

The equation for vertical motion is given by:

$$z(t) = d_1 \cos(\omega t) + d_2 \sin(\omega t) + r(t) - \frac{g}{\omega^2} \quad (1)$$

where

$$\begin{aligned} d_1 &= z_0 - r_0 + \frac{g}{\omega^2}, \\ d_2 &= \frac{\dot{z}}{\omega} - \frac{(r_T - r_0)}{T\omega}, \\ \omega &= \sqrt{\frac{k}{m}}. \end{aligned}$$