Scalable Global Optimization via Local Bayesian Optimization
Global Optimization

Find $x^* \in \Omega$ such that $f(x^*) \leq f(x), \ \forall x \in \Omega$

• $f$ is a continuous, computationally expensive, black-box function
• $\Omega \subset \mathbb{R}^d$ is a hyper-rectangle

Planning and control
Design of aerodynamic structures
Bayesian Optimization (BO)

Common restrictions:
• A few hundred evaluations
• Less than 10 tunable parameters
Bayesian Optimization (BO)

**Common restrictions:**
- A few hundred evaluations
- Less than 10 tunable parameters
Bayesian Optimization (BO)

**Common restrictions:**
- A few hundred evaluations
- Less than 10 tunable parameters
High-dimensional BO is challenging

Challenges:
1. The search space grows exponentially with dimensionality
2. A global GP model may not fit the data everywhere
3. Large areas of uncertainty leads to over-exploration

Previous work makes strong assumptions:
• Additive structure
• Low-dimensional structure
Trust-region methods

Main idea:
• Optimize a (simple) model in a local region
• Expand/shrink this region based on progress
• Only requires a locally accurate model
Trust-region BO (TuRBO)

1. Avoids over-exploration by using a trust-region framework
2. Balances exploration/exploitation by using BO inside the trust-region
3. Uses Thompson sampling to scale to large batch sizes
Experimental results

Robot pushing: 10,000 evaluations, batch size 50
Rover trajectory planning: 20,000 evaluations, batch size 100
Experimental results

200D Ackley function: 10,000 evaluations, batch size 100
TuRBO:
• Achieves excellent results for high-dimensional problems
• Combines BO with trust-regions to avoid over-exploration
• Makes no assumptions about low-dimensional structure

Code: https://github.com/uber-research/TuRBO