

Background

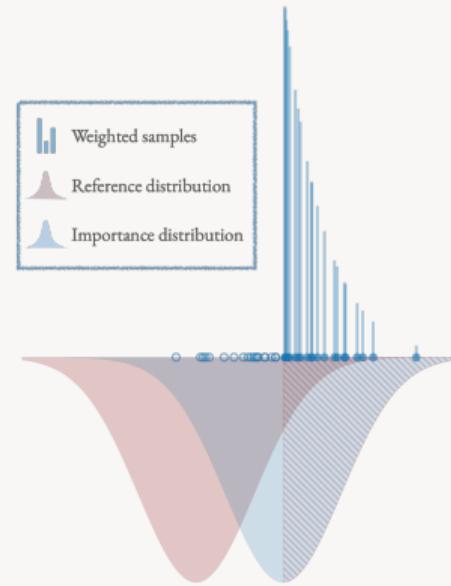
- ▷ PhD Thesis (2021-2024)
EDF R&D and CMAP, École polytechnique
Supervision by Josselin Garnier
- ▷ Postdoc (2024-2026)
CERMICS, École des ponts et chaussées
Supervision by Julien Reygner

Main research on importance sampling methods

Computing integrals by sampling and weighting random variables

$$\begin{aligned}\mathbb{E}_{X \sim p}[\phi(X)] &= \int \phi(x) \frac{p(x)}{q(x)} q(x) \mu(dx) \\ &= \mathbb{E}_{X \sim q} \left[\phi(X) \frac{p(X)}{q(X)} \right] \approx \frac{1}{n} \sum_{i=1}^n \phi(X_i) \frac{p(X_i)}{q(X_i)}\end{aligned}$$

with $X_1, \dots, X_n \sim q$ instead of p .

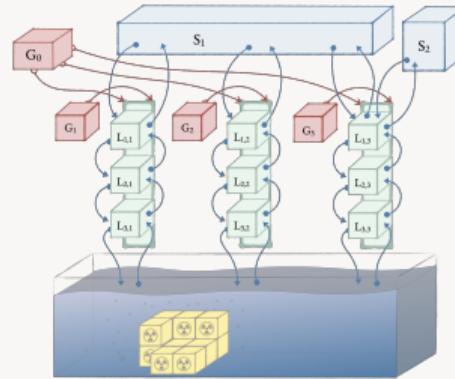


Estimation of $\mathbb{P}(\mathcal{N}(0, 1) > s)$ with data generated under $\mathcal{N}(s, 1)$.

Rare event simulation for Piecewise Deterministic Markov Processes

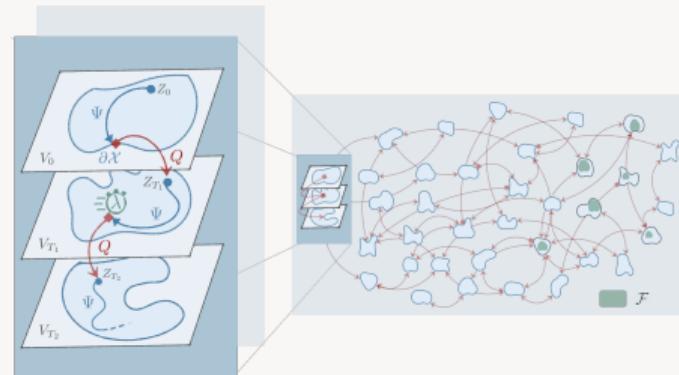
PhD thesis topic

- ▷ Modeling industrial systems with PDMPs
- ▷ Goal: estimation of failure probabilities
- ▷ Challenge: sampling rare PDMP trajectories in order to produce efficient IS estimators



Graph-informed importance sampling

- ▷ Optimal sampling policy given by (unknown) *Committor Function* of the process
- ▷ Explicit CF for a simplified process on a graph
- ▷ Use the simple model to build a family of approximations for the true complex model



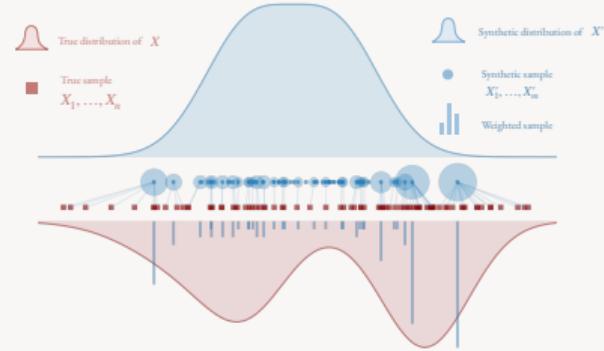
Current projects

Topic 1 — Reweighting under covariate shift

$$(\text{source}) \quad \left(X_i^{(s)}, Y_i^{(s)} \right)_{i=1}^{n_s} \sim \pi^{(s)}(dx)p(dy | x)$$

$$(\text{target}) \quad \left(X_j^{(t)} \right)_{j=1}^{n_t} \sim \pi^{(t)}(dx)$$

What about IS efficiency when performed with estimated weights $\hat{w} \in \arg \min_w \mathbf{D}\left(\hat{\pi}^{(s)} ; w \cdot \hat{\pi}^{(t)}\right)$?



Topic 2 — Optimal importance M-estimators

$$\theta^* \in \arg \min_{\theta \in \Theta} \mathcal{L}(\theta) = \arg \min_{\theta \in \Theta} \int_{\mathcal{X}} \ell(\theta, x) \mu(dx)$$

$$\hat{\theta} \in \arg \min_{\theta \in \Theta} \frac{1}{n} \sum_{i=1}^n \frac{\ell(\theta, X_i)}{q_i(X_i)} \text{ with } X_i \sim q_i$$

Asymptotic optimality of sampling policy \$(q_i)_i\$?

