

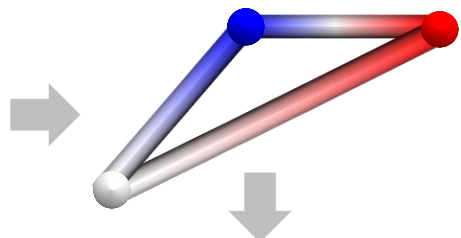
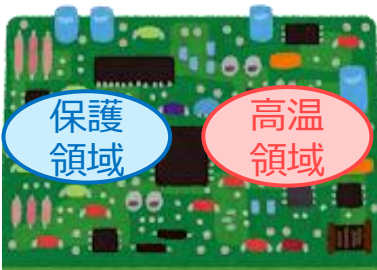
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トポロジー最適化問題

保護領域に熱を伝えないように
基板上的熱流を制御したい

グラフ構造のエッジ配置
最適化問題として
定式化

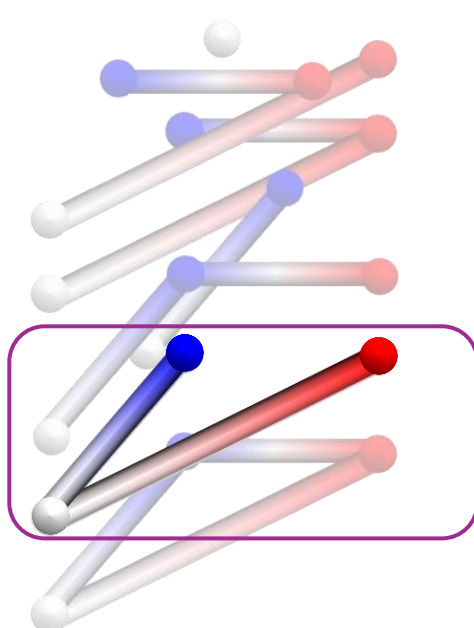
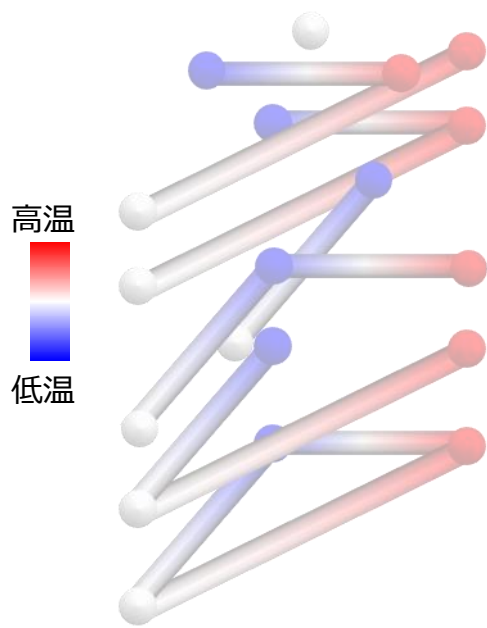
- ◆モノづくりにおいて、与えられた条件や制約のもとでの最適な形状や分布をコンピュータで計算するトポロジー最適化が活用されている
- ◆トポロジー最適化問題を
 1. 複数構造に対する並列シミュレーション
 2. 最適構造の確率増幅として、量子コンピュータで計算するアルゴリズムを提案
- ◆高温領域からの熱流を保護領域に伝えないようにする問題に適用し、実機(*ibm_kawasaki*)を用いて提案アルゴリズムを実証した



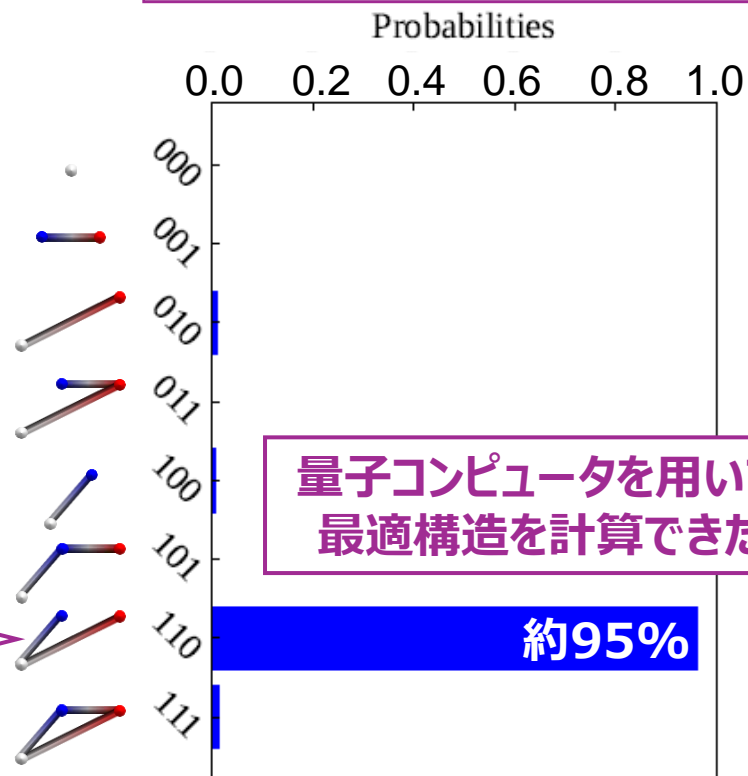
提案アルゴリズム

1. 全構造の温度分布シミュレーション

2. 最適構造の観測



*ibm_kawasaki*による計算結果



Quantum-CAE*: Topology optimization using quantum computers

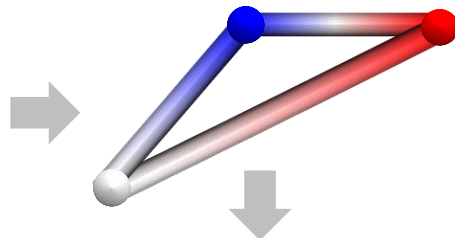
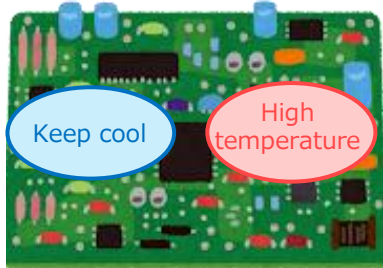
Toyota Central R&D Labs., Inc.
Toyota Motor Corporation

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Topology optimization

Control the heat flow from the high-temperature area.

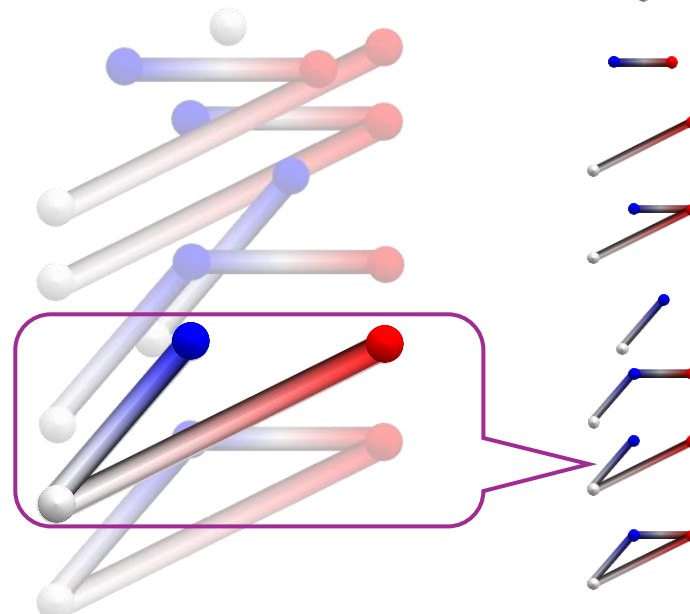
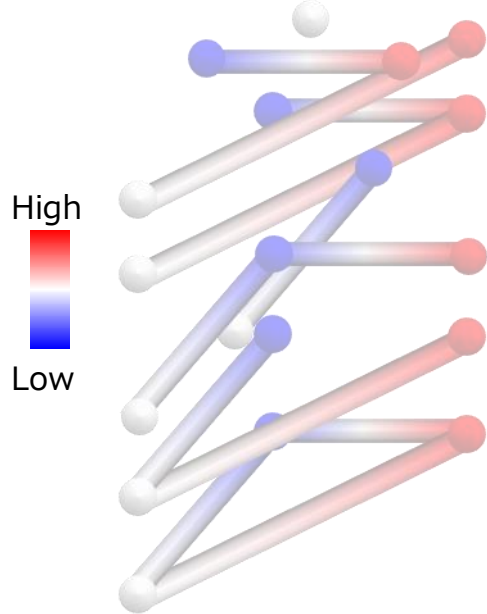
Formulation as the optimization problem for graph edge structure.



Quantum Algorithm

1. Temperature distribution simulation of all possible structures

2. Measurement of the optimal structure



- ◆ In manufacturing, topology optimization, which computes the optimal shapes and distributions under given conditions and constraints, is being utilized.
- ◆ We propose a quantum algorithm to solve topology optimization problems in the following two steps;
 1. Parallel simulation for all possible structures
 2. Amplifying the probability of the optimal structure
- ◆ Proposed algorithm was applied to the problem of controlling heat flow from high-temperature area, and it was demonstrated using the real device: *ibm_kawasaki*.

