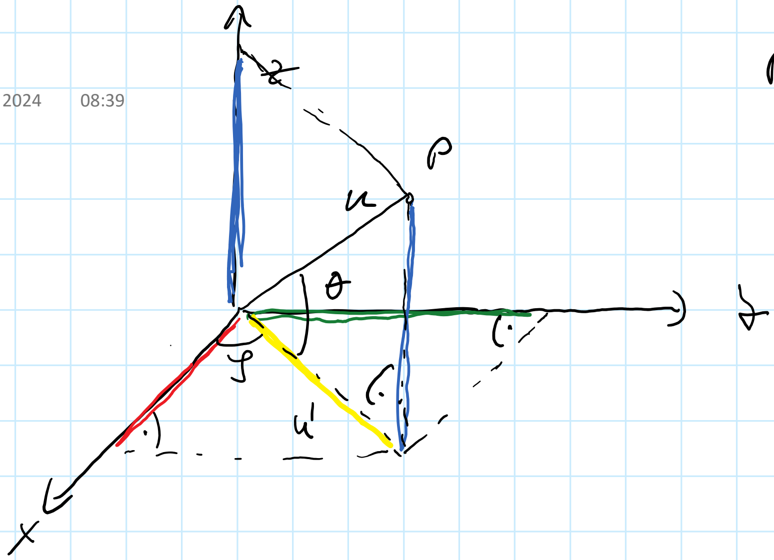
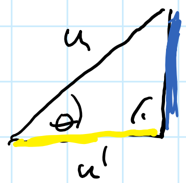


$$p = (r, \theta, \varphi)$$

$$\|u\| = 1 \qquad r = 1$$

$$\sin\theta = \frac{z}{1}$$

$$\Leftrightarrow \quad z = \sin\theta$$



Voraussetzung $\|u'\| \neq 0$

$$\cos\theta = \frac{\|u'\|}{1} \qquad \|u'\| = \cos\theta$$

$$\cos\varphi = \frac{x}{\|u'\|} \quad \Leftrightarrow \quad x = \|u'\|\cos\varphi$$

$$= \cos\theta\cos\varphi$$

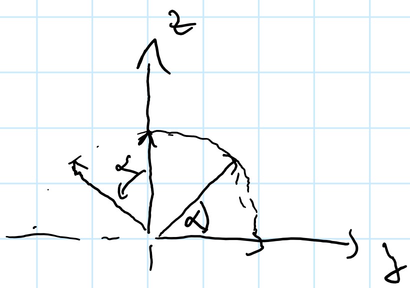
$$\sin\varphi = \frac{y}{\|u'\|} \quad \Leftrightarrow \quad y = \cos\theta\sin\varphi$$

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = r \begin{pmatrix} \cos\theta\cos\varphi \\ \cos\theta\sin\varphi \\ \sin\theta \end{pmatrix}$$

Drehmatrizen um $\hat{x}_{\alpha}$, $\hat{y}_{\beta}$, $\hat{z}_{\gamma}$

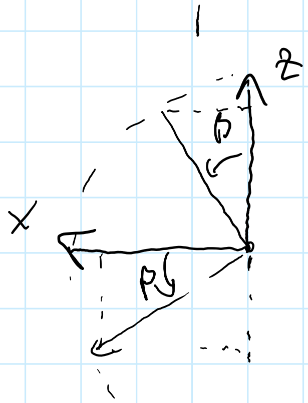
$$D_{\hat{z},\gamma} = \begin{pmatrix} \cos\gamma & -\sin\gamma & 0 \\ \sin\gamma & \cos\gamma & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$D_{\hat{x},\alpha}$



$$D_{\hat{x},\alpha} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\alpha & -\sin\alpha \\ 0 & \sin\alpha & \cos\alpha \end{pmatrix}$$

$D_{\hat{y}, \beta}$



$$D_{\hat{y}, \beta} = \begin{pmatrix} \cos\beta & 0 & \sin\beta \\ 0 & 1 & 0 \\ -\sin\beta & 0 & \cos\beta \end{pmatrix}$$