Thank God Clinton
16/ENG06/068
Mechanical Engineering
ENG 382

(i) Using an initial guess vector of $M_0 = [0; 0; 0]$ determine the values of the variables in equation.

(ii) Using Jacob Iterative method manually showing only 3 iterations.

Solution

$$\begin{bmatrix} 10M_1 & -2M_2 & +M_3 & = 9 \\ -2M_1 & +10M_2 & -2M_3 & = 12 \\ -2M_1 & -5M_2 & +10M_3 & = 18 \end{bmatrix}$$

$$M_1 = 0.2M_2 - 0.1M_2 + 0.9$$
$$M_2 = 0.2M_1 + 0.2M_3 + 1.2$$
$$M_3 = 0.2M_1 + 2.5M_2 + 1.8$$

$$\begin{bmatrix} M_1^{(k)} \\ M_2^{(k)} \\ M_3^{(k)} \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} M_1^{(k-1)} \\ M_2^{(k-1)} \\ M_3^{(k-1)} \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

$$M^0 = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

First Iteration;

$$\begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.5 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix} = \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

$$\begin{bmatrix} [(0\times0.2) + (0.2\times0) + (-0.1\times0)] + 0.9 \\ [(0.2\times0) + (0\times0) + (0.7\times0)] + 1.2 \\ [(0.5\times0) + (0.5\times0) + (0\times0)] + 1.8 \end{bmatrix} = \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

Second Iteration

$$\begin{bmatrix} M_1(2) \\ M_2(2) \\ M_3(2) \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix} = \begin{bmatrix} 0.96 \\ 1.74 \\ 2.58 \end{bmatrix}$$

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$$\left[(0 \times 0.9) + (0.2 \times 1.2) + (-0.1 \times 1.8)\right] + 0.9 = 0.96$$
$$\left[(0.2 \times 0.9) + (0 \times 1.2) + (0.2 \times 1.8)\right] + 1.2 = 1.74$$
$$\left[(0.2 \times 0.9) + (0.5 \times 1.2) + (0 \times 1.8)\right] + 1.8 = 2.58$$

$$\begin{bmatrix} 0.96 \\ 1.74 \\ 2.58 \end{bmatrix}$$

Third iteration

$$\begin{bmatrix} M_{1(3)} \\ M_{2(3)} \\ M_{3(3)} \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} 0.96 \\ 1.74 \\ 2.58 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix} = \begin{bmatrix} 0.996 \\ 1.908 \\ 2.862 \end{bmatrix}.$$

$$\left[(0 \times 0.96) + (0.2 \times 1.74) + (-0.1 \times 2.55)\right] + 0.9 = 0.996$$
$$\left[0.2 \times 0.96 + (0 \times 1.74) + (0.2 \times 2.58)\right] + 1.2 = 1.908$$
$$\left[(0.2 \times 0.96 + (0.5 \times 1.74) + (0 \times 2.58)\right] + 1.8 = 2.862$$
$$= \begin{bmatrix} 0.996 \\ 1.908 \\ 2.862 \end{bmatrix}$$

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