$$
\begin{aligned}
\dot{p}_3 =& \tau\alpha_p \left[\beta_p \left(\gamma_p \left(g_m - p_1\right) + \frac{\left(\dot{g} - \dot{p}_1\right)}{\tau}\right) + \frac{-\ddot{p}_1}{\tau^2}\right] \\
&+ \tau A f(z) \\
\dot{p}_2 =& \tau p_3 \\
\dot{p}_1 =& \tau p_2,
\end{aligned}
$$