TRINITY COLLEGE FOR WOMEN NAMAKKAL

Department of Mathematics

NUMERICAL ANALYSIS

21PMAE03 EVEN Semester

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RUNGE KUTTA METHOD

INTRODUCTION:

- Developed by two germen mathematicians Runge and kutta
- It is also called R-K Method.
- These methods were developed around 1900.

RUNGE'S KUTTA METHOD

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Runge kutta method is an effective and widely used method for solving the intial value problems of differential equations.

Runge kutta method can be used to construct higher order accurate numerical method.

The algorithm to Runge Kutta method of second order is,

k_1= hf(x_0,y_0) , k_2=hf(x_0+h,y_0 +k_1)

$$k=\frac{1}{2}(k_1+k_2)$$

$$y_1=y_0+k.$$

RUNGE KUTTA METHOD OF THIRD ORDER

FORMULAE;

$$K=\frac{1}{6}(K_1+4K_4+K_3)\ , \quad Y_1=Y_0+K$$

RUNGE KUTTA METHOD OF FOURTH ORDER

K_1=hf(x_0,y_0), k_2=hf($x_0+\frac{h}{2}$,$y_o+\frac{k1}{2}$)

k_3=hf(x_0,$\frac{h}{2}$,$y_0+\frac{k2}{2}$),

k_4=hf($x_0 + \text{h}, y_0+k_3$)

k=$\frac{1}{6}(k_1+2k_2+2k_3+k_4)$

y_1=y_0+k and x_1=x_0+h

Similar manner,

y_2 =y_1+k and x_2=x_1+h

RUNGE KUTTA METHOD FOR SIMULTANEOUS FIRST ORDER EQUATIONS

Consider the simultaneous equations ,

$$\frac{dy}{dx}=f_1(x,y,z);\frac{dx}{dz}=f_2(x,y,z)$$

If we consider the second order Runge kutta method then,

$$k_1=hf_1(x_0,y_0,z_0),l_1=hf_2(x_0,y_0,z_0)$$

k_2=h$f_1(x_0$+h,y_0+k_1,z_0+l_1);

l_2=h$f_2(x_0$+h,y_0+k_1,z_0+l_1)

k=$\frac{1}{2}(k_1 + k_2)$

l=$\frac{1}{2}(l_1 + l_2)$,

y_1=y_0+k and z_1=z_0+k

RUNGE KUTTA METHOD FOR SECOND ORDER DIFFERENTIAL EQUATIONS

Consider the second order differential equations

$$\frac{d2y}{dx2}=\varphi(x,y,\frac{dy}{dx}) \quad y(x_0) = y_0$$

let $\frac{dy}{dx}$=z then $\frac{d2y}{dx2}=\frac{dz}{dx}$

$$\frac{dz}{dx}=\varphi(x,y,z), \; z(x_0)=z_0$$

The problem reduce to sloving the simultaneous equation,

$\frac{dz}{dx}$=z=f(x,y,z) and $\frac{dz}{dx}$=z=f_2(x,y.z)

subject to y(x_0)=y_0; z(x_0)=z_0

and can be sloved as shown in the previous section.

THANK YOU

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