Trig identity 1:

Trig identity 2:

\begin{align\*} S&=\left[\begin{matrix}c&0&0\\0&c&0\\0&0&c\\\end{matrix}\right]\\ S\vec{v}&=\left[\begin{matrix}c&0&0\\0&c&0\\0&0&c\\\end{matrix}\right]\left[\begin{matrix}v\_x\\v\_y\\v\_z\\\end{matrix}\right]=\left[\begin{matrix}cv\_x\\cv\_y\\cv\_z\\\end{matrix}\right] \end{align\*}

M\vec{v}=\lambda I\vec{v}

\begin{align\*} {\vec{v}}^\prime&=cos\theta\vec{v}+\left(1-cos\theta\right)\left(\hat{k}\cdot\vec{v}\right)\hat{k}+sin\theta\left(\hat{k}\times\vec{v}\right)\\&=cos\theta\hat{k}+\left(1-cos\theta\right)\left(\hat{k}\cdot\hat{k}\right)\hat{k}+sin\theta\left(\hat{k}\times\hat{k}\right)\\&=cos\theta\hat{k}+\left(1-cos\theta\right)\hat{k}\\&=\hat{k} \end{align\*}

\begin{align\*} R\hat{k}&=I\hat{k}\\ R\hat{k}-I\hat{k}&=0\\ \left(R-I\right)\hat{k}&=0 \end{align\*}

\begin{align\*} 0&=R^T0\\ \left(R-I\right)\hat{k}&=R^T\left(R-I\right)\hat{k}\\ 0&=R^T\left(R-I\right)\hat{k}+\left(R-I\right)\hat{k}\\ 0&=(R^TR-R^T+R-I)\hat{k}\\ 0&=\left(I-R^T+R-I\right)\hat{k}\\ 0&=\left(R-R^T\right)\hat{k} \end{align\*}