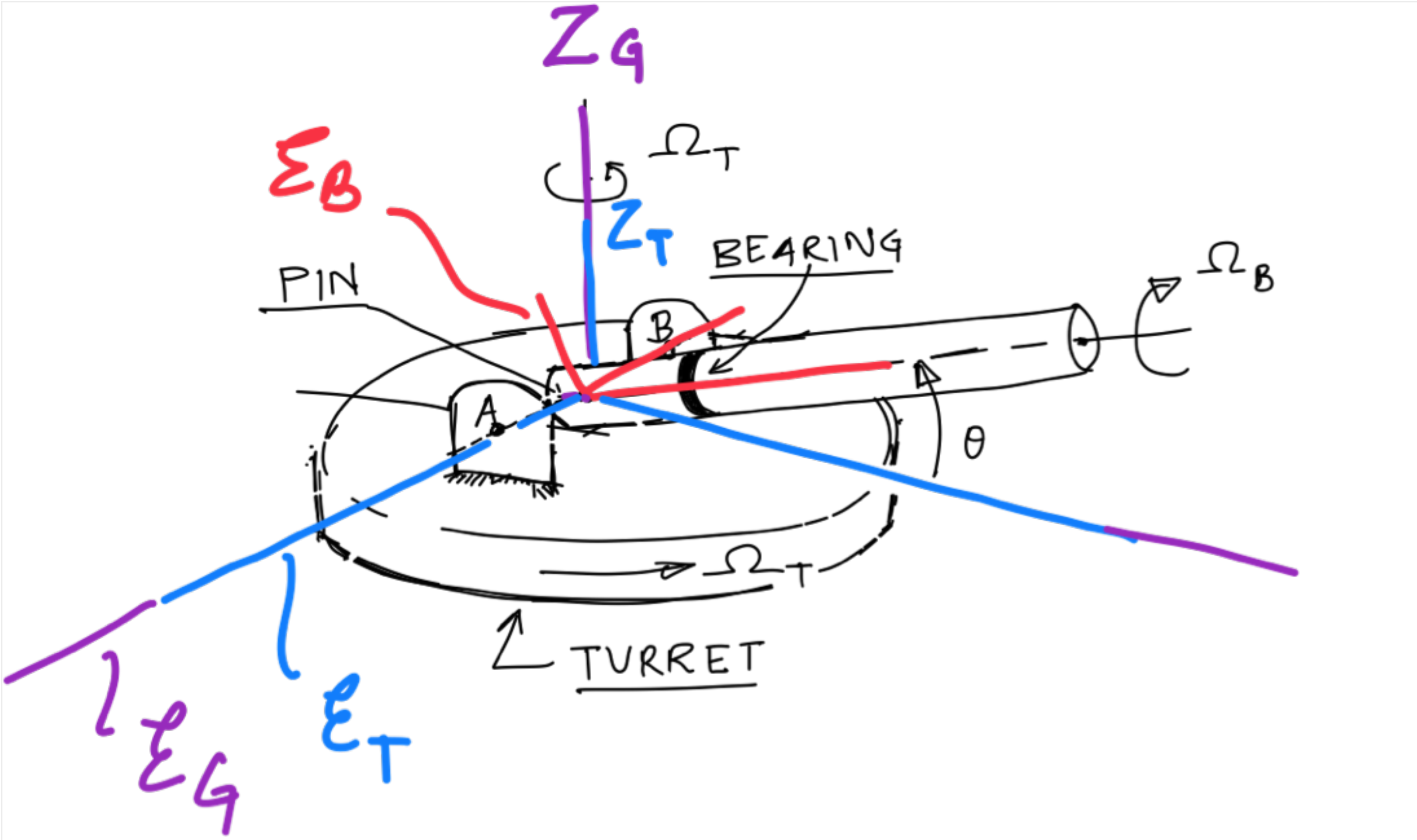
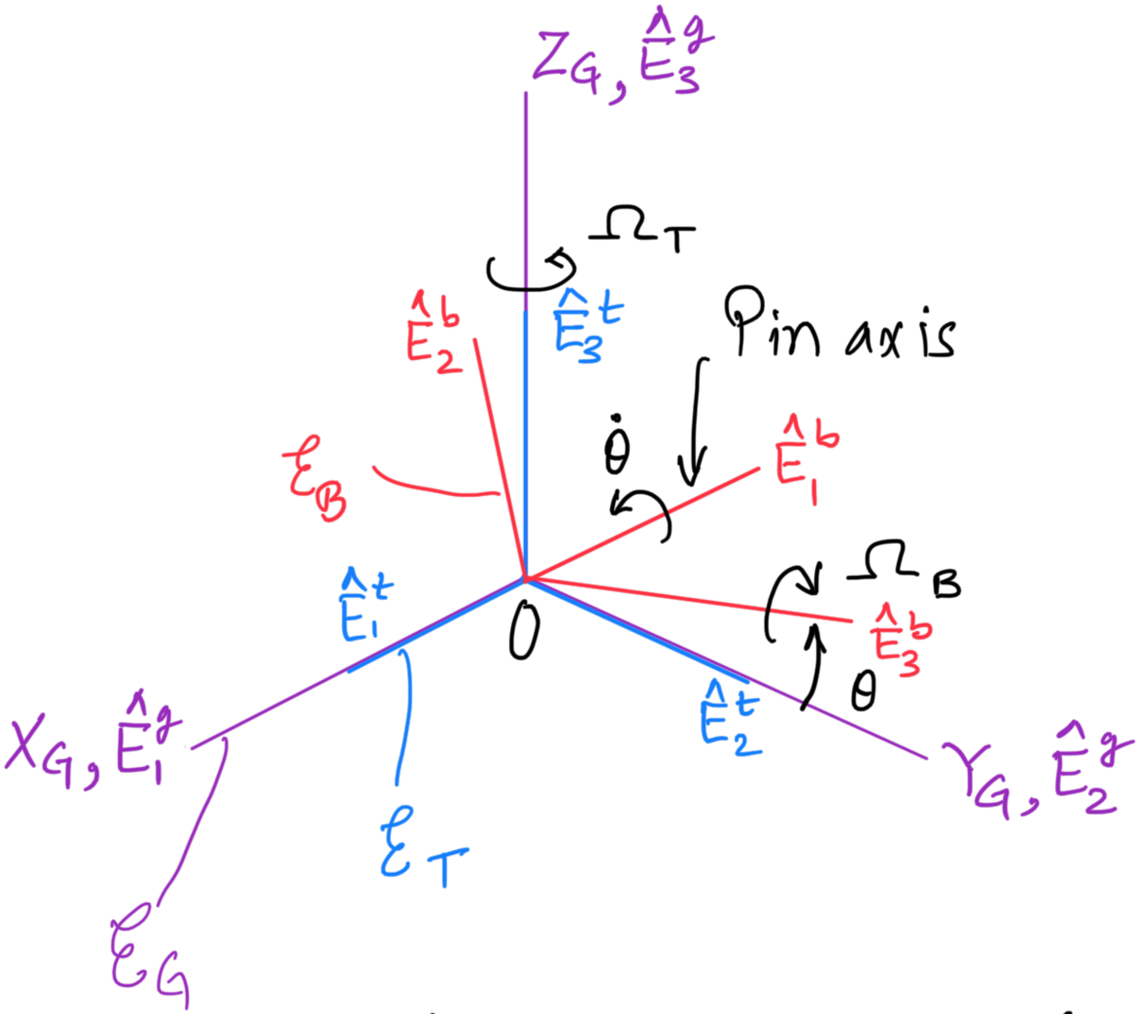


Z_G
Ω_T
ε_B
Z_T
BEARING
Ω_B
PIN
B
A
θ
Ω_T
TURRET
ε_T
ε_G



Let $\underline{\omega}_B$ be the angular velocity of barrel in $\mathcal{E}_B$

$$\therefore \quad \underline{\omega}_{B/\mathcal{E}_B} = -\Omega_B \hat{E}_3^b \quad \text{———} \quad (1)$$

Next, angular velocity of barrel in $\mathcal{E}_T$

$$\underline{\omega}_{B/\mathcal{E}_T} = \underline{\omega}_{B/\mathcal{E}_B} + \underline{\omega}_{\mathcal{E}_B/\mathcal{E}_T}$$

$$= -\Omega_B \hat{E}_3^b + \dot{\theta}\, \hat{E}_1^t$$

Aside

$\hat{E}_1^t = \hat{E}_1^g$

$$= -\Omega_B \hat{E}_3^b + \dot{\theta}\, \hat{E}_1^g \quad \text{———} \quad (2)$$

Finally, angular velocity of barrel in $\mathcal{E}_G$

$$\underline{\omega}_{B/\mathcal{E}_G} = \underline{\omega}_{B/\mathcal{E}_T} + \underline{\omega}_{\mathcal{E}_T/\mathcal{E}_G}$$

$$= -\Omega_B \hat{E}_3^b + \dot{\theta}\hat{E}_1^g + \Omega_T \hat{E}_3^g \quad \text{--- (3)}$$

From the fig. above $\hat{E}_3^b$ can be written in $\mathcal{E}_G$ as follows

$$\hat{E}_3^b = \hat{E}_2^g \cos\theta + \hat{E}_3^g \sin\theta$$

$$\therefore \underline{\omega}_{B/\mathcal{E}_G} = -\Omega_B\left(\hat{E}_2^g \cos\theta + \hat{E}_3^g \sin\theta\right) + \dot{\theta}\hat{E}_1^g + \Omega_T \hat{E}_3^g$$

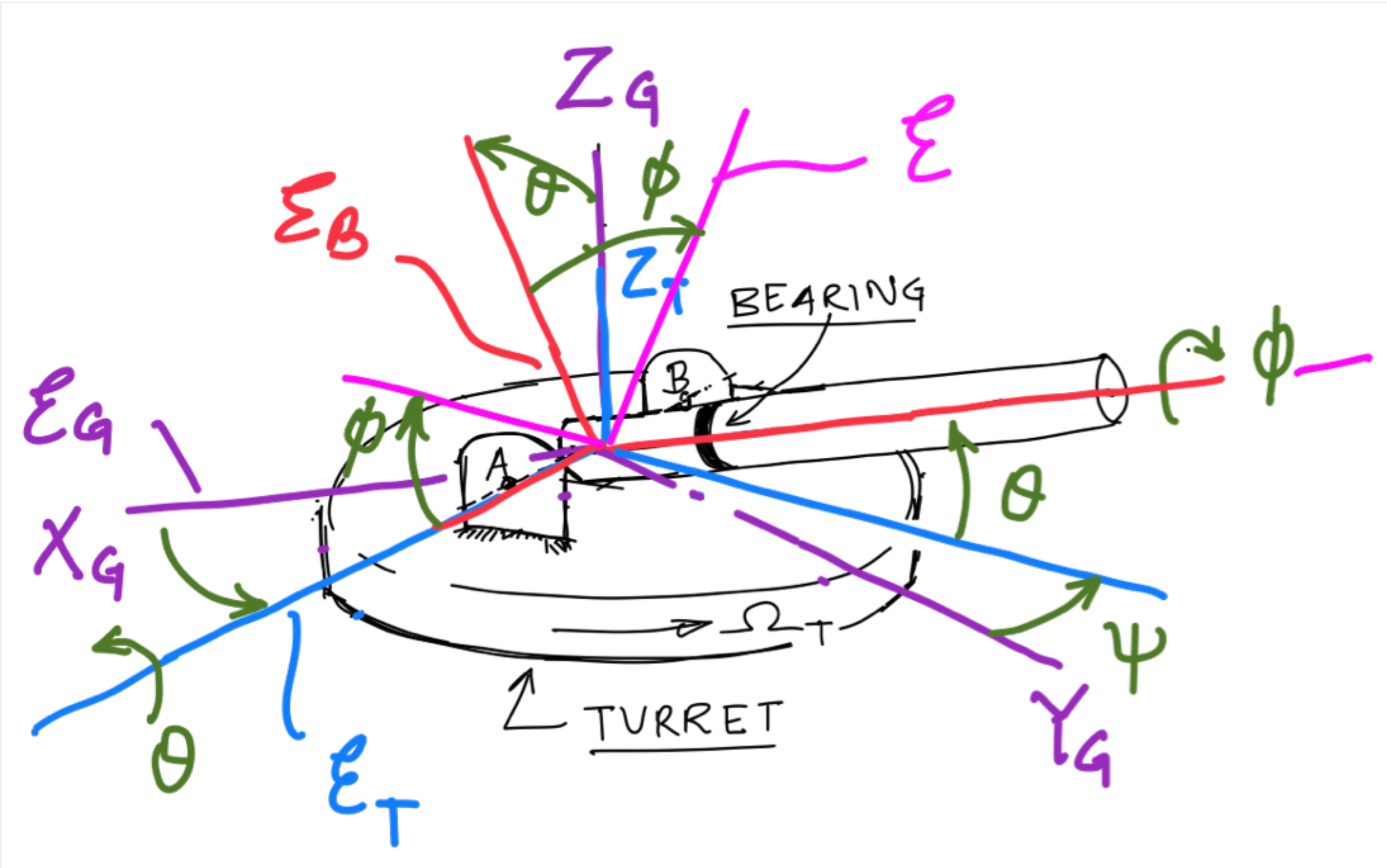
$$\underline{\omega}_{B/\mathcal{E}_G} = \dot{\theta}\hat{E}_1^g - \Omega_B \cos\theta \,\hat{E}_2^g + (\Omega_T - \Omega_B \sin\theta)\hat{E}_3^g$$

known $\dot{\theta} = \pi/4$ rad/sec ; $\theta = \pi/6$ rad.

$\Omega_T = \Omega_B = 2\pi$ rad/sec.

$$\therefore \underline{\omega}_{B/\mathcal{E}_G} = \frac{\pi}{4}\hat{E}_1^g - 2\pi\cos(30^\circ)\hat{E}_2^g + 2\pi(1-\sin 30^\circ)\hat{E}_3^g$$

or $\boxed{\underline{\omega}_{B/\mathcal{E}_G} = \frac{\pi}{4}\hat{E}_1^g - \sqrt{3}\pi\hat{E}_2^g + \pi\hat{E}_3^g \text{ rad/s}}$



Z G
ε
ε B
θ
φ
Z T
BEARING
B
A
φ
ε G
X G
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θ
Ω T
ψ
TURRET
Y G
θ
ε T

Method 2:

$$\mathcal{E}_G \xrightarrow{\underline{\underline{R}}_\psi(\hat{E}_1,\psi)} \mathcal{E}_T \xrightarrow{\underline{\underline{R}}_\theta(\hat{e}_1',\theta)} \mathcal{E}_B \xrightarrow{\underline{\underline{R}}_\phi(\hat{e}_2'',\phi)} \mathcal{E}$$

$$\underline{\underline{R}} = \underline{\underline{R}}_\psi \cdot \underline{\underline{R}}_\theta \cdot \underline{\underline{R}}_\phi$$

$$\underline{\underline{\Omega}} = \dot{\underline{\underline{R}}}\ \underline{\underline{R}}^T$$