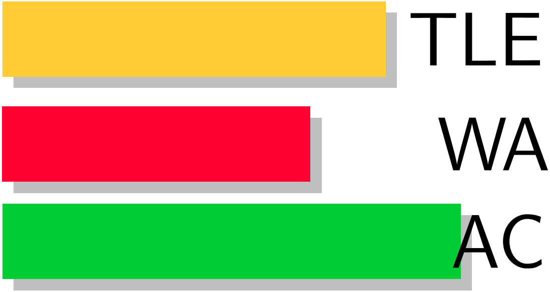
O주차 - X, X

2016 이산구조



gs1XXXX(XX기 XXX)

경기과학고등학교

2018년 9월 21일

1.1

관성계 : 절대 좌표계 (x, y, z)
비관성계 : 회전좌표계 (x', y', z') 극좌표 (r, θ, z)
$(x, y, z) \rightarrow (r, \theta, z)$
수평 방향은 정역학 평형 상태에 있으므로, $(x, y) \rightarrow (r, \theta)$
$\overrightarrow{F} = F_x \hat{i} + F_y \hat{j}$
$F_x = m\dfrac{d^2x}{dt^2}$ $F_y = m\dfrac{d^2y}{dt^2}$
$(x, y) = (r\cos\theta, r\sin\theta)$

$$F_r = F_x \cos\theta + F_y \sin\theta = m\left(\frac{d^2x}{dt^2}\cos\theta + \frac{d^2y}{dt^2}\sin\theta\right)$$

$$F_\theta = F_y \cos\theta - F_x \cos\theta = m\left(\frac{d^2y}{dt^2}\cos\theta - \frac{d^2x}{dt^2}\cos\theta\right)$$

1.2

$$x = r\cos\theta$$
$$\frac{dx}{dt} = \cos\theta\frac{dr}{dt} - r\sin\theta\frac{d\theta}{dt}$$
$$\frac{d^2x}{dt^2} = \cos\theta\frac{d^2r}{dt^2} - \sin\theta\frac{dr}{dt} - \sin\theta\frac{dr}{dt}\frac{d\theta}{dt} - r\cos\theta\frac{d^2\theta}{dt^2}$$
$$y = r\sin\theta$$
$$\frac{dy}{dt} = \sin\theta\frac{dr}{dt} + r\cos\theta\frac{d\theta}{dt}$$
$$\frac{d^2t}{dt^2} = \sin\theta\frac{d^2r}{dt^2} + \cos\theta\frac{dr}{dt} + \cos\theta\frac{dr}{dt}\frac{d\theta}{dt} - r\sin\theta\frac{d^2\theta}{dt^2}$$

1

2

1.3

$$F_r = F_x \cos\theta + F_y \sin\theta = m\left(\frac{d^2x}{dt^2}\cos\theta + \frac{d^2y}{dt^2}\sin\theta\right)$$
$$F_\theta = F_y \cos\theta - F_x \cos\theta = m\left(\frac{d^2y}{dt^2}\cos\theta - \frac{d^2x}{dt^2}\cos\theta\right)$$
$$\frac{d^2x}{dt^2} = \cos\theta\frac{d^2r}{dt^2} - \sin\theta\frac{dr}{dt} - \sin\theta\frac{dr}{dt}\frac{d\theta}{dt} - r\cos\theta\frac{d^2\theta}{dt^2}$$
$$\frac{d^2t}{dt^2} = \sin\theta\frac{d^2r}{dt^2} + \cos\theta\frac{dr}{dt} + \cos\theta\frac{dr}{dt}\frac{d\theta}{dt} - r\sin\theta\frac{d^2\theta}{dt^2}$$

정리하면,

$$F_r = m\left[\frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2\right]$$
$$-r\left(\frac{d\theta}{dt}\right)^2 \rightarrow \text{Centrifugal force}$$
$$F_\theta = m\left[r\frac{d^2\theta}{dt^2} + 2\frac{dr}{dt}\frac{d\theta}{dt}\right]$$
$$2\frac{dr}{dt}\frac{d\theta}{dt} \rightarrow \text{Coriolis force}$$

1.4

$$\frac{d\theta}{dt} = \Omega$$

$$r\frac{d\theta}{dt} = r\Omega = u_\theta$$

$$\frac{dr}{dt} = v_r$$

$$\frac{d}{dt}r^2\Omega = 2r\frac{dr}{dt}\Omega + r^2\frac{d\Omega}{dt} = r\left(r\frac{d\Omega}{dt} + 2\frac{dr}{dt}\Omega\right)$$

$$rF_\theta = m\frac{d}{dt}\left(r^2\Omega\right)$$

$$r^2\Omega = const$$

$$r\left(r\Omega\right) = ru_\theta = const$$

$$R_1 v_1 = R_2 v_2$$

2.1

$$(x, y) \rightarrow (x', y')$$
$$(x, y) \rightarrow (r, \theta)$$
$$\overrightarrow{F} = F_x \hat{i} + F_y \hat{j}$$
$$F_x = m\frac{d^2x}{dt^2} \; F_y = m\frac{d^2y}{dt^2}$$
$$x' = x\cos\omega t$$
$$y' = y\sin\omega t$$
$$\overrightarrow{F} = F_{x'} \hat{i} + F_{y'} \hat{j}$$
$$F_{x'} = F_x\cos\omega t + F_y\sin\omega t = m\left(\frac{d^2x}{dt^2}\cos\omega t + \frac{d^2y}{dt^2}\sin\omega t\right)$$
$$F_{y'} = -F_x\sin t + F_y\cos\omega t = m\left(-\frac{d^2s}{dt^2}\sin\omega t + \frac{d^2y}{dt^2}\cos\omega t\right)$$

2.2

$$x = r\cos\theta$$
$$\frac{dx}{dt} = \cos\theta\frac{dr}{dt} - r\sin\theta\frac{d\theta}{dt}$$
$$\frac{d^2x}{dt^2} = \cos\theta\frac{d^2r}{dt^2} - \sin\theta\frac{dr}{dt} - \sin\theta\frac{dr}{dt}\frac{d\theta}{dt} - r\cos\theta\frac{d^2\theta}{dt^2}$$
$$y = r\sin\theta$$
$$\frac{dy}{dt} = \sin\theta\frac{dr}{dt} + r\cos\theta\frac{d\theta}{dt}$$
$$\frac{d^2t}{dt^2} = \sin\theta\frac{d^2r}{dt^2} + \cos\theta\frac{dr}{dt} + \cos\theta\frac{dr}{dt}\frac{d\theta}{dt} - r\sin\theta\frac{d^2\theta}{dt^2}$$

2.3

$$F_r = F_x \cos\theta + F_y \sin\theta = m\left(\frac{d^2x}{dt^2}\cos\theta + \frac{d^2y}{dt^2}\sin\theta\right)$$

$$F_\theta = F_y \cos\theta - F_x \cos\theta = m\left(\frac{d^2y}{dt^2}\cos\theta - \frac{d^2x}{dt^2}\cos\theta\right)$$

$$\frac{d^2x}{dt^2} = \cos\theta\frac{d^2r}{dt^2} - \sin\theta\frac{dr}{dt} - \sin\theta\frac{dr}{dt}\frac{d\theta}{dt} - r\cos\theta\frac{d^2\theta}{dt^2}$$

$$\frac{d^2t}{dt^2} = \sin\theta\frac{d^2r}{dt^2} + \cos\theta\frac{dr}{dt} + \cos\theta\frac{dr}{dt}\frac{d\theta}{dt} - r\sin\theta\frac{d^2\theta}{dt^2}$$

정리하면,

$$F_r = m\left[\frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2\right]$$

$$-r\left(\frac{d\theta}{dt}\right)^2 \rightarrow \text{Centrifugal force}$$

$$F_\theta = m\left[r\frac{d^2\theta}{dt^2} + 2\frac{dr}{dt}\frac{d\theta}{dt}\right]$$

$$2\frac{dr}{dt}\frac{d\theta}{dt} \rightarrow \text{Coriolis force}$$

Pressure gradient force

$$dV = dx \cdot dy \cdot dz$$

x 방향

$$F_x = P \cdot \Delta y \cdot \Delta z - (P + \Delta P)\,\Delta y \cdot \Delta z$$

$$F_x = -\Delta P \cdot \Delta y \cdot \Delta z$$

$$\frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

$$f'(x) = lim \frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

$$z = f(x, y)$$

$y = b \rightarrow$ 고정

$$\frac{\partial z}{\partial x} = lim \frac{\Delta z}{\Delta x} = \frac{f(x + \Delta x, b) - f(x, b)}{\Delta x}$$

$$\frac{\partial z}{\partial y} = lim \frac{\Delta z}{\Delta y} = \frac{f(y + \Delta y, b) - f(y, b)}{\Delta y}$$

$$\Delta z = \frac{\partial z}{\partial x}\Delta x + \frac{\partial z}{\partial y}\Delta y$$

$$dz = \frac{\partial z}{\partial x}dx + \frac{\partial z}{\partial y}dy$$

Pressure gradient force

$$\Delta T = \frac{\partial T}{\partial t}\Delta t + \frac{\partial T}{\partial x}\Delta x + \frac{\partial T}{\partial y}\Delta y + \frac{\partial T}{\partial z}\Delta z$$

$$F_x = -\Delta P \cdot \Delta y \cdot \Delta z = \frac{\partial P}{\partial x} \cdot \Delta x \cdot \Delta y \cdot \Delta z$$

$$F_y = -\Delta P \cdot \Delta z \cdot \Delta x = \frac{\partial P}{\partial y} \cdot \Delta x \cdot \Delta y \cdot \Delta z$$

$$F_z = -\Delta P \cdot \Delta x \cdot \Delta y = \frac{\partial P}{\partial z} \cdot \Delta x \cdot \Delta y \cdot \Delta z$$

$$\rho = \frac{m}{\Delta x \cdot \Delta y \cdot \Delta z}$$

$$\frac{F_x}{m} = -\frac{1}{\rho}\frac{\partial P}{\partial x}$$

$$\frac{F}{m} = -\frac{1}{\rho}\left(\frac{\partial P}{\partial x}i + \frac{\partial P}{\partial y}j + \frac{\partial P}{\partial z}k\right) = -\frac{1}{\rho}\nabla P$$

Gravity

$$\Delta T = \frac{\partial T}{\partial t}\Delta t + \frac{\partial T}{\partial x}\Delta x + \frac{\partial T}{\partial y}\Delta y + \frac{\partial T}{\partial z}\Delta z$$

$$F_x = -\Delta P \cdot \Delta y \cdot \Delta z = \frac{\partial P}{\partial x} \cdot \Delta x \cdot \Delta y \cdot \Delta z$$

$$F_y = -\Delta P \cdot \Delta z \cdot \Delta x = \frac{\partial P}{\partial y} \cdot \Delta x \cdot \Delta y \cdot \Delta z$$

$$F_z = -\Delta P \cdot \Delta x \cdot \Delta y = \frac{\partial P}{\partial z} \cdot \Delta x \cdot \Delta y \cdot \Delta z$$

$$\rho = \frac{m}{\Delta x \cdot \Delta y \cdot \Delta z}$$

$$\frac{F_x}{m} = -\frac{1}{\rho}\frac{\partial P}{\partial x}$$

$$\frac{F}{m} = -\frac{1}{\rho}\left(\frac{\partial P}{\partial x}i + \frac{\partial P}{\partial y}j + \frac{\partial P}{\partial z}k\right) = -\frac{1}{\rho}\nabla P$$

4

asdf

Lorem Ipsum Dolor Sit Amet