**Reliability-Based Design Optimization (RBDO)**

- Component RBDO
  
  \[
  \min_{\mathbf{d}, \mathbf{u}_x} f(\mathbf{d}, \mathbf{u}_x)
  \quad \text{s.t.} \quad P_{\text{sys}}(E_{\text{sys}}) = \prod_{i=1}^{n} P_i(\mathbf{d}, \mathbf{X}) \leq P_{\text{sys}}^* \quad \text{d} \leq \mathbf{d} \leq \mathbf{d}^U, \quad \mu_X^I \leq \mathbf{u}_X \leq \mu_X^U
  \]

- System RBDO

**System Reliability-Based Topology Optimization**

- Objective: minimize volume \(V(\mathbf{p})\)
- Limit-States: \(C_i = 120\)
  
  \(g_i(\mathbf{p}, \mathbf{F}) = C_i - C_i(\mathbf{p}, \mathbf{F}) = C_i - \mathbf{u}^T \mathbf{F}, \quad i = 1, 2\)
- Random Loads: \(F = \left(F_1, F_2, F_3\right), N(100, 10), N(0, 30), N(0, 40)\)
- Load Cases: \(\mathbf{F}_1 = (F_1, F_2), \quad \mathbf{F}_2 = (F_1, F_3)\)

**Matrix-based System Reliability (MSR) Method**

- To compute the probability of general system events in a uniform manner by use of simple matrix calculation

  \[
  P(\mathbf{F}_{sys}) = \prod_{i=1}^{n} P_i(\mathbf{d}, \mathbf{X}) \leq P_{sys}^* \quad \text{d} \leq \mathbf{d} \leq \mathbf{d}^U, \quad \mu_X^I \leq \mathbf{u}_X \leq \mu_X^U
  \]

- To compute the probability of general system events in a random manner in order to satisfy probabilistic constraints

**Conclusion and Future work**

- SRBTO/MSR method is able to handle the statistical dependence between multiple limit-states
- Discrete representation method of a stochastic process will be employed to predict dynamic response of a structure in topology optimization

**Ongoing research**

- Topology optimization under probabilistic constraints
- \(f(t)\): earthquake excitation (discrete representation)