

$$(J_A + J_M/(N_r^2)) \ddot{\alpha}(t) = C_{asta}(t) - C_{peso}(t) + C_{mol}(t) + C_{fermo}(t)$$

$$l(t) = \sqrt{h^2 + q^2 + b^2 - 2b(-h \sin(\beta(t)/180 * \pi) + q \cos(\beta(t)/180 * \pi))},$$

$$F_m(t) = F_0 + K (l(t) - l_0),$$

$$C_{fermo}(t) = \begin{cases} -\exp((\alpha(t) - \pi/2) * K_f) & \text{if } \alpha(t) > \pi/2 \\ \exp((0.0 - \alpha(t)) * K_f) & \text{if } \alpha(t) < 0.0 \\ 0.0 & \text{otherwise} \end{cases}$$