

Scanned Documents

ADDAE macdonald 0

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MECHANICAL ENGINEERING

ENGS221 - Engineering MATHS II

Assignment 10

Q Using an initial guess vector of $m_0 = (0, 0, 0)$ determine the values of the variables in eqn (2) using Jacobi iterative method manually showing only 3 iterations

Q Write a MATLAB program to solve the problem in (a) and validate the results showing the use of iteration the corresponding values of the variables and the error, which is calculated from the norms. Take the tolerance of the error to be 10^{-5}

$$\begin{cases} 0.2m_1 - 0.2m_2 + 0.1m_3 = 0.9 \\ -0.2m_1 + 0.5m_2 - 0.2m_3 = 1.2 \\ -0.2m_1 - 0.2m_2 + 1.0m_3 = 1.8 \end{cases} \quad \dots (2)$$

Solution

Using Jacobi iterative method

writing m_1, m_2, m_3 in eqn 1-3

$$m_1 = \frac{0.2m_2 - 0.1m_3 + 0.9}{0.2} = 0.2m_2 - 0.5m_3 + 4.5$$

$$m_2 = \frac{0.2m_1 + 0.2m_3 + 1.2}{0.5} = 0.2m_1 + 0.2m_3 + 2.4$$

$$m_3 = \frac{0.2m_1 + 0.2m_2 + 1.8}{1.0} = 0.2m_1 + 0.2m_2 + 1.8$$

matrix notation $Ax = b$

$$\begin{pmatrix} m_1^{(k)} \\ m_2^{(k)} \\ m_3^{(k)} \end{pmatrix} = \begin{pmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.2 & 0 \end{pmatrix} \begin{pmatrix} m_1^{(k-1)} \\ m_2^{(k-1)} \\ m_3^{(k-1)} \end{pmatrix} + \begin{pmatrix} 0.9 \\ 1.2 \\ 1.8 \end{pmatrix}$$

$$\text{Initial: } m_1 = [0, 0, 0]$$

$$m^{(0)} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

First iteration

$$\begin{pmatrix} m_1^{(1)} \\ m_2^{(1)} \\ m_3^{(1)} \end{pmatrix} = \begin{pmatrix} 0 \\ 0.2 \\ 0.2 \end{pmatrix}$$

$$m^{(1)} = \begin{pmatrix} 0 \\ 0.2 \\ 0.2 \end{pmatrix}$$

Second iteration

$$\begin{pmatrix} m_1^{(2)} \\ m_2^{(2)} \\ m_3^{(2)} \end{pmatrix} = \begin{pmatrix} 0.9 \\ 0.2 \\ 0.2 \end{pmatrix}$$

$$m^{(2)} = \begin{pmatrix} 0.9 \\ 0.2 \\ 0.2 \end{pmatrix}$$

Third iteration

$$\begin{pmatrix} m_1^{(3)} \\ m_2^{(3)} \\ m_3^{(3)} \end{pmatrix} = \begin{pmatrix} 0.9 \\ 0.2 \\ 0.2 \end{pmatrix}$$

$$m^{(3)} = \begin{pmatrix} 0.9 \\ 0.2 \\ 0.2 \end{pmatrix}$$