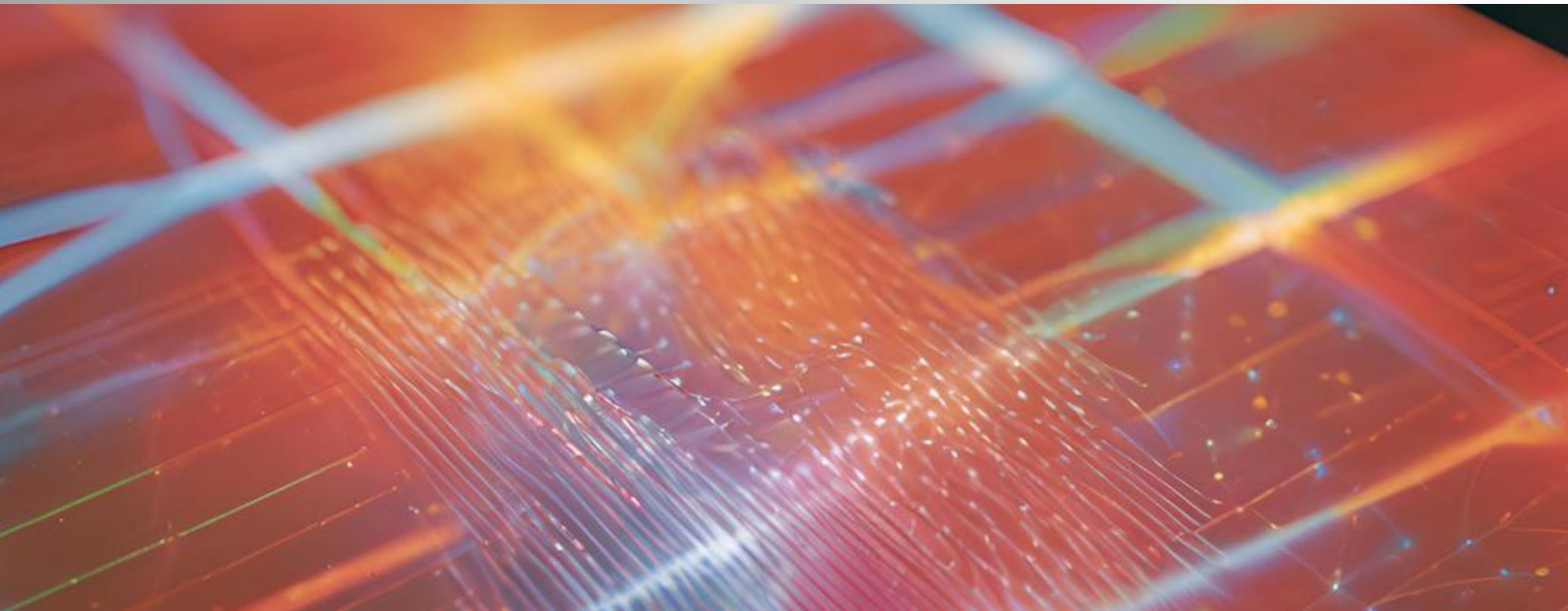


HOLOGRAPHIC CLOUD ISING MACHINE



Welcome to **Holo-CIM** Newsletter!

The project

HoloCIM (Holographic Cloud Ising Machine) proposes a holography based photonic Ising Machine that utilizes and enhances newly established holographic and nonlinear photonics principles for the efficient solution of combinatorial optimization problems (COPs). The latter cannot be efficiently solved with modern digital computer architectures. HoloCIM aims to create an online user interface to be scientifically and commercially used from interested parties such as research institutions, academia, and industry.



Partners



University
of Cyprus



University of Cyprus
Department of Computer
Science



Objectives

Holo-CIM envisions to fulfill the following objectives :

- Implement mean field Ising model with maximum spin nodes
- Study the role of the spontaneous noise on system performance
- Demonstration of higher order spin interactions to increase complexity
- Increase the Ising machine iteration speed
- Study and quantify effects of ambient temperature on Ising system performance and stability
- Offering an Ising annealing machine as a Cloud service

Real-world Problems and Challenges

Combinatorial optimization problems include many every day problems like:



Logistic Optimization

Find a route with the shortest travel distance



Molecular Design for Drug Discovery

Identify the molecular makeup of drugs with the desired efficacy



Financial Portfolio Optimization

Find a combination of different stocks with high return and low risk



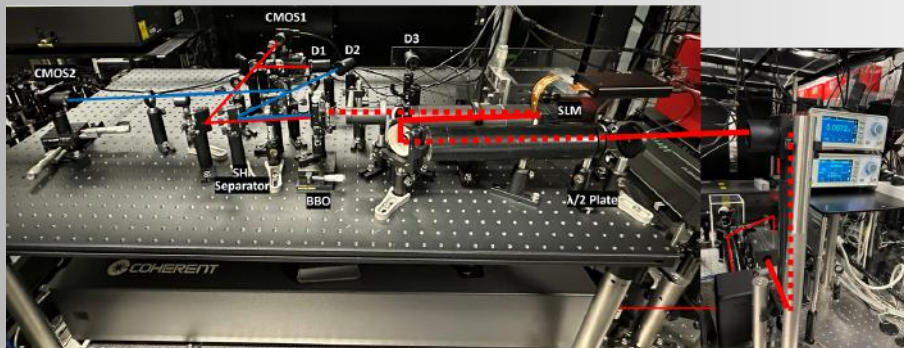
Traffic Congestion Alleviation

Determine the route of each vehicle, to minimize congestion

However, **their solutions is challenging** since require enhanced computational efficiency, which traditional von Neumann architectures struggle to deliver as they approach their limits in scalability and power efficiency.

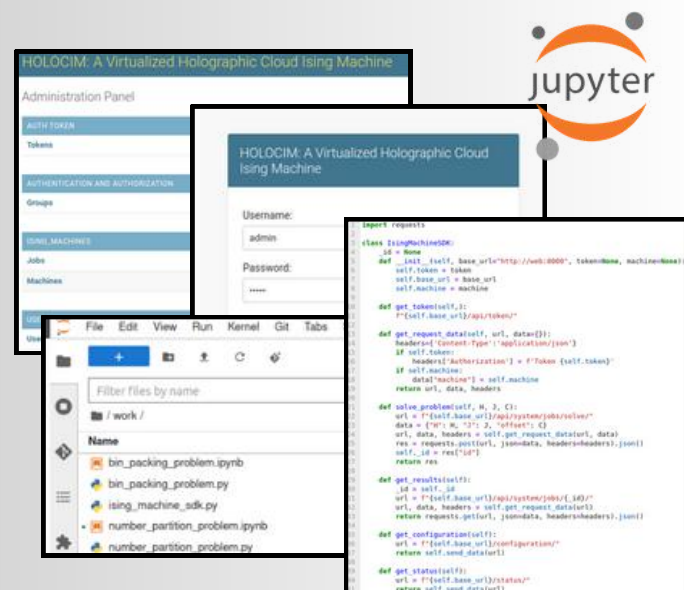
Current State of the Project

In the first year of the HoloCIM project, an **end-to-end Ising machine hardware implementation** was developed. This setup, created by UBI, employs one SLM to achieve amplitude and phase modulation, a laser, and various optical components.



Light from a stabilised laser is expanded and impinges on a reflective **spatial light modulator (SLM)**. The modulated wavefront undergoes an optical Fourier transform, while a high resolution camera is used to record the focused light intensity. The minimization of the Ising energy is performed using **Metropolis based algorithms** to observe the minimum energy of the system. A server orchestrates the hardware, utilizing a specialized **library for controlling the SLMs, laser, and camera**, and implementing an **optoelectronic feedback loop** to minimize the Ising Hamiltonian. The library also supports a web-based API for communication between HoloCIM's platform and the Ising machine.

HoloCIM offers a **cloud-based and as-a-service multi-layered platform** with user-friendly interface for handling external requests. It converts NP problems into Ising representations and deploys them using APIs. The platform also includes **user management** features, and **real-time infrastructure monitoring**. Additionally, the **HoloCIM Python library** integrates with data science tools like Jupyter Notebooks, simplifying solution implementation for users.



Check out HoloCIM demonstration on our youtube channel: https://www.youtube.com/watch?v=DO_z1zdO9Ro



Event Participation & Synergies

The HoloCIM project was showcased at a **training seminar** held by the Computer Science Department at the University of Cyprus in November 2023. Additionally, the project was disseminated through participation in the **IEEE/ACM International Conference on Utility and Cloud Computing (UCC2023)**.



HoloCIM solution was presented internally to the UBITECHTECH's customers and partners (**UBITECH Innovation Days 2023**), fostering also synergies and collaboration with relevant projects where UBITECHTECH is also participating.



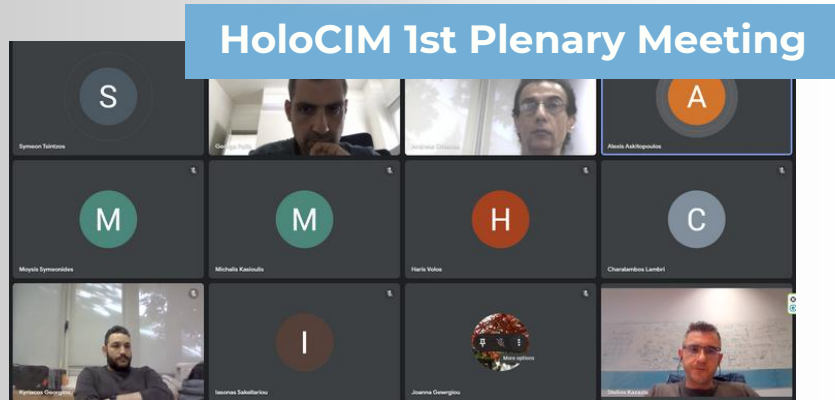
The HoloCIM project was presented at the 6th **Summit on Gender Equality in Computing (GEC24)**, an event dedicated to promoting equal access to advancements in computer science. At this summit, HoloCIM partners presented the project and its key functionalities to an audience of over fifty participants.



HoloCIM and the **HEISINGBERG** Project will be joining forces to pursue common research goals centered on quantum computing, quantum technologies, and quantum information.



On December 13th 2023, the **1st plenary meeting** of HoloCIM Project took place virtually, led by Project Coordinator UBITECH, whereas representatives from the Laboratory for Internet Computing (LIInC) as well as from Laboratory of Ultrafast Science of Computer Science and Physics Department of University of Cyprus, had a strong presence in the meeting. It's been a full day remote meeting with a lot of interesting presentations.



1st Successful Periodic Review



On April 3rd 2024, the **1st periodic review** was completed. Through the review, we highlighted HoloCIM approach to solving combinatorial optimization problems using holographic photonics principles, via a cloud-native and user-friendly platform. Additionally, the feedback from the review has provided valuable insights that will guide the next phases of the HoloCIM project, ensuring that HoloCIM meets the growing needs of our users from academia and industry.

Find us on Social Media



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Stay Tuned