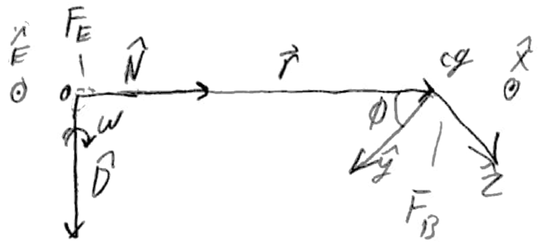
Samuel Razumovskiy | ASEN 3128 - HW1 | due 9-12-19



$|\vec{r}| = 100\,m$
$|\vec{V}^E| = 10\,\frac{m}{s}$

1) $\vec{r}$ is the vector from o to the cg of the aircraft
$\vec{r}_E$ is the vector from o to the cg in E frame coordinates
$\vec{r}_E$ would be represented as $\begin{bmatrix}100\\0\\0\end{bmatrix}[m]$

$\vec{r}_B$ is the vector from o to the cg in B frame coordinates
$\vec{r}_B$ would be represented as $\begin{bmatrix}0\\-100\cos\phi\\100\sin\phi\end{bmatrix}[m]$

2) $\vec{V}^E = \frac{d}{dt}^E \vec{r}$ says the inertial velocity vector is equal to the E frame derivative of $\vec{r}$

$\vec{V}^E_E$ is the inertial velocity in E frame coordinates represented as $\vec{V}^E_E = [0\ 10\ 0]^T [\frac{m}{s}]$

$\vec{V}^E_B$ is the inertial velocity in B frame coordinates represented as $\vec{V}^E_B = [10\ 0\ 0]^T [\frac{m}{s}]$

3) $\vec{\omega}^{EB}$ is the angular velocity of the B frame as seen from E

$\vec{\omega}^{EB}_E$ is $\vec{\omega}^{EB}$ represented in E frame coordinates as $\begin{bmatrix}0\\0\\.1\end{bmatrix}[\frac{rad}{s}]$

$\vec{\omega}^{EB}_E$ is $\vec{\omega}^{EB}$ represented in B frame coordinates as $\begin{bmatrix}0\\.1\sin(\phi)\\.1\cos(\phi)\end{bmatrix}[\frac{rad}{s}]$

4) $\frac{d^B}{dt}\vec{r}$ is the B frame derivative of $\vec{r}$

$\left(\frac{d^B}{dt}\vec{r}\right)_E$ is the B frame derivative of $\vec{r}$ in E frame coordinates

represented as $[0\ 0\ 0]^T \left[\frac{m}{s}\right]$

$\left(\frac{d^B}{dt}\vec{r}\right)_B$ is the B frame derivative of $\vec{r}$ in B frame coordinates

represented as $[0\ 0\ 0]^T \left[\frac{m}{s}\right]$

5) $\left(\frac{d^E}{dt}\vec{V}^E\right)_E$ is the E frame derivative of the inertial velocity

in E frame coordinates represented as $[-1\ 0\ 0] \left[\frac{m}{s^2}\right]$

$\left(\frac{d^B}{dt}\vec{V}^E\right)_B$ is the B frame derivative of the inertial velocity

in B frame coordinates represented as $[0\ 0\ 0] \left[\frac{m}{s^2}\right]$

6) $\frac{d^E}{dt}\vec{V}^E = \overset{0}{\cancel{\frac{d^B}{dt}\vec{V}^E}} + \vec{w}^{EB} \times \vec{V}^E$ $\quad \begin{vmatrix} \hat{N} & \hat{E} & \hat{D} \\ 0 & 0 & .1 \\ 0 & 10 & 0 \end{vmatrix} = -\hat{N} \left[\frac{m}{s^2}\right]$

$$\frac{d^E}{dt}\vec{V}^E = -\hat{N} \left[\frac{m}{s^2}\right]$$

7) $\vec{f} = m\vec{a}$ which is ~~is~~ a vector

$\vec{f}_E = m\left(\frac{d^E}{dt}\vec{V}^E\right)_E$ which is $[-m\ 0\ 0]^T [N]$

$\vec{f}_B = m\left(\frac{d^E}{dt}\vec{V}^E\right)_B$ which is $\begin{bmatrix} 0 \\ m\cos\phi \\ m\sin\phi \end{bmatrix} [N]$

8) $\vec{V}^E = \vec{w} + \vec{V}$

$\vec{V}^E = 10\hat{E} \left[\frac{m}{s}\right]$ $\vec{w} = 2\hat{N} + 3\hat{E} - 1\hat{D} \left[\frac{m}{s}\right]$

$\vec{V} = \vec{V}^E - \vec{w} = -2\hat{N} + 7\hat{E} + 1\hat{D} \left[\frac{m}{s}\right]$

$\boxed{\vec{V} = -2\hat{N} + 7\hat{E} + 1\hat{D} \left[\frac{m}{s}\right]}$

$\vec{V}_B = [-7 \quad -2\cdot -\cos\phi + \sin\phi \quad -2\cdot -\sin\phi + \cos\phi]$

$\boxed{\vec{V}_B = [7 \quad 2\cos\phi + \sin\phi \quad 2\sin\phi + \cos\phi]}$