TOSHIBA

STAC Summit -TOKYO-
(Innovation Roundup) 11:41-11:48, Sep. 18, 2025

Enhancing high-speed trading strategies with quantum-inspired technology

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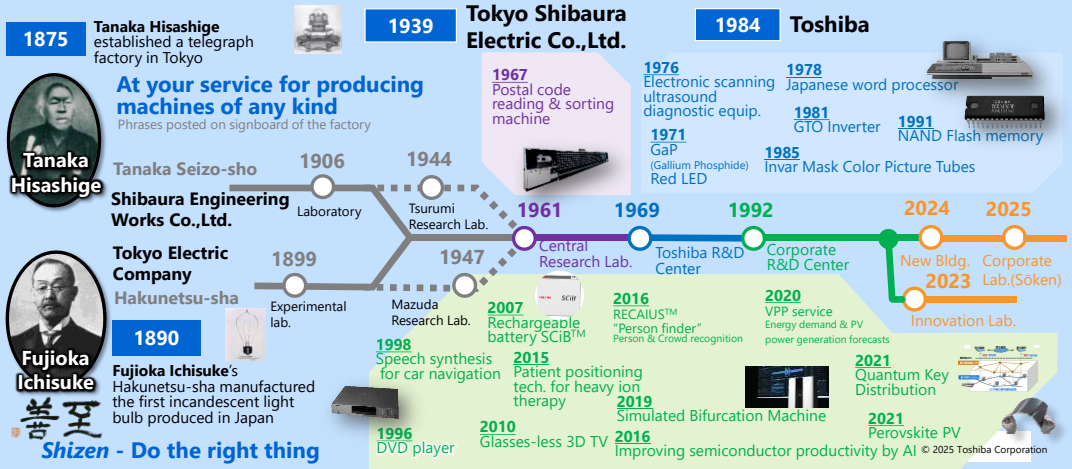
*1 https://www.global.toshiba/ww/technology/corporate/rdc.html

Financial traders/managers are technology-hungry

Collaborate with TOSHIBA for Quantum-era

TOSHIBA as a Technology vendor

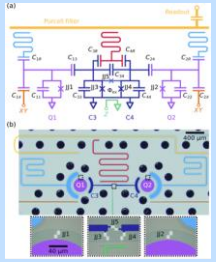
150 years of R&D history



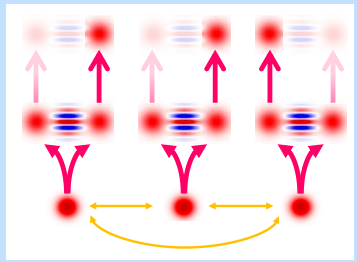
+20 years of Quantum R&D

Quantum/quantum-inspired computers

DTC qubit



Quantum bifurcation



Simulated bifurcation

Quantum communication

QKD

×

Financial institutes

Prop. trading firm

Securities firm

Asset management

Risk management

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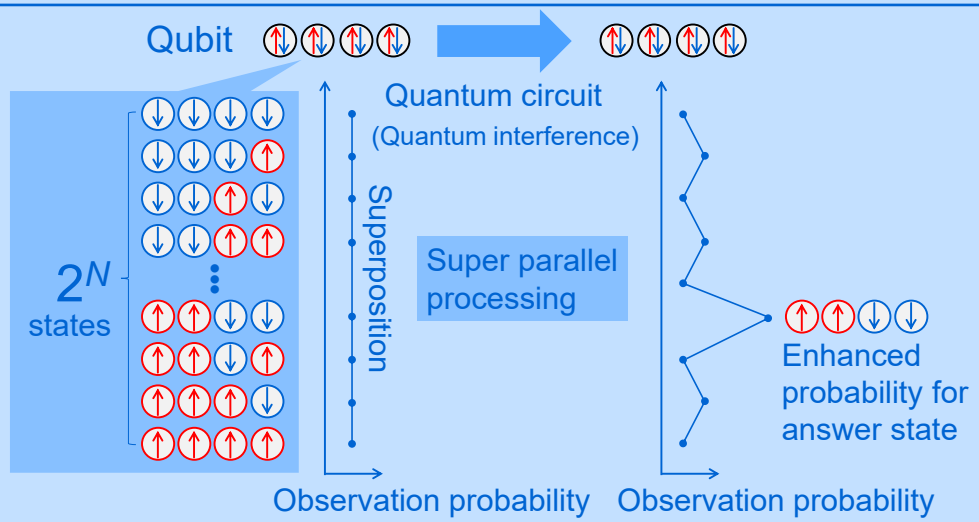
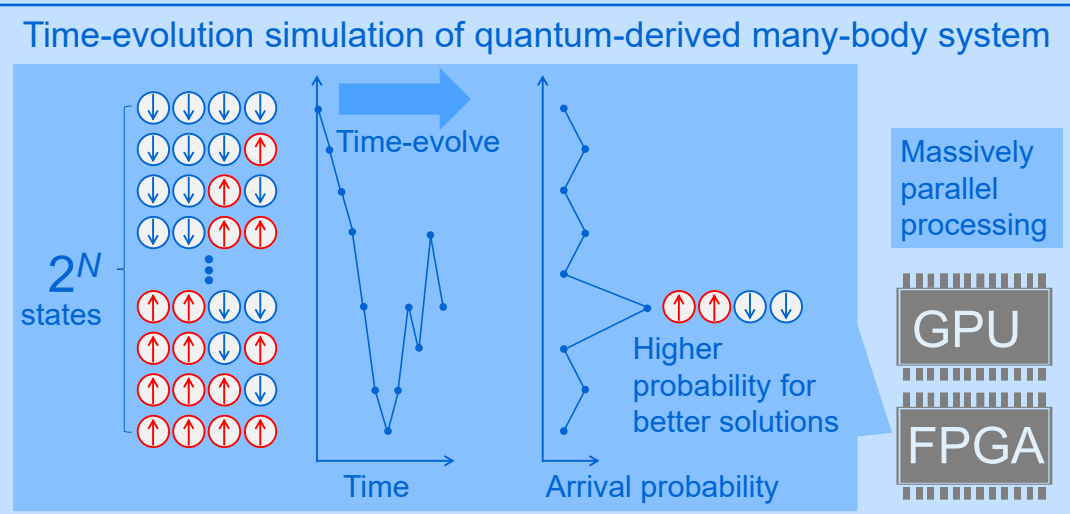
Quantum computer & Quantum-inspired computer

Enable previously-impossible performance

A strategic differentiator shaping company competitiveness

Type	Quantum computer	**Quantum-inspired computer**
Principle	Quantum algorithms based on the principles of quantum mechanics	Highly-parallelizable classical algorithms derived from quantum theory
Info. unit	Qubit (superposition of 0 and 1)	Classical bit (either 0 or 1)
Function	Find the “answer” state in an unprecedented short time from among all the possible states (2^N) representable by N bits	
Mechanism		

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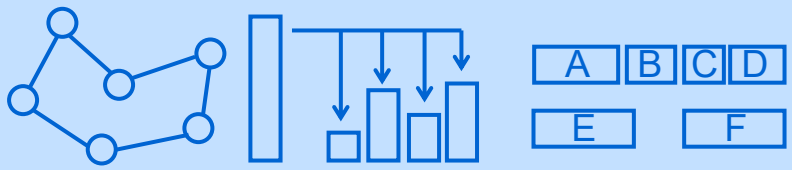
*1 Andrew Lucas, "Ising formulations of many NP problems", *Frontiers in Physics* **2**, 5 (2014)

Ising machines (Quantum-inspired computer)

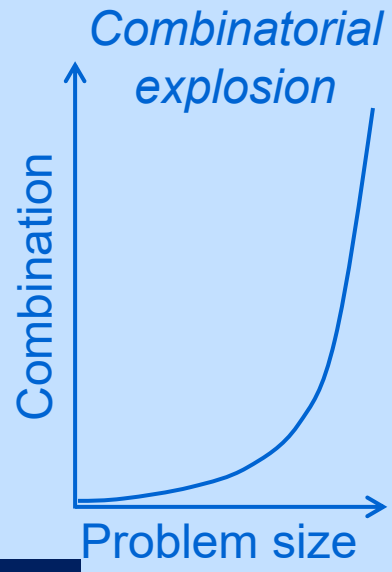
Special-purpose computers for hard combinatorial optimization

Combinatorial optimization (Quadratic discrete optimization)

Routing Allocation Scheduling



	Continuous variables	Discrete variables
Linear		
Quadratic		**NP-hard**



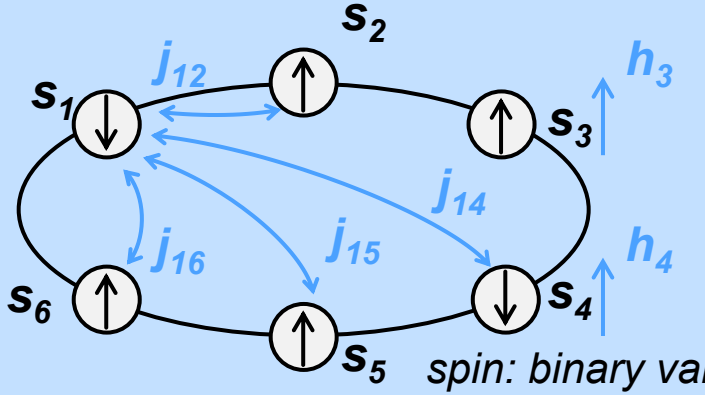
Important but hard problems in *Finance*

Arbitrage path finding problem
Discrete portfolio optimization
Portfolio trajectory optimization
Min-cost risk hedge problem, etc

Mapping to Ising model*1

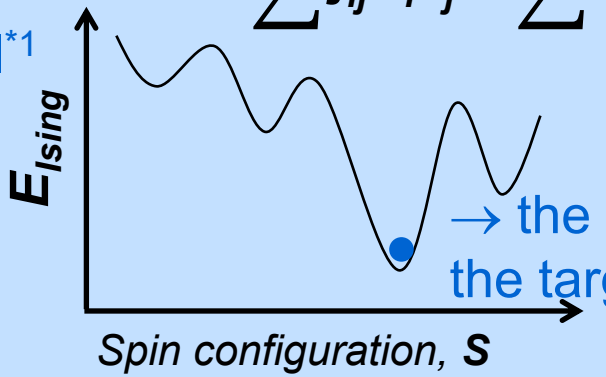
Ising machine

search for the lowest-*E* state of Ising model



spin: binary variable

$$E = \sum j_{ij} s_i s_j + \sum h_i s_i$$



→ the solution to the target problem

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TOSHIBA's quantum-inspired optimization technology

*1 H. Goto *et al.*, *Sci. Adv.* **5**, eaav2372, '19
*2 H. Goto *et al.*, *Sci. Adv.* **7**, eabe7953, '21
*3 K. Tatsumura *et al.*, *Nat. Ele.* **4**, 208–217, '21
*4 T. Kashimata *et al.*, *IEEE Access* **12**, '24

Simulated Bifurcation Machine, SBM

Algorithm

Quantum-inspired

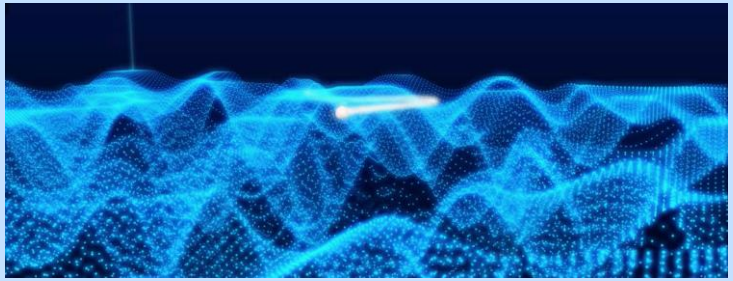
Quantum bifurcation machine

in a quantum principle

Discovery

Simulated bifurcation algorithm

in a new classical principle



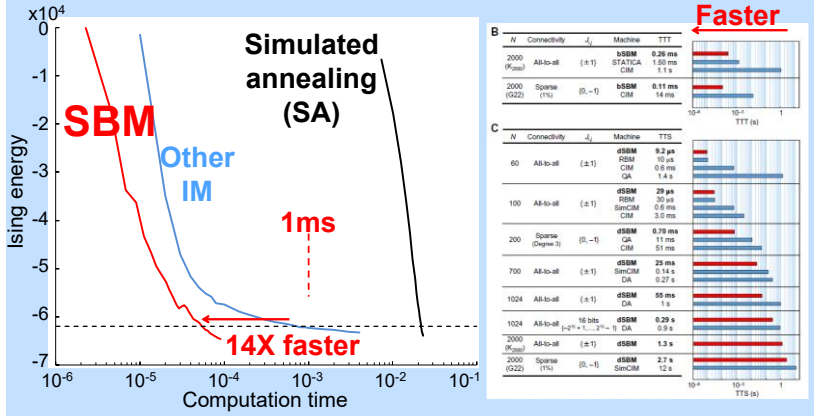
Highly parallelizable

Implementation & Performance

High speed *1,2,3,4

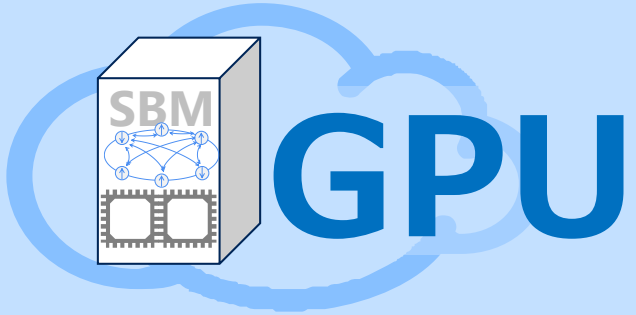
High academic reputation

(totally 1,412 citations)

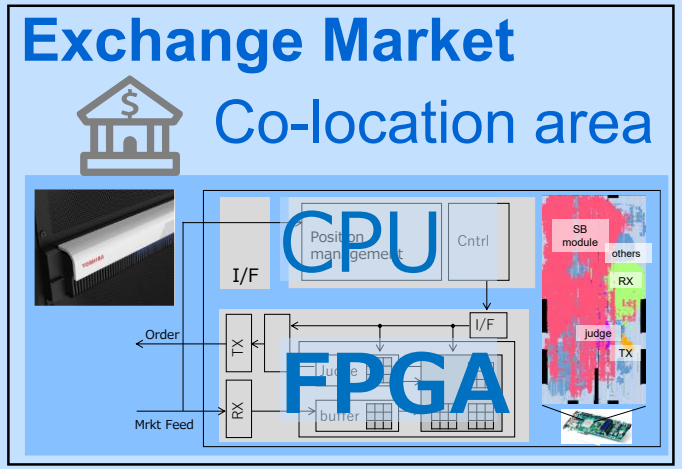


Practicality

Cloud



Edge



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*1 K. Tatsumura et al., IEEE ISCAS., (2020) https://doi.org/10.1109/ISCAS45731.2020.9181114

SBM: Simulated bifurcation machine

Enhancing high-speed real-time trading with SBM

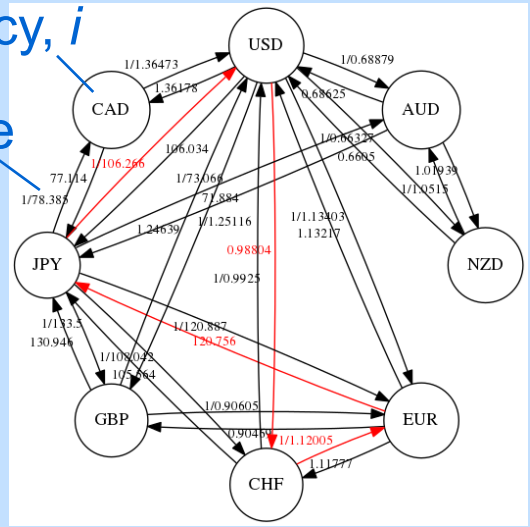
Find the best trading opportunity from all the possibilities in microsecond latency

Cross-currency arbitrage problem

Market Graph

currency, i

exchange rate, $r_{i,j}$



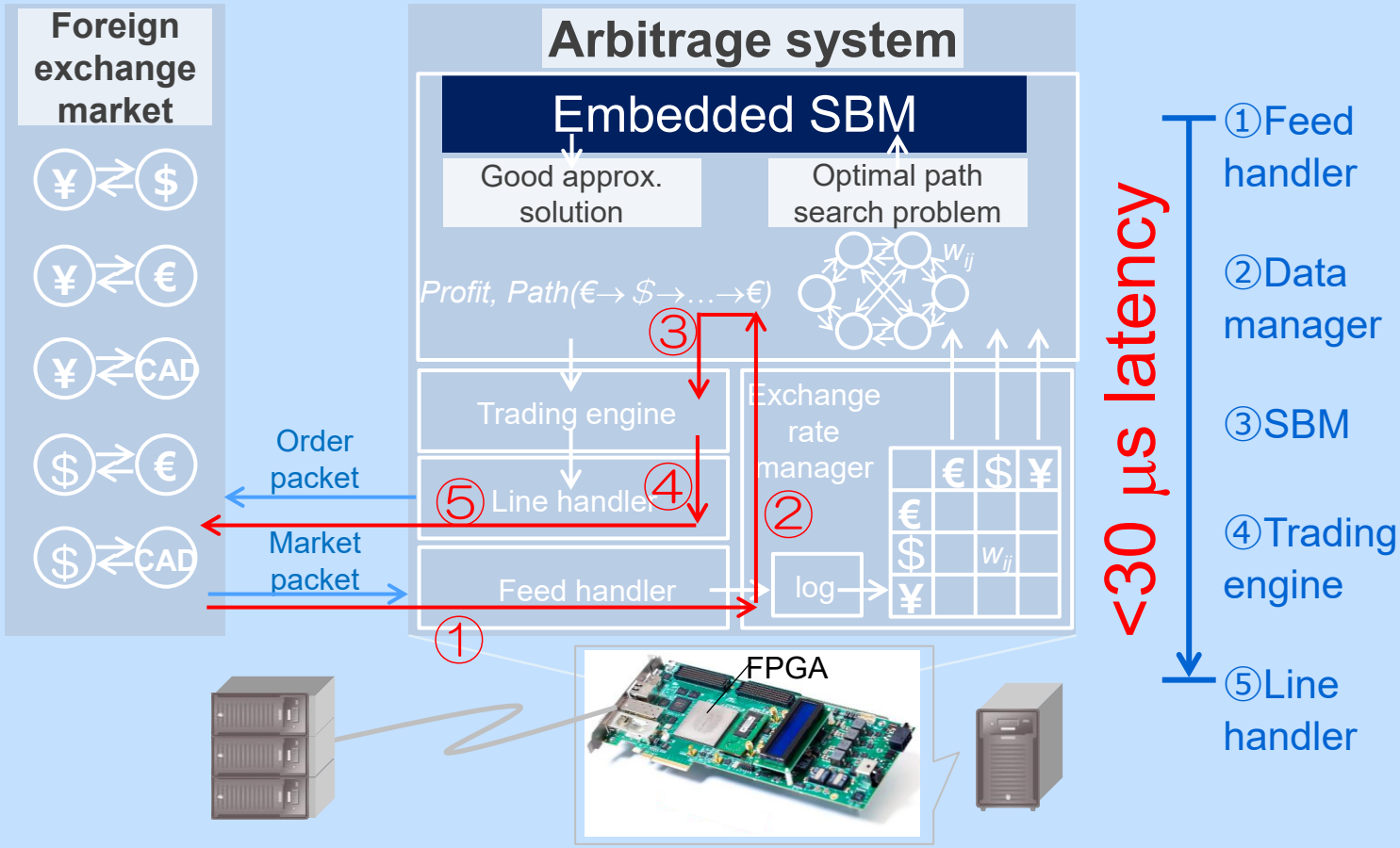
Ising (QUBO) formulation

$$C_{tot} = m_c C + m_p P$$

$$C' = \prod {r_{i,j}}^{b_{i,j}} \quad \boxed{w_{i,j} = -\log r_{i,j}} \quad C = \sum w_{i,j}\, b_{i,j}$$

$$P = \sum_i \sum_{j \neq j'} b_{i,j}\, b_{i,j'} + \sum_j \sum_{i \neq i'} b_{i,j}\, b_{i',j} + \sum_i \left(\sum_j b_{i,j} - \sum_j b_{j,i} \right)^2 + \sum_{i,j} b_{i,j}\, b_{j,i}$$

Trading system



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*1 K. Tatsumura et al., IEEE ISCAS., (2020) https://doi.org/10.1109/ISCAS45731.2020.9181114

SBM: Simulated bifurcation machine

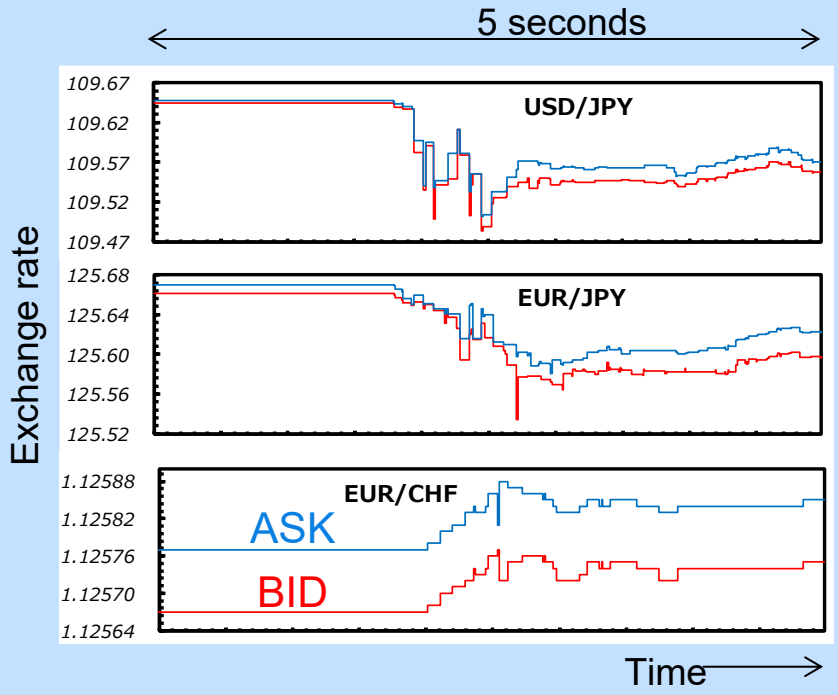
Enhancing High-speed real-time trading with SBM

Find the best trading opportunity from all the possibilities in microsecond latency

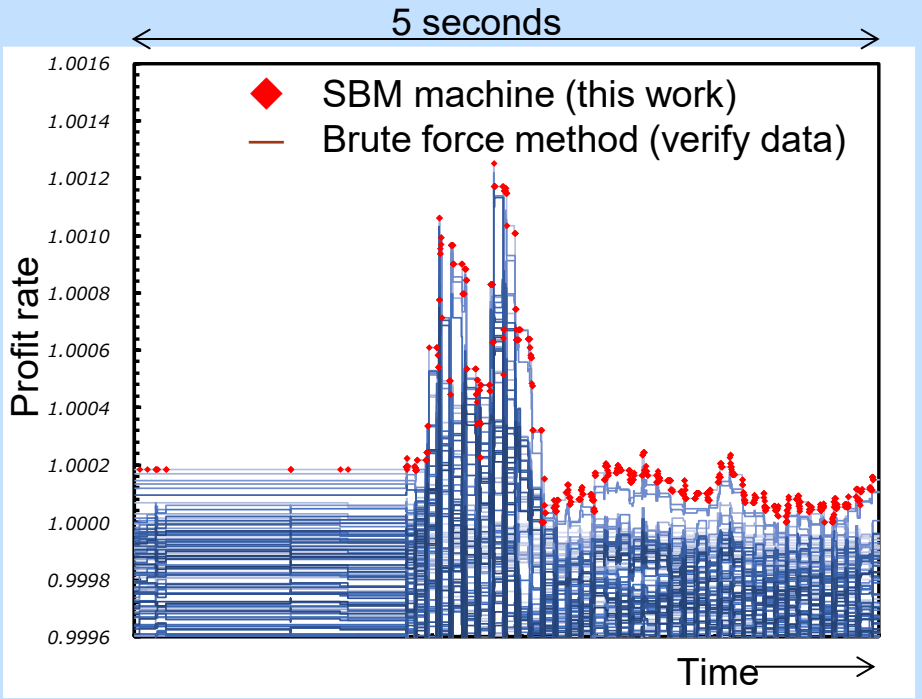
Results

<30 μs system-wide latency & 91% Top-1 probability

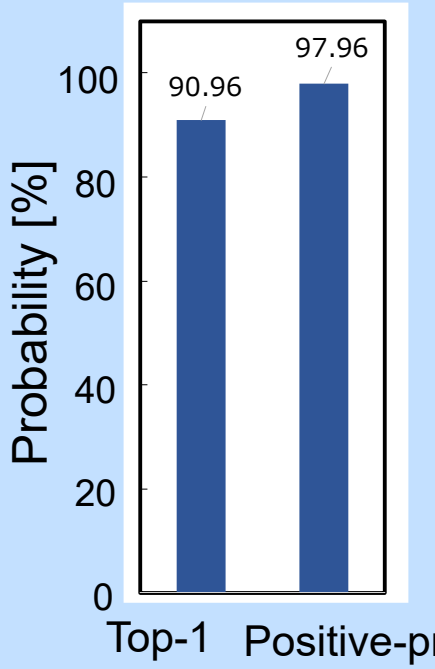
Exchange rates on Jan. 2nd, 2019



Profit rates for arbitrage paths



Solution accuracy



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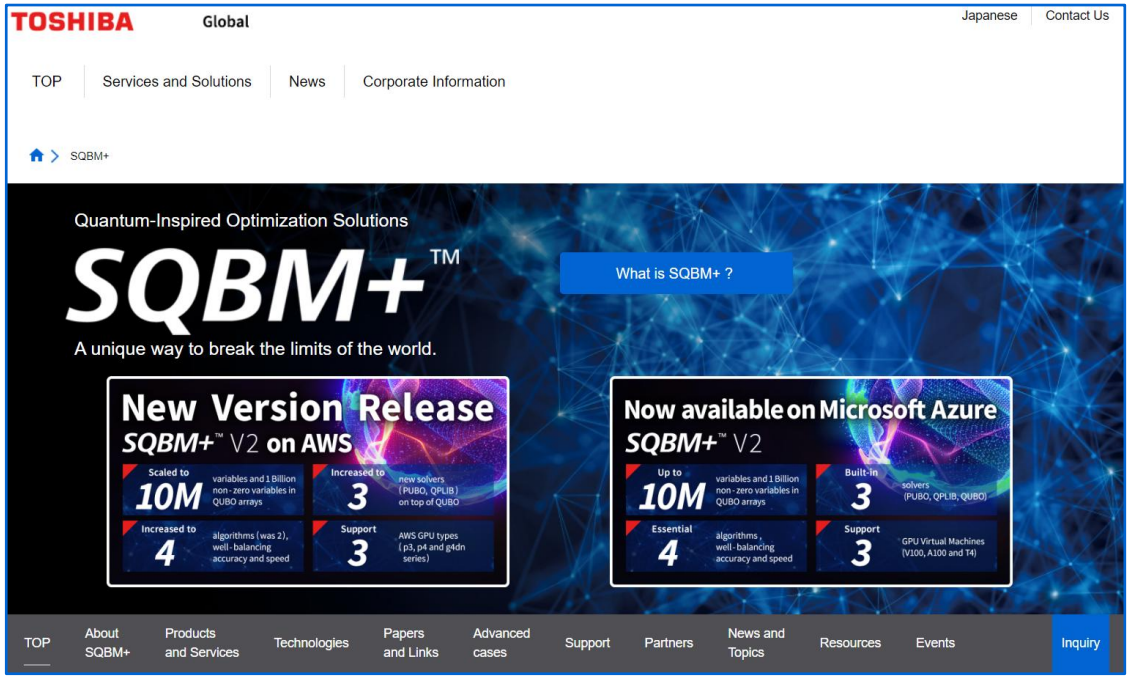
Enhancing trading strategies with quantum-inspired technology

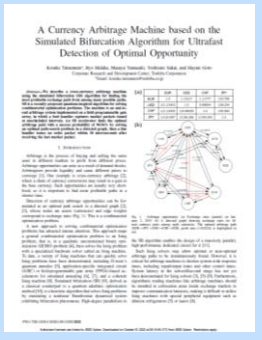
New strategies based on detection of ever-untargeted trading opportunities

Try SBM

Search by “SQBM+”



Use-cases

Type	High-speed real-time trading			Asset management
Target	Currency	Stock		
Strategy	Cross-currency arbitrage*1	Extended pair-trade*2	High-speed basket trade*3	Correlation-diversified portfolio*4
Opt.	Optimal path search in market graph	Optimal path search in market graph	Discrete portfolio optimization	Maximum independent set
Paper				

#1 The world’s first demonstration of systems that execute unprecedented stock trading strategies based on computationally-hard quadratic discrete optimization by using quantum-inspired computer

*1 https://doi.org/10.1109/ISCAS45731.2020.9181114
*2 https://doi.org/10.1109/ACCESS.2023.3316727
*3 https://doi.org/10.1109/ACCESS.2023.3326816
*4 https://doi.org/10.1109/ACCESS.2023.3341422

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