

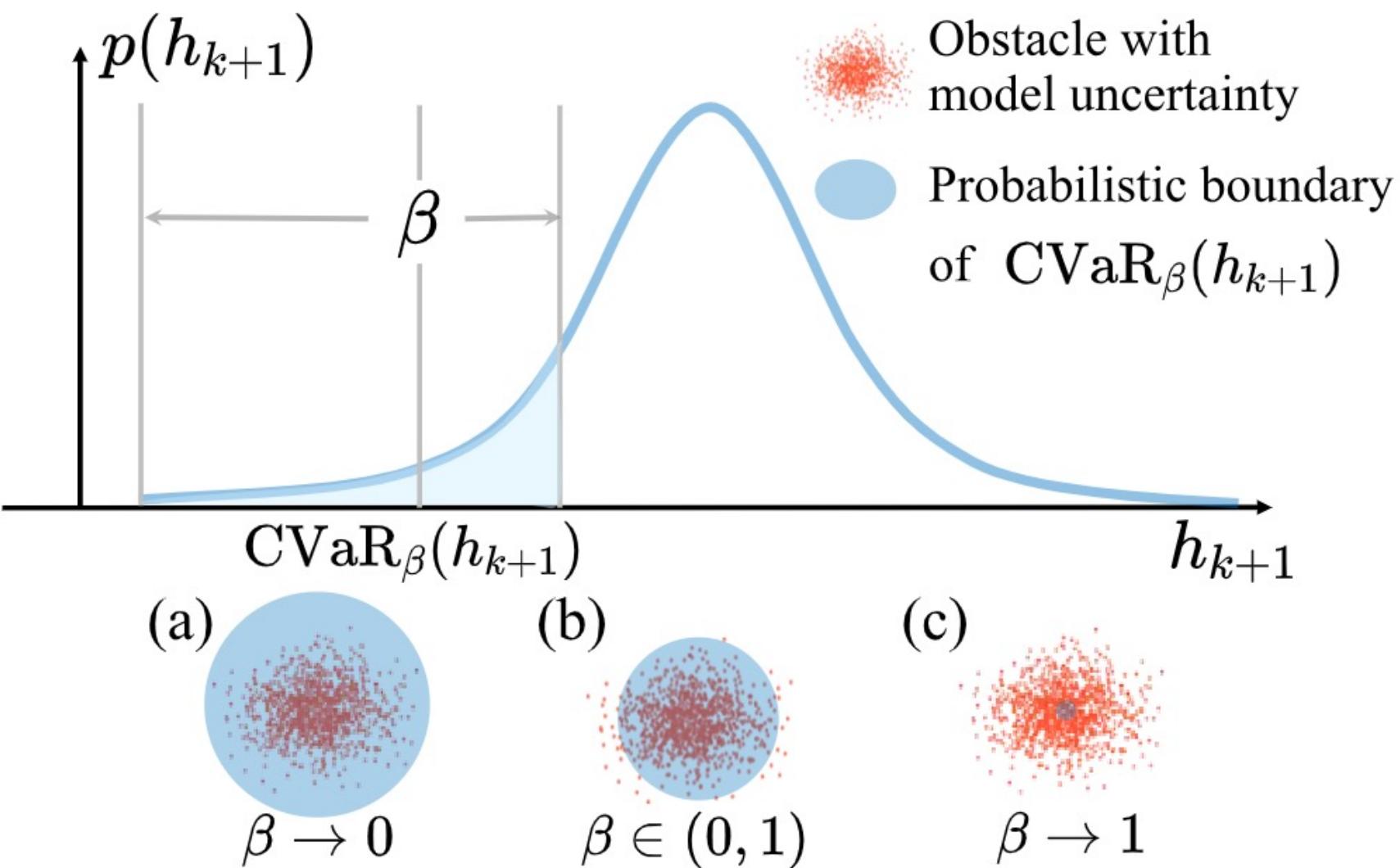
Optimization formulation

$$\min_{\mathbf{u}_k \in \mathcal{U}} \|\mathbf{u}_k - \bar{\mathbf{u}}_k\|^2 \quad \text{s.t. } \text{CVaR}_{\beta}^k(h_{k+1}) \geq (1 - \gamma) h_k.$$

Risk Adaptation

$$\beta_k = \min\{\beta \in (0, \beta_u] \mid \mathcal{U}_{\beta}^k \neq \emptyset\}$$

- Take the minimum necessary risk.
- Improve optimization feasibility.



Dynamic Zone

$$h_k^Z := \|\mathbf{p}_k - \mathbf{p}_k^o\|^2 - R_{\text{safe}}^2(1 + \Delta_k)$$

- Proactively avoid obstacles.
- Expand available risk adjustment space.
- Maintain desired probabilistic safety guarantee.

