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Assignment - 3

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ME - 685A

Q-1 given $f(x) = x^4 - 14x^3 + 60x^2 - 70x$

→ to solve for min

$g(x) = \frac{df}{dx} = 4x^3 - 42x^2 + 120x - 70$

→ finding ~~the~~ roots of $g(x)$ and checking them for minima or max

⇒ roots of $g(x)$

= 0.78088, 5.9571, 3.7619

→ $h(x) = 12x^2 - 84x + 120$

$h(0.78088) > 0$

$h(5.9571) > 0$

minima

$h(3.7619) < 0$

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→ for the case of programing provid proper interval which all the roots appears

→ program will return that that root which appeared first a[...] is minima

→ if ~~improper~~ ~~to~~ wrong interval provided then program will nearest root having minima condition provided & that roo[...] should not be too far i.e [...] 0.1 and recursion depth [...]

Q-3 for given

$$A = \begin{bmatrix} 2 & 3 & 2 & 4 \\ 3 & 3 & 4 & 1 \\ 2 & 6 & 1 & 2 \\ 4 & 1 & 2 & 0 \end{bmatrix}$$

let $x_0 = (1, 1, 1, 1)$

⇒ after multiple iteration

$\lambda_1 = 10.28488$

$x' = (1, 1.1011, 1.079$

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by using deflate the matrix and again using the power method gives $\lambda_2 = -4.012855$

$x^2 = (1, -0.6018, 1.32, -1.017)$

largest e-value $= \lambda_1$

2^{nd} largest (absolute) $= \lambda_2$

-4 using gram schmit algorithm on

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -24 & 40 & -35 & 13 \end{bmatrix} = [a_1\ a_2\ a_3\ a_4]$$

$u_1 = (0, 0, 0, -24)$, $e_1 = \frac{u_1}{|u_1|}$

$u_2 = a_2 - (a_2 \cdot e_1) e_1$

$e_2 = \frac{u_2}{|u_2|}$

$u_3 = a_3 - (a_3 \cdot e_1) e_1 - (a_3 \cdot e_2) e_2$

repeating this for all a_i

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→ then $Q = [e_i]$

$R = Q^T A$

new $A = RQ$, repeating until A = upper triang

⇒ actual
$\lambda = 9.82, 1.80, 0.68 \pm 0$

code $\lambda = 9.82, 1.80, 1.25, 0.11$

as there is osciclation for comp e-values and not easy to catch real part

Q-5 By neglecting gravity

→ for given system generalized co- are q_1, q_2, q_3 = displacement mass from fi

→ Euler lagrange eq^n

$$\frac{d}{dt}\frac{\partial L}{\partial \dot{q}_i} - \frac{\partial L}{\partial q_i} = 0$$

here $L = E^K - U$

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$$E^K = \frac{1}{2}\left(m_1 \dot{q}_1^2 + m_2 \dot{q}_2^2 + m_3 \dot{q}_3^2\right)$$

$$U = \frac{1}{2} k \left(q_1^2 + q_2^2 + q_3^2\right)$$

→ Equation of motion

$$m_1 \ddot{q}_1 + (k_1 + k_2) q_1 - k_2 q_2 = 0$$

$$m_2 \ddot{q}_2 + (k_2 - k_3) q_2 + k_3 q_3 - k_2 q_1 = 0$$

$$m_3 \ddot{q}_3 + k_3 q_3 - k_3 q_2 = 0$$

→ assume solution

$$\underline{z} = \underline{A_1}\, e^{st}$$

→ EOM:

$$s^2 \underline{\underline{M}} + \underline{\underline{K}} = [0]$$

$$K_1 = K_2 = K_3 = 1$$

where

$$\underline{\underline{K}} = \begin{bmatrix} K_1 + K_2 & -K_2 & 0 \\ -K_2 & K_2 - K_3 & K_3 \\ 0 & -K_3 & K_3 \end{bmatrix} = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 0 & 1 \\ 0 & -1 & 1 \end{bmatrix}$$

$$\underline{\underline{M}} = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$$

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→ solving above eqⁿ gives frequenc[y]
i.e. find e-values of $\underline{K}$ $(\lambda_i$
and $S_i = \sqrt{\frac{\lambda_i}{m_i}}$

e-vectors are mode of system

Q-2 (A) let $\underline{x_0} = (1,1,1,1,1)$

Calculate $\rightarrow f_i = f($

$$E(x) = \frac{1}{2} \sum (f_i - y_i)^2$$

Calculate $g(\underline{x}) = \nabla$

$$J = \nabla f(t, \underline{x})$$

→ Calculating $g(\underline{x_0})$

$$\underline{\underline{H}}(\underline{x_0}) = J^T J \Big|_{\underline{x} = \underline{x_0}} + \lambda\, di$$

Solving $\underline{\underline{H}} \Delta \underline{x} = -g$ to get

$\Delta \underline{x}$

repeating to get convergence in
$E(\underline{x})$

→ that $\underline{x}$ value is required ans

Ans = 43.1016

7.7737

-8.3262

18.9343

-0.20347