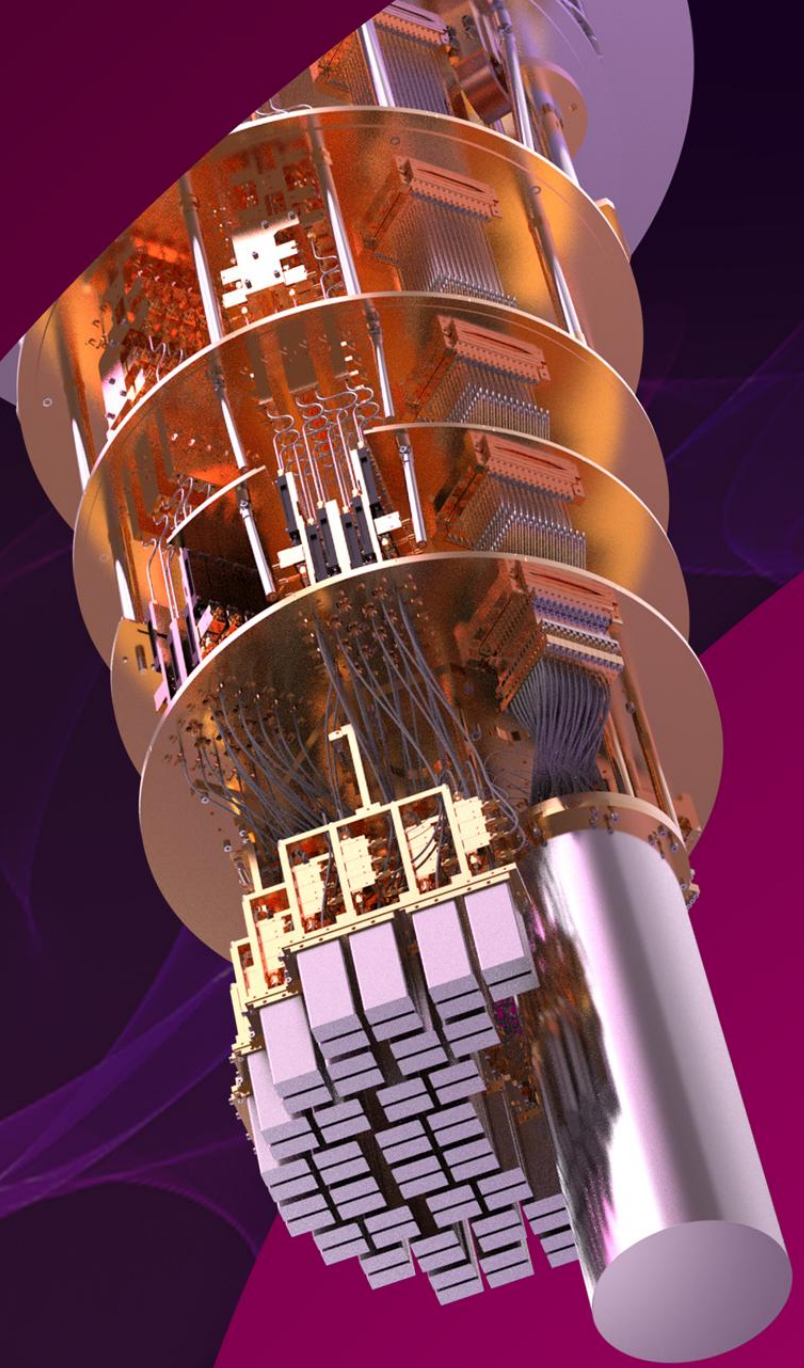
Real-world applications and demos



Applications enabled by the integration of quantum, supercomputing, and AI technologies

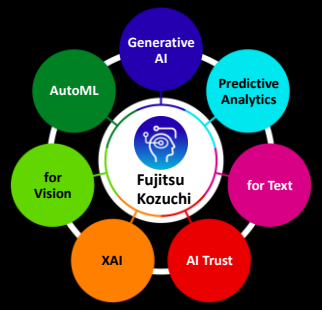
Quantum computing + Other Fujitsu strength technologies → New Application

Flow of Quantum Applications

Input → AI & Optimization → Quantum → supercomputer → quantum → supercomputer → AI & Optimization → Output

AI & Optimization

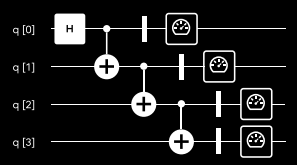
Proprietary AI technologies such as causal search



Fujitsu Kozuchi

Quantum Computer

world's largest
256 qubits
quantum computer



world's fastest
40 qubits
quantum simulator

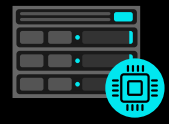
Supercomputer

HPC, etc.

Supercomputer technology cultivated at "Fugaku"

Arm System

x86 System



GPU System

Examples of applications achievable by integrating quantum computing, supercomputers, and AI

A workflow that combines quantum, supercomputer and AI technologies for the right approach to today's increasingly complex challenges

Quantum
quantum computer
quantum simulator

Computing
Ex. supercomputer

AI and Optimization

Materiality	Field	Target Example	concrete Application	An image of a workflow utilizing quantum, supercomputers, and AI in tandem
Development of the Digital Society	Chemistry	Search for new materials	Highly efficient development of catalyst materials	Step 1: Catalyst surface modeling (QFT) → Step 2: Adsorption simulation on the surface → Step 3: New Candidate search for material
Well-being	DX	Motor control (e.g. robots)	Articulated model orbit calculation	Step 1: motor control Preparation → Step 2: inverse kinematics Calculate ↔ Step 3: forward kinematics Calculate (entangled)
Management base	Finance	Sustainable management Forecasting and analysis for financial stability	Financial portfolio optimization	Step 1: Quant Cut: division of quantum circuits → Step 2: Combination Optimize (QAOA) → Step 3: Portfolio Optimize

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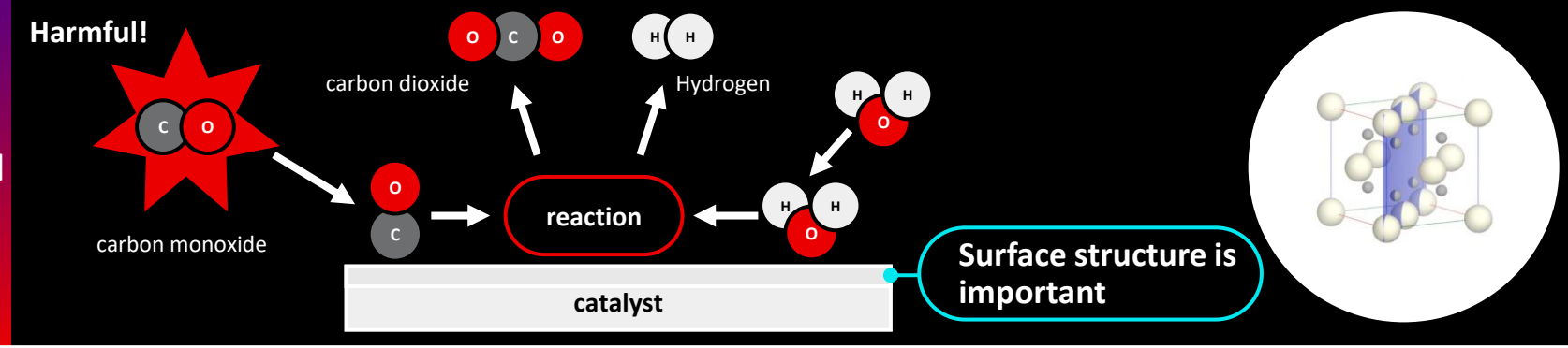
Catalyst Discovery

Collaborating with Prof. Sekine, Waseda University

Catalyst

A material that promotes chemical reactions



Step 1 **Exploring surface structure of a material**

Quantum computation
(Quantum Fourier Transform)

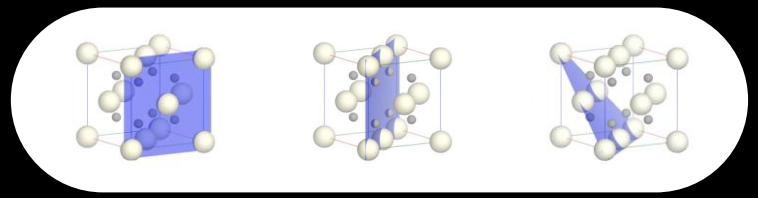
Step 2 **Adsorption simulation on the surface**

Quantum inspired optimization technology

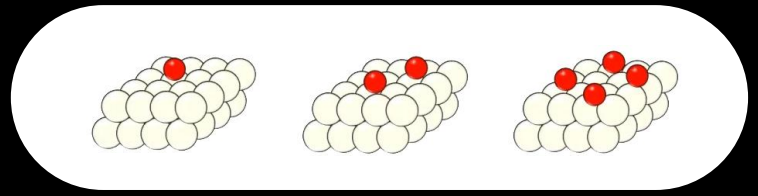
Step 3 **Search for new candidate substances**

AI Learning

Comprehensive **search for the surface cross-sectional structure of catalysts**



Simulates the adsorption of materials on each surface



Instead of experiments, we performed calculations of the catalyst's cross-sectional structure and adsorption simulations.

Using the vast amount of generated data to train AI, with the potential to automate the search for new materials

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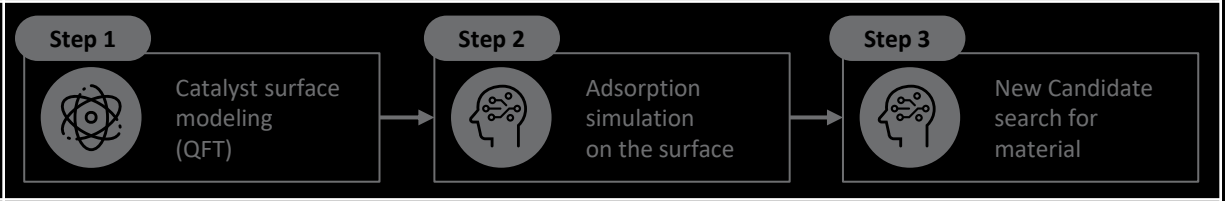
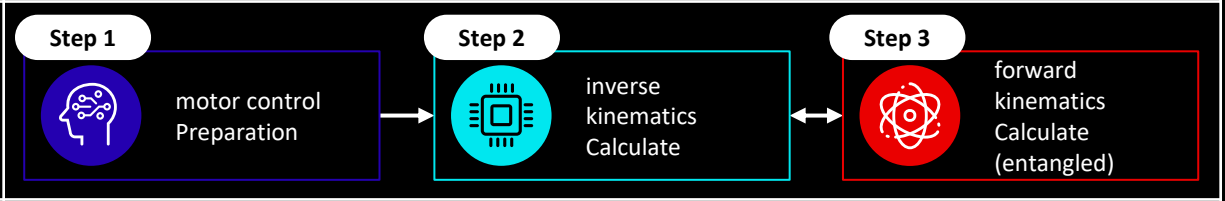
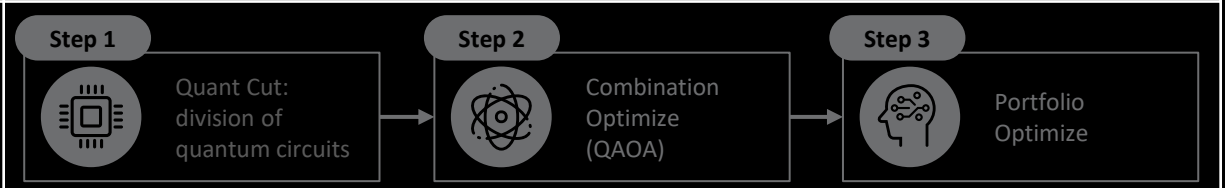
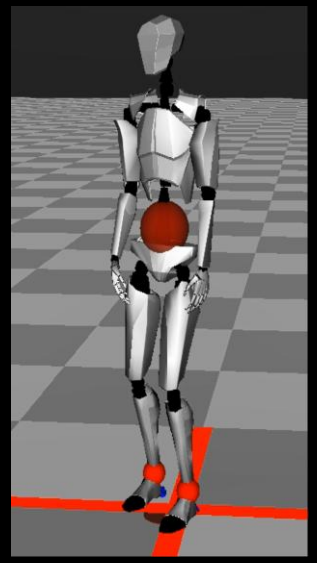
Development of the Digital Society	Chemistry	Search for new materials	Highly efficient development of catalyst materials	
Well-being	DX	Motor control (e.g. robots)	Articulated model orbit calculation	
Management base	Finance	Sustainable management Forecasting and analysis for financial stability	Financial portfolio optimization	

Robot Control

Collaborating with Associate Prof. Otani, Shibaura Institute of Tech./Prof. Takanishi, Waseda University

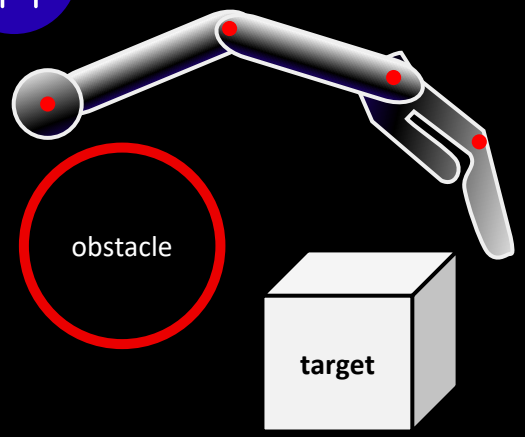
Exp. Humanoid robot



Step 1 **Motor control preparation**

Determine the position and posture of the work area, such as the arm tip based on the input conditions

Arm of the controlled robot



Realization of attitude control

Alternate between inverse kinematics calculations and forward kinematics calculations to determine detailed posture control.

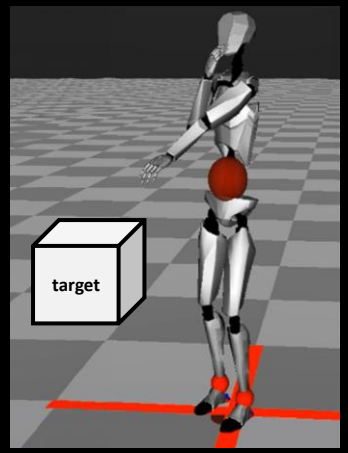
Step 2 **forward kinematic calculation**

To efficiently reach a target with your fingertips, predict how the joints will move ※1

※1 From the information of the joint angle given, the trajectory is simulated by the quantum circuit including the entangle, and the hand position is solved.

Quantum computation

time joint angle ↑↓ position of the hand



Step 3 **inverse kinematic calculation**

From the information of the target position and the forward kinematics results, it is assumed that it is necessary to reach

Sequential calculation and estimation of joint angle information by time

Quantum computing, which directly handles phase information using qubits, enables high-precision robots capable of simultaneously controlling multiple joints—something conventional technology cannot achieve

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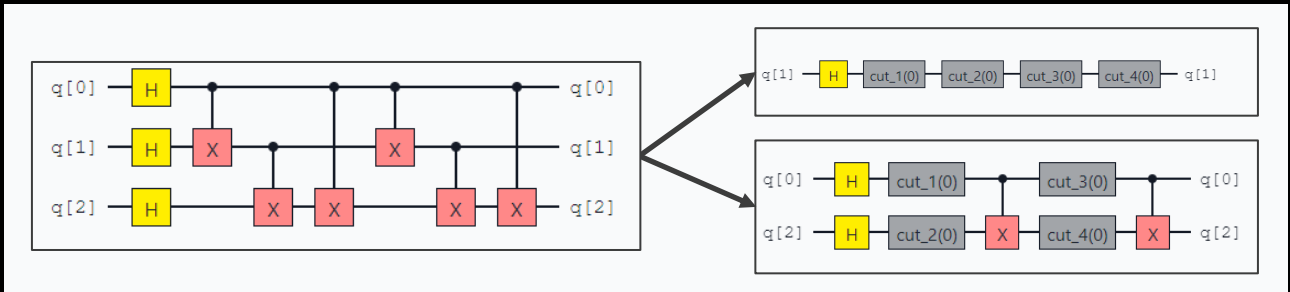
Financial Portfolio Optimization Application

Step 1

Quant Cut: splitting quantum circuits

Given a quantum circuit,
Divide into multiple smaller quantum circuits



Portfolio optimization calculation

Step 2 **Combinatorial optimization**

Quantum computation
QAOA; quantum approximation optimization algorithm)

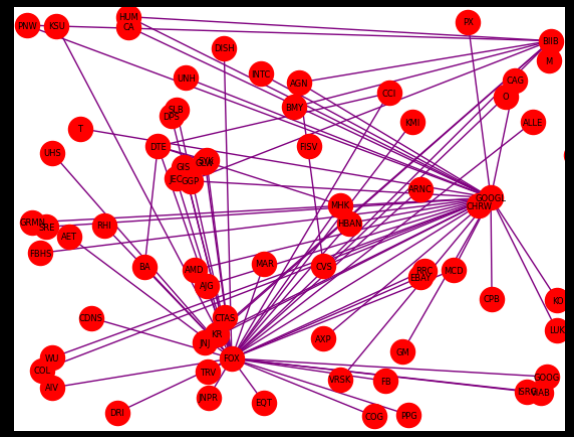
Step 3 **Portfolio optimization**

Solve each partitioned quantum circuit using QAOA and integrate the results.

Financial portfolio optimization

The problem of determining the optimal portfolio strategy for purchasing securities to minimize risk during operations

Solve relationships such as the similarity of stock price fluctuations between stocks as a combinatorial optimization problem using mathematical models.



By leveraging Quant Cut technology, it may be possible to compute problems exceeding 1,000 logical qubits even on a machine with 250 logical qubits

Thank you