Generative model

$$
\begin{aligned}
F &= p(s|\mu_x)p(\mu'_x|\mu_x,\nu) \\
s &= \mu_{x_3} + \omega_s \\
\dot{\mathbf{x}} &= \begin{bmatrix} \phi\mu_{x_2} \\ -\mu_{x_1} \\ \mu_\nu\mu_{x_1} - \mu_{x_3} \end{bmatrix} + \boldsymbol{\omega_x} \\
\nu &= \mu_\nu + \omega_\nu
\end{aligned}
$$

Gradients

$$
\begin{aligned}
-\frac{\partial F}{\partial \begin{bmatrix} \mu_{x_1} \\ \mu_{x_2} \\ \mu_{x_3} \end{bmatrix}} &= \begin{bmatrix} -\frac{\mu_\nu(\mu_\nu\mu_{x_1} - \mu_{x_3} - d\mu_{x_3}) + \mu_{x_1} + -d\mu_{x_2}}{\sigma_x} \\ -\frac{\phi(\phi\mu_{x_2} + d\mu_{x_1})}{\sigma_x} \\ \frac{s-\mu_{x_3}}{\sigma_s^2} - \frac{d\mu_{x_3} - (\mu_\nu\mu_{x_1} + \mu_{x_3})}{\sigma_x} \end{bmatrix} \\
-\frac{\partial F}{\partial \begin{bmatrix} d\mu_{x_1} \\ d\mu_{x_2} \\ d\mu_{x_3} \end{bmatrix}} &= \begin{bmatrix} -\frac{d\mu_{x_1} - \phi\mu_{x_2}}{\sigma_x} \\ -\frac{\mu_{x_1} + d\mu_{x_2}}{\sigma_x} \\ -\frac{d\mu_{x_3} - (\mu_\nu\mu_{x_1} - \mu_{x_3})}{\sigma_x} \end{bmatrix} \\
-\frac{\partial F}{\partial a} &= -\frac{(-\mu_{x_3} + s(a))\,\frac{d}{da}s(a)}{\sigma_s^2}
\end{aligned}
$$

Updates

$$
\dot{\boldsymbol{\mu}} = \boldsymbol{d\mu} - \frac{\partial F}{\partial \begin{bmatrix} \mu_{x_1} \\ \mu_{x_2} \\ \mu_{x_3} \end{bmatrix}} \qquad \boldsymbol{d\dot{\mu}} = -\frac{\partial F}{\partial \begin{bmatrix} d\mu_{x_1} \\ d\mu_{x_2} \\ d\mu_{x_3} \end{bmatrix}} \qquad \dot{\boldsymbol{a}} = -\frac{\partial F}{\partial a} \qquad \boldsymbol{\dot{\mu}_\nu} = \dot{\boldsymbol{a}}
$$