Team Project

Consider the following two dimensional gyrator

$$\gamma \dot{x}_1 = -kx_1 + \epsilon x_2 + \sigma_1 \xi_1$$
$$\gamma \dot{x}_2 = -kx_2 - \delta x_1 + \sigma_2 \xi_2$$

conservative non-conservative

$$\sigma_i = \sqrt{2\gamma T_i} \quad (k_\mathrm{B} = 1 \text{ unit})$$
$$\langle \xi_i(t)\xi_j(t')\rangle = \delta_{ij}\delta(t-t')$$

relevant system: Brownian gyrator

Filliger *et al.*, PRL 99, 230602 (2007)

Chiang *et al.*, PRE 96, 032123 (2017)

1. When the observable is the work done by the nonconservative force, that is, $\Theta(\tau) = \int_0^\tau dt\, \mathbf{\Lambda}(x,t)^\mathrm{T} \circ \dot{\boldsymbol{x}}(t)$, where $\mathbf{\Lambda}(x,t)^\mathrm{T} = (\epsilon x_2, -\delta x_1)$,

   1) Write the matrices A, D, and W.

   2) Calculate the mean and variance of the observable in the steady state.

   3) Calculate the entropy production rate in the steady state.

   4) Calculate $\mathcal{Q} = \dfrac{\mathcal{D}}{\langle\dot{\Theta}\rangle^2}\langle \dot{S}_\mathrm{tot}\rangle$ factors for various model parameters and check whether TUR holds.

2. Repeat the above calculation when the observable is heat: $\Theta(\tau) = \int_0^\tau dt\, \mathbf{\Lambda}(x,t)^\mathrm{T} \circ \dot{\boldsymbol{x}}(t)$, where $\mathbf{\Lambda}(x,t)^\mathrm{T} = (kx_1 - \epsilon x_2, kx_2 + \delta x_1)$.