?
α
α

$$\frac{d\vec{r_\alpha}}{dt} = \vec{V_\alpha}(t) \tag{1}$$

α

$$\frac{d\vec{V_\alpha}}{dt} = \vec{f_\alpha}(t) + \vec{\xi_\alpha}(t) \tag{2}$$

$\vec{\xi_\alpha}(t)$
α
$\vec{f_\alpha}(t)$
α

$$\vec{f_\alpha} = \vec{f_\alpha^0}\left(\vec{V_\alpha}\right) + \vec{f_{\alpha B}}(\vec{r_\alpha}) + \sum_{\beta \neq \alpha} \vec{f_{\alpha\beta}}\left(\vec{r_\alpha}, \vec{V_\alpha}, \vec{r_\beta}, \vec{V_\beta}\right) + \sum_i \vec{f_{\alpha i}}(\vec{r_\alpha}, \vec{r_i}, t) \tag{3}$$

$$\vec{f_\alpha^0}\left(\vec{V_\alpha}\right) = \frac{1}{\tau}\left(V_\alpha^0 \vec{e_\alpha} - \vec{V_\alpha}\right) \tag{4}$$

τ
$\vec{V_\alpha}$
V_α^0
V_α^0

$$V_\alpha^0 = [1 - \eta_\alpha(t)]\, V_\alpha^0(0) + \eta_\alpha(t)\, V_\alpha^{max} \tag{5}$$

$V_\alpha^0(0)$
V_α^{max}
α
α
V_α^{max}
η_α

$$\eta_\alpha(t) = 1 - \frac{\overline{V}_\alpha(t)}{V_\alpha^0(t)} \tag{6}$$

$\overline{V}$
$V_\alpha^0(0)$
α^α

$$\vec{f_{\alpha B}}(\vec{r_\alpha}) = -\nabla_{\vec{r_\alpha}} V_B\left(\|\vec{r_\alpha} - \vec{r_B^\alpha}\|\right) \tag{7}$$

$\nabla_{\vec{r_\alpha}}$
V_B
$\|\vec{r_\alpha} -$
$\vec{r_B^\alpha}\|$
α
simulation dynamical features of escape panic

$$\vec{f_{\alpha B}}(\vec{r_\alpha}) = A_\alpha exp\left[\frac{(r_\alpha - d_{\alpha B})}{B_\alpha}\right] + kg(r_\alpha - d_{\alpha B})\,\eta_{\alpha B} - kg(r_\alpha - d_{\alpha B})\left(\vec{V_\alpha} \cdot \vec{t}_{\alpha B}\right)\vec{t}_{\alpha B} \tag{8}$$

$\eta_{\alpha B}$
$t_{\alpha B}$
α
β

$$\sum_{\beta(\neq\alpha)} \vec{f_{\alpha\beta}}(t) = A_\alpha^1 exp\left(\frac{r_{\alpha\beta} - d_{\alpha\beta}}{B_\alpha^1}\right)\vec{\eta_{\alpha\beta}} \cdot (\lambda_\alpha + (1 - \lambda_\alpha)) + A_\alpha^2 exp\left(\frac{r_{\alpha\beta} - d_{\alpha\beta}}{B_\alpha^2}\right)\vec{\eta_{\alpha\beta}} \tag{9}$$

A_α^1
A_α^2
B_α^1
B_α^2
λ_α