

$$\frac{dx_1}{dt} = r_1 - r_2 - r_3$$

$$\frac{dx_3}{dt} = r_2 - r_5$$

$$\frac{dx_2}{dt} = r_3 - r_4$$

$$\begin{bmatrix} 1 & -1 & -1 & 0 & 0 \\ 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 1 & -1 & 0 \end{bmatrix} \begin{bmatrix} r_1 \\ r_2 \\ r_3 \\ r_4 \\ r_5 \end{bmatrix}$$

\approx

$$0 = J_1 - J_2 - J_3 \quad (1)$$

$$0 = J_2 - J_5 \quad (2)$$

$$0 = J_3 - J_4 \quad (3)$$

$$J_1 = J_2 + J_3$$

$$J_2 = J_5$$

$$J_3 = J_4$$

$$\begin{bmatrix} J_1 \\ J_2 \end{bmatrix}$$

②

$$\frac{dx_2}{dt} = r_1 - r_2$$

①

$$\frac{dx_1}{dt} = r_3 - r_1$$

②

$$\frac{dx_2}{dt} = r_1 - r_3$$

③

$$\frac{dx_3}{dt} = r_2 - r_3$$

④

$$\begin{bmatrix} 1 & -1 & 0 \\ -1 & 0 & 1 \\ 1 & 0 & -1 \\ 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} r_1 \\ r_2 \\ r_3 \end{bmatrix}$$

$$0 = J_1 - J_2$$

$$\Rightarrow J_1 = J_2$$

$$0 = J_3 - J_1$$

$$J_1 = J_3$$

$$0 = J_1 - J_3$$

$$J_1 = J_3$$

$$0 = J_2 - J_3$$

$$J_2 = J_3$$

$$\frac{d(m_1 + m_2)}{dt} = 0$$

[J]

$$\textcircled{2} + \textcircled{3} = \frac{dm_1}{dt} + \frac{dm_2}{dt} = 0$$

$$m_1 + m_2 = \text{constant}$$

$$m_1 = \text{constant} - m_2$$

$$\textcircled{1} + \textcircled{4} = r_1 - r_3$$

$$+ \textcircled{2} = r_1 - r_3 + r_3 - r_1$$

$$= 0$$

$$\frac{dx_2}{dt} + \frac{dx_3}{dt} + \frac{dm_1}{dt} = 0$$

$$x_2 + x_3 + m_1 = \text{constant}^2$$