SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIT – V
Stability Studies and Reactive Power Compensation
RUNGE – KUTTA METHOD

CONTENTS

FIRST ORDER RUNGE – KUTTA METHOD

Considering the differential equation

$dy/dx=f(x,y)$

With the initial condition $y(x_0)=y_0$

By the Euler's method

$y_{n+1}=y_n + h*f(x_n,y_n)$

$y_{n+1}=y_n + h*y'_n + (h^2/2!)y''_n + \ldots$ (by Taylor's series)

SECOND ORDER RUNGE – KUTTA METHOD

$Y_{n+1} = y_n + k$

Where $k = (1/2)(k1 + k2)$

$K1 = h * f(x_n , y_n)$

$K2 = h * f(x_n + h , y_n + k1)$

Third Order Runge – Kutta method

- $Y_{n+1} = y_n + k$
  - Where $k = (1/6)(k1 + 4k2 + k3)$

    $K1 = h*f(x_n, y_n)$

    $K2 = h*f(x_n + (h/2), y_n + (k1/2))$

    $K3 = h*f(x_n + h, y_n + 2k2 - k1)$

Fourth Order Runge – Kutta method

- $Y_{n+1} = y_n + k$
  - Where $k = (1/6)(k1 + 2k2 + 2k3 + k4)$

    $K1 = h*f(x_n, y_n)$

    $K2 = h*f(x_n + (h/2), y_n + (k1/2))$

    $K3 = h*f(x_n + (h/2), y_n + (k2/2))$

    $K4 = h*f(x_n + h, y_n + k3)$

EXAMPLE

- Solve the differential equation dy/dx=x+y , with the fourth order Runge-Kutta method ,where y(0)=1 with x=0.2 with h=0.1.

- Given data y(0)=1 and h=0.1
- dy/dx = x+y

f(x,y)=dy/dx=x+y

EXAMPLE

- 1^{st} iteration

$X_0=0$, $y_0=1$, $h=0.01$, $n=0$

K1 $=h*f(x_0,y_0)$

$=0.1*(0,1)$

$=0.1*(0+1)$

$=0.1$

EXAMPLE

$$K2 = h*f(x_0 + (h/2), y_0 + (k1/2))$$
$$= 0.1*f(0 + (0.1/2), 1 + (0.1/2))$$
$$= 0.1*f(0.05, 1.05)$$
$$= 0.1*(0.05+1.05)$$
$$= 0.11$$

$$K3 = h*f(x_0 + (h/2), y_0 + (k2/2))$$
$$= 0.1*f(0+ (0.1/2), 1+ (0.11/2))$$
$$= 0.1*f(0.05, 1.055)$$
$$= 0.1*(0.05+1.055)$$
$$= 0.1105$$

EXAMPLE

K4 $= h*f(x_0 + h, y_0 + k3)$

$= 0.1*f(0+0.1, 1+0.1105)$

$= 0.1*f(0.1, 1.1105)$

$= 0.1*(0.1+1.1105)$

$= 0.1211$

So y1 $= y_0 + k$

$= y_0 + (1/6)(k1 + 2k2 + 2k3 + k4)$

$= 1 + (1/6)(0.1 + 2(0.11) + 2(0.1105) + 0.1211)$

$= 1.1103$


thank
you