$$
\begin{aligned}
&\dot{\boldsymbol{P}}^{\mathsf{S}}\cdot\boldsymbol{P}^{\mathsf{S}} = \\
&= (\boldsymbol{k}\boldsymbol{k}-\boldsymbol{E})\,\dot{\vartheta}\sin\vartheta\cdot\boldsymbol{E}\cos\vartheta + (\boldsymbol{k}\dot{\boldsymbol{k}}+\dot{\boldsymbol{k}}\boldsymbol{k})(1-\cos\vartheta)\cdot\boldsymbol{E}\cos\vartheta\,+ \\
&\qquad + \cancel{(\boldsymbol{k}\boldsymbol{k}-\boldsymbol{E})\,\dot{\vartheta}\sin\vartheta\cdot\boldsymbol{k}\boldsymbol{k}\,(1-\cos\vartheta)} + (\boldsymbol{k}\dot{\boldsymbol{k}}+\dot{\boldsymbol{k}}\boldsymbol{k})(1-\cos\vartheta)\cdot\boldsymbol{k}\boldsymbol{k}\,(1-\cos\vartheta) = \\
&= (\boldsymbol{k}\boldsymbol{k}-\boldsymbol{E})\,\dot{\vartheta}\sin\vartheta\cos\vartheta + (\boldsymbol{k}\dot{\boldsymbol{k}}+\dot{\boldsymbol{k}}\boldsymbol{k})\cos\vartheta\,(1-\cos\vartheta) + (\cancel{\boldsymbol{k}\dot{\boldsymbol{k}}\cdot\boldsymbol{k}\boldsymbol{k}}+\dot{\boldsymbol{k}}\boldsymbol{k}\cdot\boldsymbol{k}\boldsymbol{k})\,(1-\cos\vartheta)^2 = \\
&= (\boldsymbol{k}\boldsymbol{k}-\boldsymbol{E})\,\dot{\vartheta}\sin\vartheta\cos\vartheta + \boldsymbol{k}\dot{\boldsymbol{k}}\cos\vartheta\,(1-\cos\vartheta)\,+ \\
&\qquad + \dot{\boldsymbol{k}}\boldsymbol{k}\cos\vartheta - \dot{\boldsymbol{k}}\boldsymbol{k}\cos^2\vartheta + \dot{\boldsymbol{k}}\boldsymbol{k} - 2\,\dot{\boldsymbol{k}}\boldsymbol{k}\cos\vartheta + \dot{\boldsymbol{k}}\boldsymbol{k}\cos^2\vartheta = \\
&\qquad = (\boldsymbol{k}\boldsymbol{k}-\boldsymbol{E})\,\dot{\vartheta}\sin\vartheta\cos\vartheta + \boldsymbol{k}\dot{\boldsymbol{k}}\cos\vartheta - \boldsymbol{k}\dot{\boldsymbol{k}}\cos^2\vartheta + \dot{\boldsymbol{k}}\boldsymbol{k}\,(1-\cos\vartheta)\,,
\end{aligned}
$$

$$
\begin{aligned}
&\dot{\boldsymbol{P}}^{\mathsf{A}}\cdot\boldsymbol{P}^{\mathsf{S}} = \\
&= (\boldsymbol{k}\times\boldsymbol{E})\cdot\boldsymbol{E}\,\dot{\vartheta}\cos^2\vartheta + (\dot{\boldsymbol{k}}\times\boldsymbol{E})\cdot\boldsymbol{E}\sin\vartheta\cos\vartheta\,+ \\
&\qquad + \cancel{(\boldsymbol{k}\times\boldsymbol{E})\cdot\boldsymbol{k}\boldsymbol{k}\,\dot{\vartheta}\cos\vartheta\,(1-\cos\vartheta)} + (\dot{\boldsymbol{k}}\times\boldsymbol{E})\cdot\boldsymbol{k}\boldsymbol{k}\sin\vartheta\,(1-\cos\vartheta) = \\
&\qquad = \boldsymbol{k}\times\boldsymbol{E}\,\dot{\vartheta}\cos^2\vartheta + \dot{\boldsymbol{k}}\times\boldsymbol{E}\sin\vartheta\cos\vartheta + \dot{\boldsymbol{k}}\times\boldsymbol{k}\boldsymbol{k}\sin\vartheta\,(1-\cos\vartheta)\,,
\end{aligned}
$$

$$
\begin{aligned}
&\dot{\boldsymbol{P}}^{\mathsf{S}}\cdot\boldsymbol{P}^{\mathsf{A}} = \\
&= (\boldsymbol{k}\boldsymbol{k}-\boldsymbol{E})\,\dot{\vartheta}\sin\vartheta\cdot(\boldsymbol{k}\times\boldsymbol{E})\sin\vartheta + (\boldsymbol{k}\dot{\boldsymbol{k}}+\dot{\boldsymbol{k}}\boldsymbol{k})(1-\cos\vartheta)\cdot(\boldsymbol{k}\times\boldsymbol{E})\sin\vartheta = \\
&= \cancel{\boldsymbol{k}\boldsymbol{k}\cdot(\boldsymbol{k}\times\boldsymbol{E})\,\dot{\vartheta}\sin^2\vartheta} - \boldsymbol{E}\cdot(\boldsymbol{k}\times\boldsymbol{E})\,\dot{\vartheta}\sin^2\vartheta + \Big(\boldsymbol{k}\dot{\boldsymbol{k}}\cdot(\boldsymbol{k}\times\boldsymbol{E}) + \cancel{\dot{\boldsymbol{k}}\boldsymbol{k}\cdot(\boldsymbol{k}\times\boldsymbol{E})}\Big)\sin\vartheta\,(1-\cos\vartheta) = \\
&\qquad = -\boldsymbol{k}\times\boldsymbol{E}\,\dot{\vartheta}\sin^2\vartheta + \boldsymbol{k}\dot{\boldsymbol{k}}\times\boldsymbol{k}\sin\vartheta\,(1-\cos\vartheta)\,,
\end{aligned}
$$

$$
\begin{aligned}
&\dot{\boldsymbol{P}}^{\mathsf{A}}\cdot\boldsymbol{P}^{\mathsf{A}} = (\boldsymbol{k}\times\boldsymbol{E})\,\dot{\vartheta}\cos\vartheta\cdot(\boldsymbol{k}\times\boldsymbol{E})\sin\vartheta + (\dot{\boldsymbol{k}}\times\boldsymbol{E})\cdot(\boldsymbol{k}\times\boldsymbol{E})\sin^2\vartheta = \\
&\qquad = (\boldsymbol{k}\boldsymbol{k}-\boldsymbol{E})\,\dot{\vartheta}\sin\vartheta\cos\vartheta + \boldsymbol{k}\dot{\boldsymbol{k}}\sin^2\vartheta\,;
\end{aligned}
$$

$$
\begin{aligned}
&\dot{\boldsymbol{P}}\cdot\boldsymbol{P}^{\mathsf{T}} = \dot{\boldsymbol{P}}^{\mathsf{S}}\cdot\boldsymbol{P}^{\mathsf{S}} + \dot{\boldsymbol{P}}^{\mathsf{A}}\cdot\boldsymbol{P}^{\mathsf{S}} - \dot{\boldsymbol{P}}^{\mathsf{S}}\cdot\boldsymbol{P}^{\mathsf{A}} - \dot{\boldsymbol{P}}^{\mathsf{A}}\cdot\boldsymbol{P}^{\mathsf{A}} = \\
&\qquad = (\boldsymbol{k}\boldsymbol{k}-\boldsymbol{E})\,\dot{\vartheta}\sin\vartheta\cos\vartheta + \boldsymbol{k}\dot{\boldsymbol{k}}\cos\vartheta - \boldsymbol{k}\dot{\boldsymbol{k}}\cos^2\vartheta + \dot{\boldsymbol{k}}\boldsymbol{k}\,(1-\cos\vartheta)\,+ \\
&\qquad + \boldsymbol{k}\times\boldsymbol{E}\,\dot{\vartheta}\cos^2\vartheta + \dot{\boldsymbol{k}}\times\boldsymbol{E}\sin\vartheta\cos\vartheta + \dot{\boldsymbol{k}}\times\boldsymbol{k}\boldsymbol{k}\sin\vartheta\,(1-\cos\vartheta)\,+ \\
&\quad + \boldsymbol{k}\times\boldsymbol{E}\,\dot{\vartheta}\sin^2\vartheta - \boldsymbol{k}\dot{\boldsymbol{k}}\times\boldsymbol{k}\sin\vartheta\,(1-\cos\vartheta) - (\boldsymbol{k}\boldsymbol{k}-\boldsymbol{E})\,\dot{\vartheta}\sin\vartheta\cos\vartheta - \boldsymbol{k}\dot{\boldsymbol{k}}\sin^2\vartheta = \\
&= \boldsymbol{k}\times\boldsymbol{E}\,\dot{\vartheta} + (\dot{\boldsymbol{k}}\boldsymbol{k}-\boldsymbol{k}\dot{\boldsymbol{k}})(1-\cos\vartheta) + \dot{\boldsymbol{k}}\times\boldsymbol{E}\sin\vartheta\cos\vartheta + (\dot{\boldsymbol{k}}\times\boldsymbol{k}\boldsymbol{k}-\boldsymbol{k}\dot{\boldsymbol{k}}\times\boldsymbol{k})\sin\vartheta\,(1-\cos\vartheta) = \\
&= \boldsymbol{k}\times\boldsymbol{E}\,\dot{\vartheta} + \boldsymbol{k}\times\dot{\boldsymbol{k}}\times\boldsymbol{E}\,(1-\cos\vartheta) + \dot{\boldsymbol{k}}\times\boldsymbol{E}\sin\vartheta\cos\vartheta + \boldsymbol{k}\times(\dot{\boldsymbol{k}}\times\boldsymbol{k})\times\boldsymbol{E}\sin\vartheta\,(1-\cos\vartheta) = \\
&= \boldsymbol{k}\times\boldsymbol{E}\,\dot{\vartheta} + \dot{\boldsymbol{k}}\times\boldsymbol{E}\sin\vartheta\cos\vartheta + (\dot{\boldsymbol{k}}\boldsymbol{k}\cdot\boldsymbol{k} - \cancel{\boldsymbol{k}\dot{\boldsymbol{k}}\cdot\boldsymbol{k}})\times\boldsymbol{E}\sin\vartheta\,(1-\cos\vartheta) + \boldsymbol{k}\times\dot{\boldsymbol{k}}\times\boldsymbol{E}\,(1-\cos\vartheta) = \\
&\qquad = \boldsymbol{k}\times\boldsymbol{E}\,\dot{\vartheta} + \dot{\boldsymbol{k}}\times\boldsymbol{E}\sin\vartheta + \boldsymbol{k}\times\dot{\boldsymbol{k}}\times\boldsymbol{E}\,(1-\cos\vartheta)\,.
\end{aligned}
$$

$$o_{i'k} = \begin{bmatrix} o_{1'1} & o_{1'2} & o_{1'3} \\ o_{2'1} & o_{2'2} & o_{2'3} \\ o_{3'1} & o_{3'2} & o_{3'3} \end{bmatrix} = \begin{bmatrix} \cos\measuredangle(\boldsymbol{e}'_1, \boldsymbol{e}_1) & \cos\measuredangle(\boldsymbol{e}'_1, \boldsymbol{e}_2) & \cos\measuredangle(\boldsymbol{e}'_1, \boldsymbol{e}_3) \\ \cos\measuredangle(\boldsymbol{e}'_2, \boldsymbol{e}_1) & \cos\measuredangle(\boldsymbol{e}'_2, \boldsymbol{e}_2) & \cos\measuredangle(\boldsymbol{e}'_2, \boldsymbol{e}_3) \\ \cos\measuredangle(\boldsymbol{e}'_3, \boldsymbol{e}_1) & \cos\measuredangle(\boldsymbol{e}'_3, \boldsymbol{e}_2) & \cos\measuredangle(\boldsymbol{e}'_3, \boldsymbol{e}_3) \end{bmatrix}$$

$$\left(o_{i'k}\right)^{\mathsf{T}} = \begin{bmatrix} o_{1'1} & o_{2'1} & o_{3'1} \\ o_{1'2} & o_{2'2} & o_{3'2} \\ o_{1'3} & o_{2'3} & o_{3'3} \end{bmatrix} = \begin{bmatrix} \cos\measuredangle(\boldsymbol{e}'_1, \boldsymbol{e}_1) & \cos\measuredangle(\boldsymbol{e}'_2, \boldsymbol{e}_1) & \cos\measuredangle(\boldsymbol{e}'_3, \boldsymbol{e}_1) \\ \cos\measuredangle(\boldsymbol{e}'_1, \boldsymbol{e}_2) & \cos\measuredangle(\boldsymbol{e}'_2, \boldsymbol{e}_2) & \cos\measuredangle(\boldsymbol{e}'_3, \boldsymbol{e}_2) \\ \cos\measuredangle(\boldsymbol{e}'_1, \boldsymbol{e}_3) & \cos\measuredangle(\boldsymbol{e}'_2, \boldsymbol{e}_3) & \cos\measuredangle(\boldsymbol{e}'_3, \boldsymbol{e}_3) \end{bmatrix}$$