

$$\begin{aligned}
& -k_0 (\eta_4(t) - \eta_5(t)) + k_0 \eta_5(t) - \\
& \frac{1}{2} m_0 \left( 2 (-\cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t))) \right. \\
& \quad \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \right. \\
& \quad \left. \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \eta_5'(t) \right) \right) + \\
& \quad 2 \cos(\alpha(t)) \alpha'(t) \left( \cos(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t) + \sin(\alpha(t)) \eta_5'(t) \right) + \\
& \quad 2 (\cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t)) \\
& \quad \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t) + \cos(\theta(t)) R(t) \theta'(t) + \right. \\
& \quad \left. \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \eta_5'(t) \right) \right) \Bigg) - \\
& \frac{1}{2} m_0 \left( 2 (-\cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t))) \right. \\
& \quad \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{3L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - \right. \\
& \quad \left. R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \right. \\
& \quad \left. \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_4'(t) + \eta_5'(t)) \right) \right) + \\
& \quad 2 \cos(\alpha(t)) \alpha'(t) \left( \cos(\alpha(t)) \left( \frac{3L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \sin(\alpha(t)) (\eta_4'(t) + \eta_5'(t)) \right) + \\
& \quad 2 (\cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t)) \\
& \quad \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \left. \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{3L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \right. \\
& \quad \left. \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_4'(t) + \eta_5'(t)) \right) \right) \Bigg) - \\
& \frac{1}{2} m_0 \left( 2 (-\cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t))) \right.
\end{aligned}$$

$$\begin{aligned}
& \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - \right. \\
& \quad R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \\
& \quad \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) + 2 \cos(\alpha(t)) \alpha'(t) \\
& \quad \left( \cos(\alpha(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \sin(\alpha(t)) (\eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) + \\
& \quad 2 \left( \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t) \right) \\
& \quad \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \\
& \quad \left. \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) \right) - \\
& \quad \frac{1}{2} m_0 \left( 2 \left( -\cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \right) \right. \\
& \quad \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{7L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - \right. \\
& \quad R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \\
& \quad \left. (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) + \\
& \quad 2 \cos(\alpha(t)) \alpha'(t) \left( \cos(\alpha(t)) \left( \frac{7L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \left. \sin(\alpha(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) + \\
& \quad 2 \left( \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t) \right) \\
& \quad \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \left. \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{7L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right)
\end{aligned}$$

$$\begin{aligned}
& \left( (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) \Bigg) - \\
& \frac{1}{2} m_0 \left( 2 \left( -\cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \right) \right. \\
& \quad \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - \right. \\
& \quad \left. R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right) \\
& \quad \left. (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) + \\
& \quad 2 \cos(\alpha(t)) \alpha'(t) \left( \cos(\alpha(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \left. \sin(\alpha(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) + \\
& \quad 2 \left( \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t) \right) \\
& \quad \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \left. \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right) \\
& \quad \left. (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) \Bigg) - \\
& \frac{1}{2} M_{P1} \left( 2 \left( -\cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \right) \right. \\
& \quad \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \right. \\
& \quad \left. \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \right. \\
& \quad \left. (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta'(t) + \psi'(t)) + \right. \\
& \quad \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \right) + \\
& \quad 2 \cos(\alpha(t)) \alpha'(t) \left( \cos(\alpha(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha'(t) + \right. \\
& \quad \left. \sin(\alpha(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \right) + \\
& \quad 2 \left( \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t) \right) \\
& \quad \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \right. \\
& \quad \left. \alpha'(t) + \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \right. \\
& \quad \left. (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta'(t) + \psi'(t)) + \right. \\
& \quad \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \right) \Bigg) +
\end{aligned}$$

$$\begin{aligned}
& \frac{1}{2} m_0 \left( -2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \right. \right. \\
& \quad \left. \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \right. \\
& \quad \left. \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \eta_5'(t) \right) - 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \right. \\
& \quad \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \right. \\
& \quad \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \eta_5'(t) \right) + \\
& \quad \left. 2 \cos(\alpha(t)) \alpha'(t) \left( \cos(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t) + \sin(\alpha(t)) \eta_5'(t) \right) - \right. \\
& \quad \left. 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t) \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t) + \right. \right. \\
& \quad \left. \left. \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \right. \right. \\
& \quad \left. \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \eta_5'(t) \right) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \right. \\
& \quad \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t) + \cos(\theta(t)) R(t) \theta'(t) + \right. \\
& \quad \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \eta_5'(t) \right) + \\
& \quad \left. 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( -\cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t)^2 + \right. \right. \\
& \quad \left. \left. 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t)) \alpha'(t) - \right. \right. \\
& \quad \left. \left. 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \eta_5'(t) \alpha'(t) - \cos(\theta(t)) R(t) \theta'(t)^2 - \right. \right. \\
& \quad \left. \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t))^2 - 2 \sin(\theta(t)) R'(t) \theta'(t) - \right. \right. \\
& \quad \left. \left. 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \eta_5'(t) + \cos(\theta(t)) R''(t) - \right. \right. \\
& \quad \left. \left. \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha''(t) - R(t) \sin(\theta(t)) \theta''(t) - \right. \right.
\end{aligned}$$

$$\begin{aligned}
& \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta''(t) + \psi''(t)) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \eta_5''(t) \Bigg) + \\
& 2 \sin(\alpha(t)) \left( -\sin(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t)^2 + 2 \cos(\alpha(t)) \eta_5'(t) \alpha'(t) + \right. \\
& \left. \cos(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha''(t) + \sin(\alpha(t)) \eta_5''(t) \right) + \\
& 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( -\cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha'(t)^2 - 2 \cos(\theta(t) + \psi(t)) \right. \\
& \left. \sin(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t)) \alpha'(t) - 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \eta_5'(t) \alpha'(t) - \right. \\
& \left. R(t) \sin(\theta(t)) \theta'(t)^2 - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta'(t) + \psi'(t))^2 + \right. \\
& \left. 2 \cos(\theta(t)) R'(t) \theta'(t) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \eta_5'(t) + \sin(\theta(t)) R''(t) - \right. \\
& \left. \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \alpha''(t) + \cos(\theta(t)) R(t) \theta''(t) + \cos(\alpha(t)) \right. \\
& \left. \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) (\theta''(t) + \psi''(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \eta_5''(t) \right) \Bigg) + \\
& \frac{1}{2} m_0 \left( -2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \right. \right. \\
& \left. \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \right. \\
& \left. \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_4'(t) + \eta_5'(t)) \right) - \\
& 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \right. \\
& \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_4'(t) + \eta_5'(t)) \Bigg) + \\
& 2 \cos(\alpha(t)) \alpha'(t) \left( \cos(\alpha(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \sin(\alpha(t)) (\eta_4'(t) + \eta_5'(t)) \right) - \\
& 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t)
\end{aligned}$$

$$\begin{aligned}
& \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \\
& \quad \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_4'(t) + \eta_5'(t)) \right) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \\
& (\theta'(t) + \psi'(t)) \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \\
& \quad \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_4'(t) + \eta_5'(t)) \right) + \\
& 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( -\cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 + \right. \\
& \quad 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) \alpha'(t) - \\
& \quad 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) (\eta_4'(t) + \eta_5'(t)) \alpha'(t) - \cos(\theta(t)) R(t) \theta'(t)^2 - \\
& \quad \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t))^2 - \\
& \quad 2 \sin(\theta(t)) R'(t) \theta'(t) - 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) (\eta_4'(t) + \eta_5'(t)) + \\
& \quad \cos(\theta(t)) R''(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha''(t) - \\
& \quad R(t) \sin(\theta(t)) \theta''(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta''(t) + \psi''(t)) + \\
& \quad \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_4''(t) + \eta_5''(t)) \right) + \\
& 2 \sin(\alpha(t)) \left( -\sin(\alpha(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 + 2 \cos(\alpha(t)) (\eta_4'(t) + \eta_5'(t)) \alpha'(t) + \right. \\
& \quad \left. \cos(\alpha(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha''(t) + \sin(\alpha(t)) (\eta_4''(t) + \eta_5''(t)) \right) + \\
& 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( -\cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 - \right.
\end{aligned}$$

$$\begin{aligned}
& 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) \alpha'(t) - \\
& 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_4'(t) + \eta_5'(t)) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t)^2 - \\
& \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t))^2 + 2 \cos(\theta(t)) R'(t) \theta'(t) + \\
& 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) (\eta_4'(t) + \eta_5'(t)) + \sin(\theta(t)) R''(t) - \\
& \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \alpha''(t) + \cos(\theta(t)) R(t) \theta''(t) + \\
& \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) (\theta''(t) + \psi''(t)) + \\
& \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_4''(t) + \eta_5''(t)) \Big) \Big) + \\
& \frac{1}{2} m_0 \left( -2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \right. \right. \\
& \quad \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \\
& \quad \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \\
& \quad \left. \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) \right) - 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \quad (\theta'(t) + \psi'(t)) \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - \right. \\
& \quad \left. R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \right. \\
& \quad \left. \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) \right) + 2 \cos(\alpha(t)) \alpha'(t) \\
& \quad \left( \cos(\alpha(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \sin(\alpha(t)) (\eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) - \\
& 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t) \\
& \quad \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \left. \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \right.
\end{aligned}$$

$$\begin{aligned}
& \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) \Bigg) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \\
& (\theta'(t) + \psi'(t)) \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \\
& \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) \right) + \\
& 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( -\cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 + \right. \\
& 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) \alpha'(t) - \\
& 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) \alpha'(t) - \cos(\theta(t)) R(t) \theta'(t)^2 - \\
& \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t))^2 - \\
& 2 \sin(\theta(t)) R'(t) \theta'(t) - 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \left( \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) + \\
& \cos(\theta(t)) R''(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha''(t) - \\
& R(t) \sin(\theta(t)) \theta''(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \\
& \left. (\theta''(t) + \psi''(t)) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \eta_3''(t) + \eta_4''(t) + \eta_5''(t) \right) \right) \Bigg) + 2 \sin(\alpha(t)) \\
& \left( -\sin(\alpha(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 + 2 \cos(\alpha(t)) \left( \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) \alpha'(t) + \right. \\
& \left. \cos(\alpha(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha''(t) + \sin(\alpha(t)) \left( \eta_3''(t) + \eta_4''(t) + \eta_5''(t) \right) \right) \Bigg) + \\
& 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( -\cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 - \right. \\
& 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) \alpha'(t) - \\
& 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t)^2 - \\
& \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t))^2 + \right.
\end{aligned}$$



$$\begin{aligned}
& 2 \cos(\theta(t)) R'(t) \theta'(t) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) (\eta_3'(t) + \eta_4'(t) + \eta_5'(t)) + \\
& \sin(\theta(t)) R''(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha''(t) + \\
& \cos(\theta(t)) R(t) \theta''(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \\
& \left( \theta''(t) + \psi''(t) \right) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_3''(t) + \eta_4''(t) + \eta_5''(t)) \Bigg) + \\
& \frac{1}{2} m_0 \left( -2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \right. \right. \\
& \quad \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \\
& \quad \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \\
& \quad \left. \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) \right) - \\
& 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \left( \cos(\theta(t)) R'(t) - \right. \\
& \quad \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \\
& \quad \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \\
& \quad \left. \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) \right) + \\
& 2 \cos(\alpha(t)) \alpha'(t) \left( \cos(\alpha(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \left. \sin(\alpha(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) - 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t) \\
& \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \quad \left. \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right. \\
& \quad \left. \left( \theta'(t) + \psi'(t) \right) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) +
\end{aligned}$$

$$\begin{aligned}
& 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \right. \\
& \quad \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \cos(\theta(t)) R(t) \theta'(t) + \\
& \quad \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \\
& \quad \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \\
& \quad \left( -\cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 + \right. \\
& \quad 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) \alpha'(t) - \\
& \quad 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \alpha'(t) - \cos(\theta(t)) R(t) \theta'(t)^2 - \\
& \quad \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t))^2 - 2 \sin(\theta(t)) \\
& \quad R'(t) \theta'(t) - 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) + \\
& \quad \cos(\theta(t)) R''(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha''(t) - \\
& \quad R(t) \sin(\theta(t)) \theta''(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \\
& \quad \left. (\theta''(t) + \psi''(t)) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_2''(t) + \eta_3''(t) + \eta_4''(t) + \eta_5''(t)) \right) + \\
& \quad 2 \sin(\alpha(t)) \left( -\sin(\alpha(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 + \right. \\
& \quad 2 \cos(\alpha(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \alpha'(t) + \\
& \quad \cos(\alpha(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha''(t) + \\
& \quad \left. \sin(\alpha(t)) (\eta_2''(t) + \eta_3''(t) + \eta_4''(t) + \eta_5''(t)) \right) + 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \quad \left( -\cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 - \right. \\
& \quad \left. 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) \alpha'(t) - \right.
\end{aligned}$$

$$\begin{aligned}
& 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t)^2 - \\
& \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t))^2 + 2 \cos(\theta(t)) \\
& R'(t) \theta'(t) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) (\eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) + \\
& \sin(\theta(t)) R''(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha''(t) + \\
& \cos(\theta(t)) R(t) \theta''(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \\
& (\theta''(t) + \psi''(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_2''(t) + \eta_3''(t) + \eta_4''(t) + \eta_5''(t)) \Big) \Big) + \\
& \frac{1}{2} m_0 \left( -2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \right. \right. \\
& \left. \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \right. \\
& \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \right. \\
& \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) - \\
& 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \left( \cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \right. \\
& \left. \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \right. \\
& \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) + \right. \\
& \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) + \\
& 2 \cos(\alpha(t)) \alpha'(t) \left( \cos(\alpha(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right. \\
& \left. \sin(\alpha(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \right) - 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t) \\
& \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \right.
\end{aligned}$$

$$\begin{aligned}
& \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \\
& \left( \theta'(t) + \psi'(t) \right) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) \Bigg) + \\
& 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \theta'(t) + \psi'(t) \right) \left( \sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \right. \\
& \left. \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t) + \cos(\theta(t)) R(t) \theta'(t) + \right. \\
& \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \left( \theta'(t) + \psi'(t) \right) + \right. \\
& \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) \right) \Bigg) + \\
& 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( -\cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \right. \\
& \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 + 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \left( \theta'(t) + \psi'(t) \right) \alpha'(t) - 2 \cos(\theta(t) + \psi(t)) \\
& \sin(\alpha(t)) \left( \eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) \alpha'(t) - \cos(\theta(t)) R(t) \theta'(t)^2 - \\
& \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \left( \theta'(t) + \psi'(t) \right)^2 - \\
& 2 \sin(\theta(t)) R'(t) \theta'(t) - 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \theta'(t) + \psi'(t) \right) \\
& \left( \eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) + \cos(\theta(t)) R''(t) - \cos(\theta(t) + \psi(t)) \\
& \sin(\alpha(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha''(t) - R(t) \sin(\theta(t)) \theta''(t) - \\
& \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \left( \theta''(t) + \psi''(t) \right) + \\
& \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \eta_1''(t) + \eta_2''(t) + \eta_3''(t) + \eta_4''(t) + \eta_5''(t) \right) \Bigg) + \\
& 2 \sin(\alpha(t)) \left( -\sin(\alpha(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 + \right. \\
& \left. 2 \cos(\alpha(t)) \left( \eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) \right) \alpha'(t) + \right.
\end{aligned}$$

$$\begin{aligned}
& \cos(\alpha(t)) \left( \frac{9L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha''(t) + \\
& \sin(\alpha(t)) (\eta_1''(t) + \eta_2''(t) + \eta_3''(t) + \eta_4''(t) + \eta_5''(t)) \Big) + 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \left( -\cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha'(t)^2 - \right. \\
& 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \left( \frac{9L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta'(t) + \psi'(t)) \\
& \alpha'(t) - 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) \alpha'(t) - R(t) \\
& \sin(\theta(t)) \theta'(t)^2 - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \\
& (\theta'(t) + \psi'(t))^2 + 2 \cos(\theta(t)) R'(t) \theta'(t) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \\
& (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t)) + \sin(\theta(t)) R''(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \left( \frac{9L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \alpha''(t) + \cos(\theta(t)) R(t) \theta''(t) + \\
& \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{9L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) (\theta''(t) + \psi''(t)) + \\
& \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_1''(t) + \eta_2''(t) + \eta_3''(t) + \eta_4''(t) + \eta_5''(t)) \right) \Big) + \\
& \frac{1}{2} M_{P1} \left( -2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \alpha'(t) (\cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \right. \\
& (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \\
& \sin(\theta(t) + \psi(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta'(t) + \psi'(t)) + \\
& \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \Big) - \\
& 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) (\cos(\theta(t)) R'(t) - \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) \\
& (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t) - \cos(\alpha(t)) \\
& \sin(\theta(t) + \psi(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta'(t) + \psi'(t)) + \\
& \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \Big) + \\
& 2 \cos(\alpha(t)) \alpha'(t) (\cos(\alpha(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha'(t) + \\
& \sin(\alpha(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \Big) - \\
& 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \alpha'(t) (\sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha'(t) + \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \\
& \cos(\theta(t) + \psi(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta'(t) + \psi'(t)) + \\
& \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \right) +
\end{aligned}$$

$$\begin{aligned}
& 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) (\sin(\theta(t)) R'(t) - \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \quad (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha'(t) + \cos(\theta(t)) R(t) \theta'(t) + \cos(\alpha(t)) \\
& \quad \cos(\theta(t) + \psi(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta'(t) + \psi'(t)) + \\
& \quad \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t))) + \\
& 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (-\cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \\
& \quad (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha'(t)^2 + 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \quad (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta'(t) + \psi'(t)) \alpha'(t) - \\
& \quad 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \alpha'(t) - \\
& \quad \cos(\theta(t)) R(t) \theta'(t)^2 - \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \\
& \quad (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta'(t) + \psi'(t))^2 - \\
& \quad 2 \sin(\theta(t)) R'(t) \theta'(t) - 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \\
& \quad (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) + \cos(\theta(t)) R''(t) - \\
& \quad \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha''(t) - \\
& \quad R(t) \sin(\theta(t)) \theta''(t) - \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \quad (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta''(t) + \psi''(t)) + \\
& \quad \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\eta_1''(t) + \eta_2''(t) + \eta_3''(t) + \eta_4''(t) + \eta_5''(t) + \eta_{P1}''(t))) + \\
& 2 \sin(\alpha(t)) (-\sin(\alpha(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha'(t)^2 + \\
& \quad 2 \cos(\alpha(t)) (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \alpha'(t) + \\
& \quad \cos(\alpha(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha''(t) + \sin(\alpha(t)) \\
& \quad (\eta_1''(t) + \eta_2''(t) + \eta_3''(t) + \eta_4''(t) + \eta_5''(t) + \eta_{P1}''(t))) + 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \quad (-\cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha'(t)^2 - \\
& \quad 2 \cos(\theta(t) + \psi(t)) \sin(\alpha(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \\
& \quad (\theta'(t) + \psi'(t)) \alpha'(t) - 2 \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) \\
& \quad (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) \alpha'(t) - R(t) \sin(\theta(t)) \theta'(t)^2 - \\
& \quad \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \\
& \quad (\theta'(t) + \psi'(t))^2 + 2 \cos(\theta(t)) R'(t) \theta'(t) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) (\theta'(t) + \psi'(t)) \\
& \quad (\eta_1'(t) + \eta_2'(t) + \eta_3'(t) + \eta_4'(t) + \eta_5'(t) + \eta_{P1}'(t)) + \sin(\theta(t)) R''(t) - \\
& \quad \sin(\alpha(t)) \sin(\theta(t) + \psi(t)) (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) \alpha''(t) + \\
& \quad \cos(\theta(t)) R(t) \theta''(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \\
& \quad (L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t)) (\theta''(t) + \psi''(t)) + \\
& \quad \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) (\eta_1''(t) + \eta_2''(t) + \eta_3''(t) + \eta_4''(t) + \eta_5''(t) + \eta_{P1}''(t))) + \\
& \left( \mu m_0 \left( 2 \left( \frac{L_0}{10} + \eta_5(t) \right) \sin^2(\alpha(t)) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \right. \right.
\end{aligned}$$

$$\begin{aligned}
& \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \right) + \\
& 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \right) \Bigg) / \\
& \left( 2 \left( \sin^2(\alpha(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \right)^2 + \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \right)^2 + \right. \\
& \left. \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{10} + \eta_5(t) \right) \right)^2 \right)^{3/2} \Bigg) + \\
& \left( \mu m_0 \left( 2 \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \sin^2(\alpha(t)) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \right. \right. \\
& \left. \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \right) + 2 \cos(\alpha(t)) \right. \\
& \left. \sin(\theta(t) + \psi(t)) \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \right) \right) \Bigg) / \\
& \left( 2 \left( \sin^2(\alpha(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \right)^2 + \right. \\
& \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \right)^2 + \\
& \left. \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{3 L_0}{10} + \eta_4(t) + \eta_5(t) \right) \right)^2 \right)^{3/2} \Bigg) + \\
& \left( \mu m_0 \left( 2 \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \sin^2(\alpha(t)) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \right. \right. \\
& \left. \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right) + 2 \cos(\alpha(t)) \right. \\
& \left. \sin(\theta(t) + \psi(t)) \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right) \right) \Bigg) / \\
& \left( 2 \left( \sin^2(\alpha(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right)^2 + \right. \\
& \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right)^2 +
\end{aligned}$$

$$\begin{aligned}
& \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{L_0}{2} + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right)^2 \Big)^{3/2} + \\
& \left( \mu m_0 \left( 2 \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \sin^2(\alpha(t)) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \right. \right. \\
& \quad \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right) + 2 \\
& \quad \left. \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \right. \right. \\
& \quad \left. \left. \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right) \right) \right) \Big) / \\
& \left( 2 \left( \sin^2(\alpha(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right)^2 + \right. \right. \\
& \quad \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right)^2 + \\
& \quad \left. \left. \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{7 L_0}{10} + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right)^2 \right)^{3/2} \right) + \\
& \left( \mu m_0 \left( 2 \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \sin^2(\alpha(t)) + 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \right. \right. \\
& \quad \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right) + \\
& \quad \left. \left. 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \right. \right. \\
& \quad \left. \left. \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right) \right) \right) \Big) / \\
& \left( 2 \left( \sin^2(\alpha(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right)^2 + \left( \cos(\theta(t)) R(t) + \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \right. \right. \right. \\
& \quad \left. \left. \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right)^2 + \left( R(t) \sin(\theta(t)) + \right. \right. \\
& \quad \left. \left. \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( \frac{9 L_0}{10} + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) \right) \right)^2 \right)^{3/2} \Big) + \\
& \left( \mu M_{P1} \left( 2 \left( L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t) \right) \sin^2(\alpha(t)) + \right. \right. \\
& \quad 2 \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( \cos(\theta(t)) R(t) + \right. \\
& \quad \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{P1}(t) \right) \right) + \\
& \quad \left. \left. 2 \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \right) \right) \right)
\end{aligned}$$



$$\begin{aligned}
& \left( L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{\mathbf{P1}}(t) \right) \Big) \Big) \Big) \Big) \Big) / \\
& \left( 2 \left( \sin^2(\alpha(t)) \left( L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{\mathbf{P1}}(t) \right)^2 + \left( \cos(\theta(t)) R(t) + \right. \right. \right. \\
& \quad \left. \left. \cos(\alpha(t)) \cos(\theta(t) + \psi(t)) \left( L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \eta_4(t) + \eta_5(t) + \eta_{\mathbf{P1}}(t) \right) \right)^2 + \right. \\
& \quad \left. \left( R(t) \sin(\theta(t)) + \cos(\alpha(t)) \sin(\theta(t) + \psi(t)) \left( L_0 + \eta_1(t) + \eta_2(t) + \eta_3(t) + \right. \right. \right. \\
& \quad \left. \left. \left. \eta_4(t) + \eta_5(t) + \eta_{\mathbf{P1}}(t) \right) \right)^2 \right)^{3/2} \Big) = c_0(\dot{\eta}_4 - \dot{\eta}_5) - c_0 \dot{\eta}_5
\end{aligned}$$