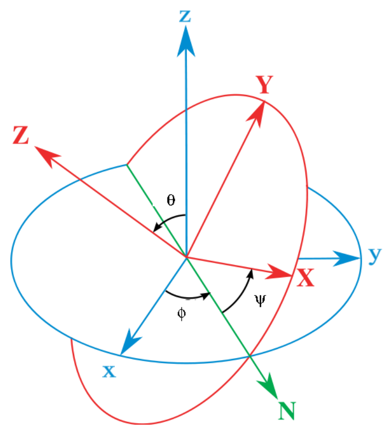
October 24, 2012

PHY 711 – Problem Set # 17

Finish reading Chapter 5 in **Fetter and Walecka**.

In most Classsical Mechanics texts (besides **Fetter and Walecka**), the Euler angles are defined with a different convention as shown below. (This figure was slightly modified from one available on the website `http://en.wikipedia.org/wiki/Euler_angles`.)



In this case, the first rotation is about the original $\hat{\mathbf{z}}$ axis by ϕ corresponding to the rotation matrix

$$\mathcal{R}_\phi = \begin{pmatrix} \cos\phi & \sin\phi & 0 \\ -\sin\phi & \cos\phi & 0 \\ 0 & 0 & 1 \end{pmatrix}. \tag{1}$$

The second rotation is about the new $\hat{\mathbf{x}}$ axis by θ corresponding to the rotation matrix

$$\mathcal{R}_\theta = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{pmatrix}. \tag{2}$$

In this case, the last rotation is about the new $\hat{\mathbf{z}}$ axis by ψ corresponding to the rotation matrix

$$\mathcal{R}_\psi = \begin{pmatrix} \cos\psi & \sin\psi & 0 \\ -\sin\psi & \cos\psi & 0 \\ 0 & 0 & 1 \end{pmatrix}. \tag{3}$$

For this convention, write a general expression for the angular velocity vector ω in terms of the time rate of change of these Euler angles – $\dot{\phi}$, $\dot{\theta}$, and $\dot{\psi}$ corresponding to the 29.7 of your text.