SAMPLING COUPLER FOR OSCILLATOR ISING MACHINES

Tech ID: 33569 / UC Case 2024-136-0

PATENT STATUS

Patent Pending

BRIEF DESCRIPTION

Ising machines represent a promising frontier in unconventional computing, designed to solve complex combinatorial optimization problems by mimicking the behavior of magnetic spins. However, the quality of the solution depends heavily on the precision of the "coupling" between individual spins. UC Berkeley researchers have developed an advanced sampling coupler specifically for Oscillator Ising Machines (OIMs). This spin coupling unit utilizes a high-precision sampling circuit and a programmable current source to establish interactions between oscillators. By sampling the waveform of one oscillator at the exact transition point of another, the system generates a discrete state value that determines the corrective current injected back into the oscillator. This method allows for finely tuned, programmable conductance parameters, enabling the Ising machine to reach lower energy states more reliably and achieve superior optimization results.

SUGGESTED USES

- Combinatorial Optimization: Solving NP-hard problems such as the Traveling Salesperson Problem, Max-Cut, and scheduling.
- Hardware Accelerators: Providing high-speed, low-power alternatives to traditional CMOS-based optimization solvers.
- Drug Discovery: Simulating molecular folding and protein-ligand interactions through energy-minimization modeling.
- Financial Modeling: Optimizing large-scale portfolios and risk assessment through complex variable correlation.
- Logistics and Supply Chain: Real-time optimization of routing and resource allocation in highly dynamic networks.

ADVANTAGES

- Superior Optimization Quality: The sampling-based coupling method provides more accurate spin-state transitions, leading to higher-quality global minima.

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INVENTORS

- Roychowdhury, Jaijeet Shankar

OTHER INFORMATION

CATEGORIZED AS

- **Computer**
  - Hardware
- **Engineering**
  - Engineering
  - Robotics and Automation
- **Semiconductors**
  - Design and Fabrication

RELATED CASES

2024-136-0

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Programmable Precision: Features a programmable conductance parameter, allowing the machine to be reconfigured for a wide variety of problem sets.

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Hardware Efficiency: Utilizes a streamlined circuit design that integrates sampling and current injection, reducing power consumption compared to digital emulators.

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Scalability: The modular nature of the spin coupling units allows for the construction of large-scale Ising machines with thousands of interconnected oscillators.

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Robust Phase Locking: Improves the stability of the phase-relationship between oscillators, which is critical for the accuracy of Ising model solutions.

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Field-Programmable Ising Machines (FPIM)

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