$$\bar{x} = \begin{bmatrix} x_1(t) \\ x_2(t) \\ \vdots \\ x_n(t) \end{bmatrix} \qquad \frac{d\bar{x}}{dt} = \begin{bmatrix} \frac{dx_1(t)}{dt} \\ \frac{dx_2(t)}{dt} \\ \vdots \\ \frac{dx_n(t)}{dt} \end{bmatrix}$$

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & & a_{2n} \\ \vdots & & & \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}$$

$$\frac{d}{dt}\bar{x} = A\bar{x}.$$

$$\left[\begin{array}{l} \dfrac{d^2x(t)}{dt^2} = 3\,x(t) + 4y(t) \\[2ex] \dfrac{d^2y(t)}{dt^2} = 6x(t) + 8y(t) \end{array}\right.$$

$$\frac{dx(t)}{dt} = xx(t) \longrightarrow \frac{d^2x(t)}{dt^2} = \frac{dxx(t)}{dt}$$

$$\frac{dy(t)}{dt} = yy(t) \longrightarrow \frac{d^2y(t)}{dt^2} = \frac{d\,yy(t)}{dt}.$$

$$\bar{X}(t) = \begin{bmatrix} x(t) \\ y(t) \\ xx(t) \\ yy(t) \end{bmatrix} \qquad \frac{d}{dt}\bar{X}(t) = \begin{bmatrix} \dfrac{dx(t)}{dt} \\[1ex] \dfrac{dy(t)}{dt} \\[1ex] \dfrac{dxx(t)}{dt} \\[1ex] \dfrac{dyy(t)}{dt} \end{bmatrix}$$

$$\frac{dx(t)}{dt} = xx(t)$$

$$\frac{dy(t)}{dt} = yy(t)$$

$$\frac{dxx(t)}{dt} = 3x(t) + 4y(t)$$

$$\frac{dyy(t)}{dt} = 6x(t) + 8y(t).$$

$$\bar{X} = \begin{bmatrix} x(t) \\ y(t) \\ xx(t) \\ yy(t) \end{bmatrix} \qquad \frac{d}{dt}\bar{X} = \begin{bmatrix} \frac{dx(t)}{dt} \\ \frac{dy(t)}{dt} \\ \frac{dxx(t)}{dt} \\ \frac{dyy(t)}{dt} \end{bmatrix}$$

$$\frac{d}{dt}\bar{X} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 3 & 4 & 0 & 0 \\ 6 & 8 & 0 & 0 \end{bmatrix} \begin{bmatrix} x(t) \\ y(t) \\ xx(t) \\ yy(t) \end{bmatrix}$$

$$\frac{d^3y}{dt^3} - 6\frac{d^2y}{dt} + 4\frac{dy}{dt} - 3y = 0$$

$$y(t) = y_1(t)$$

$$\frac{dy}{dt} = \frac{dy_1}{dt} = y_2(t)$$

$$\frac{d^2y}{dt^2} = \frac{dy_2}{dt} = y_3(t)$$

$$\frac{d^3y}{dt^3} = \frac{dy_3}{dt}$$

$$\frac{dy_1}{dt} = y_2$$

$$\frac{dy_2}{dt} = y_3$$

$$\frac{dy_3}{dt} = 3y_1 - 4y_2 + 6y_3$$

$$\frac{d}{dt}\bar{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 3 & -4 & 6 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix}$$

$$EDO(n)L \iff S(n) \subseteq DOL(1).$$

Matriz Exponencial

$$\frac{d}{dt}\bar{x} = A\bar{x} \qquad n \times n \qquad \bar{x}(0)$$

$$\bar{x} = \left[e^{At}\right]\bar{x}(0) \qquad n \times n$$

$$e^{at}$$

$$\frac{de^{at}}{dt} = ae^{at}$$

$$e^{a(0)} = 1$$

$$e^{At}$$

$$\frac{d}{dt}e^{At} = Ae^{At}$$

$$e^{A(0)} = I.$$

$$e^{t} = 1 + t + \frac{t^2}{2} + \frac{t^3}{3!} + \dots + \frac{t^n}{n!} + \dots \infty$$

$$e^{0} = 1$$

$$e^{1} = 1 + 1 + \frac{1}{2} + \frac{1}{6} + \frac{1}{24} + \dots \infty$$

$$= 2 + 0.5 + 0.1666 + 0.04166 + \dots$$

$$= 2.70833 \rightarrow 2.72$$

$$e^{at} = 1 + at + \frac{a^2}{2}t^2 + \frac{a^3}{3!}t^3 + \dots$$

$$e^{At} = I + \frac{A}{1} t + \frac{A^2}{2} t^2 + \frac{A^3}{3!} t^3 + \dots + \frac{A^n}{n!} t^n + \dots$$

$$A = \begin{bmatrix} 1 & 2 \\ -2 & 1 \end{bmatrix}$$

$$\frac{dx_1}{dt} = x_1 + 2x_2 \qquad x_1(0) = 4$$

$$\frac{dx_2}{dt} = -2x_1 + x_2 \qquad x_2(0) = -2$$