Higher Order Differential Equations: Background

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$$\frac{dy}{dx} = f(x,y), \quad y(a) = y_a$$

$$2\frac{dy}{dx} + 3y = 5x, \quad y(0) = 7$$

$$\frac{dy}{dx} = \frac{5x-3y}{2}, \quad y(0) = 7$$

$$= f(x,y)$$

$$5\frac{d^2y}{dt^2} + 13\frac{dy}{dt} + 17y = 23e^{-t}, y(0) = 7, \frac{dy}{dt}(0) = 11$$

$$5\frac{d^3y}{dx^3} + 3\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 7y = e^{-x}, y(0) = 13,\ y'(0) = 17, y''(0) = 23$$

Given

$$5\frac{d^2y}{dt^2} + 13\frac{dy}{dt} + 17y = 23e^{-t}, y(0) = 7, \frac{dy}{dt}(0) = 11$$

Reduce the above ODE to simultaneous first order ODEs so that numerical methods can be used to solve the ODE.

$\frac{dy}{dt} = z$ (say), $\frac{d^2y}{dt^2} = \frac{dz}{dt}$

$5\frac{dz}{dt} + 13z + 17y = 23e^{-t}$

$\frac{dz}{dt} = \frac{23e^{-t} - 13z - 17y}{5}$, $z(0) = \frac{dy}{dt}(0) = 11$

$$\frac{dz}{dt} = \frac{23e^{-t} - 17y - 13z}{5}, \quad z(0) = 11$$

$$= f_1(t, y, z) \qquad \text{——} (1)$$

$$\frac{dy}{dt} = z$$

$$= f_2(t, y, z), \quad y(0) = 7$$

—— (2)

Simultaneous 2 first order ODEs

END

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