# Report: Simulation of a Vibrating System

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## 1 Equations satisfied by the system using Newton's second law of motion.

### 1.1

$m_1\ddot{x}_1 = -k_1x_1 + k_2(x_2 - x_1)$

### 1.2

$m_2\ddot{x}_2 = -k_2(x_2 - x_1) + k_3(x_3 - x_2)$

### 1.3

$m_3\ddot{x}_3 = -k_3(x_3 - x_2) - k_4x_3$

## 2 System of equations expressed as an eigen problem.

$Av = \lambda v$

$A = \begin{bmatrix} \frac{k_1+k_2}{m_1} & \frac{-k_1}{m_1} & 0 \\ \frac{-k_2}{m_2} & \frac{k_2+k_3}{m_2} & \frac{-k_2}{m_2} \\ 0 & \frac{-k_3}{m_3} & \frac{k_3}{m_3} \end{bmatrix}$ where $v$ is an eigenvector and $\lambda$ is a corresponding scalar eigenvalue.

## 3 Eigenvector matrix and eigenvalue matrix.

$v = \begin{bmatrix} -0.2798 & 0.6620 & 0.5239 \\ 0.8229 & 0.0446 & 0.4409 \\ -0.4944 & 0.7482 & 0.7288 \end{bmatrix}$ $\lambda = \begin{bmatrix} 22.2041 & 0 & 0 \\ 0 & 7.8367 & 0 \\ 0 & 0 & 3.2925 \end{bmatrix}$

## 4 Frequencies and amplitudes.

$\omega = \begin{bmatrix} 4.7121 & 2.7994 & 1.8145 \end{bmatrix}$