An example of Programming in MATLAB to obtain natural frequencies and mode shapes of MDOF systems

Define \([M]\) and \([K]\) matrices
\[
M = \begin{bmatrix} 11 & 0 \\ 0 & 22 \end{bmatrix} \\
K = \begin{bmatrix} 1000 & -500 \\ -500 & 2000 \end{bmatrix}
\]

Form the system matrix
\[
A = \text{inv}(M) \times K
\]

Obtain eigenvalues and eigenvectors of A
\[
[V, D] = \text{eig}(A)
\]

V and D above are matrices.
V-matrix gives the eigenvectors and the diagonal of D-matrix gives the eigenvalues

Sort eigen-values and eigen-vectors
\[
[D_{\text{sorted}}, \text{ind}] = \text{sort(diag(D)},'ascend');
V_{\text{sorted}} = V(:,\text{ind});
\]

Obtain natural frequencies and mode shapes
\[
nat\_freq\_1 = \sqrt{D_{\text{sorted}(1)}} \\
nat\_freq\_2 = \sqrt{D_{\text{sorted}(2)}} \\
mode\_shape\_1 = V_{\text{sorted}}(:,1) \\
mode\_shape\_2 = V_{\text{sorted}}(:,2)
\]
Results of MATLAB run

M =
    11  0
     0 22

K =
    1000   -500
   -500   2000

A =
    90.9091  -45.4545
   -22.7273   90.9091

V =
    0.8165   0.8165
   -0.5774   0.5774

D =
    123.0503   0
     0   58.7679

nat_freq_1 =
   7.6660

nat_freq_2 =
  11.0928

mode_shape_1 =
    0.8165
    0.5774

mode_shape_2 =
    0.8165
   -0.5774