$$g = \begin{bmatrix} 1 & (e_E \cdot e_B) & (e_E \cdot e_k) & 0 \\ (e_E \cdot e_B) & 1 & (e_B \cdot e_k) & 0 \\ (e_E \cdot e_k) & (e_B \cdot e_k) & 1 & 0 \\ 0 & 0 & 0 & -1 \end{bmatrix}$$

$$X = x_E e_E + x_B e_B + x_k e_k + t e_t$$

$$K = k e_k + \omega e_t$$

$$K \cdot X = (e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k$$

$$\begin{aligned} F = {} & (e_B \cdot e_k)\, B \sin\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_E \wedge e_B \\ & - B \sin\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_E \wedge e_k \\ & + E \sin\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_E \wedge e_t \\ & + (e_E \cdot e_B)\, B \sin\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_B \wedge e_k \end{aligned}$$

$$\begin{aligned} \boldsymbol{\nabla} F = 0 = {} & \left(-(e_B \cdot e_k)^2 B k + B k + E \omega\right) \cos\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_E \\ & + B k \left((e_B \cdot e_k)\,(e_E \cdot e_k) - (e_E \cdot e_B)\right) \cos\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_B \\ & + B k \left((e_B \cdot e_k)\,(e_E \cdot e_B) - (e_E \cdot e_k)\right) \cos\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_k \\ & + (e_E \cdot e_k)\, E k \cos\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_t \\ & + (e_B \cdot e_k)\, B k \cos\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_E \wedge e_B \wedge e_k \\ & + (e_B \cdot e_k)\, B \omega \cos\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_E \wedge e_B \wedge e_t \\ & + (-B\omega - E k) \cos\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_E \wedge e_k \wedge e_t \\ & + (e_E \cdot e_B)\, B \omega \cos\left((e_B \cdot e_k)\, k x_B + (e_E \cdot e_k)\, k x_E - \omega t + k x_k\right) e_B \wedge e_k \wedge e_t \end{aligned}$$

Substituting $e_E \cdot e_B = e_E \cdot e_k = e_B \cdot e_k = 0$

$$\begin{aligned} (\boldsymbol{\nabla} F) \,/\, (\cos\left(K \cdot X\right)) = 0 = {} & (B k + E \omega)\, e_E \\ & + (-B\omega - E k)\, e_E \wedge e_k \wedge e_t \end{aligned}$$