ϕ = azimuth, θ = elevation

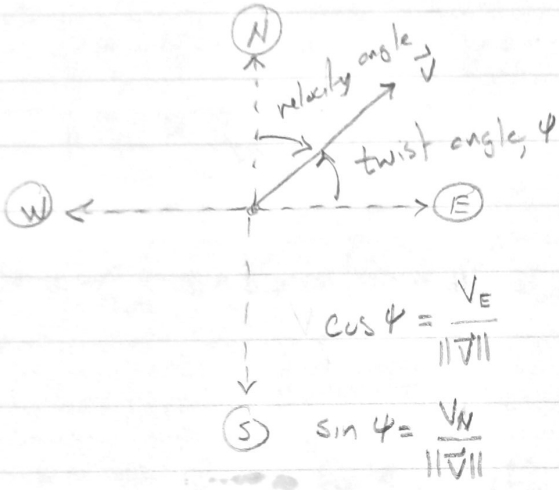
$\sin\theta = \frac{z}{r} \Rightarrow z = r\sin\theta$

$\cos\theta = \frac{l}{r} \Rightarrow l = r\cos\theta$

ψ = twist angle

$l\phi = s_\phi \qquad \frac{ds_\phi}{dt} = \|\vec{v}\|\cos\psi$

$\dot{\phi} = \frac{\dot{s}_\phi}{l} = \frac{\|\vec{v}\|}{l}\cos\psi = \frac{\|\vec{v}\|\cos\psi}{r\cos\theta}$



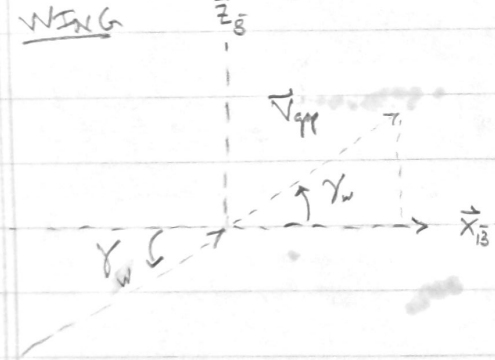
$r\theta = s_\theta \qquad \frac{ds_\theta}{dt} = \|\vec{v}\|\sin\psi$

$\dot{\theta} = \frac{\|\vec{v}\|\sin\psi}{r}$

$\cos\psi = \frac{V_E}{\|\vec{v}\|}$

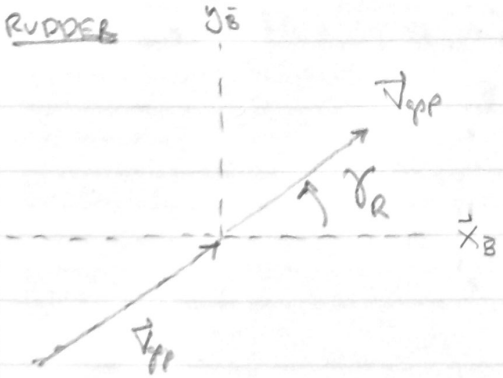
$\sin\psi = \frac{V_N}{\|\vec{v}\|}$

WING



$\tan\gamma_w = \frac{v_{app,z}}{v_{app,x}} \Rightarrow \gamma_w = a\tan\left(\frac{v_{app,z}}{v_{app,x}}\right)$

RUDDER



$\tan\gamma_R = \frac{v_{app,y}}{v_{app,x}} \Rightarrow \gamma_R = a\tan\left(\frac{v_{app,y}}{v_{app,x}}\right)$