000
   20.0000  -15.0000   -4.0000
   -5.0000    4.0000    1.0000
```

From the above results, the written function and the blackbox function provide the same absolute values of every matrix except the inverse of A because matrix I isn't rounded. However, the signs for the values don't match. This is likely because of the ordering of eigenvalues or eigenvectors or because the signs of the eigenvectors weren't correct when they were first calculated.

Spring System Function

Explaining the Spring System Function

The spring system function returns the displacements (u), the elongations (e), and the internal forces/stresses (w) when given the number of masses, spring constants, the masses, and the number of fixed ends. It also prints the singular values, eigenvalues, and condition number of matrix K.

Using the Spring System Function

Enter the desired values for the number of masses, the spring constants, the masses, and the numbers of fixed ends in the line that calls the spring function. One fixed end implies one free end and one fixed end. Two fixed ends implies that there are no free ends. The function will then return the displacements, elongations, and the internal forces/stresses while also printing the singular values, eigenvalues, and condition number of K.

Sample Output

For 3 masses, spring constants of 1, masses of 1, and 1 fixed end:

```
Singular Values:        u =
    3.2470
    1.5550                 29.4300
    0.1981                 49.0500
                           58.8600

Eigenvalues:
   10.5429              w =
    2.4179
    0.0392                 29.4300
                           19.6200
                            9.8100
Condition Number:
   16.3937
                        e =

                           29.4300
                           19.6200
                            9.8100
```

Two Free End Examination

Two free ends in a spring mass system certainly doesn't make sense physically because the springs and masses aren't connected to anything. No outside forces are working on the springs or masses in this case. Fixed ends also allow for displacement values of 0, allowing one or two of the elongation equations to be equal to just one displacement. This allows for the ideal number of equations and unknowns to solve the system, however, two free ends does not lend itself to this. Not only is two free ends unintuitive, it is underdetermined because there will be more unknowns than equations, making a unique solution impossible.