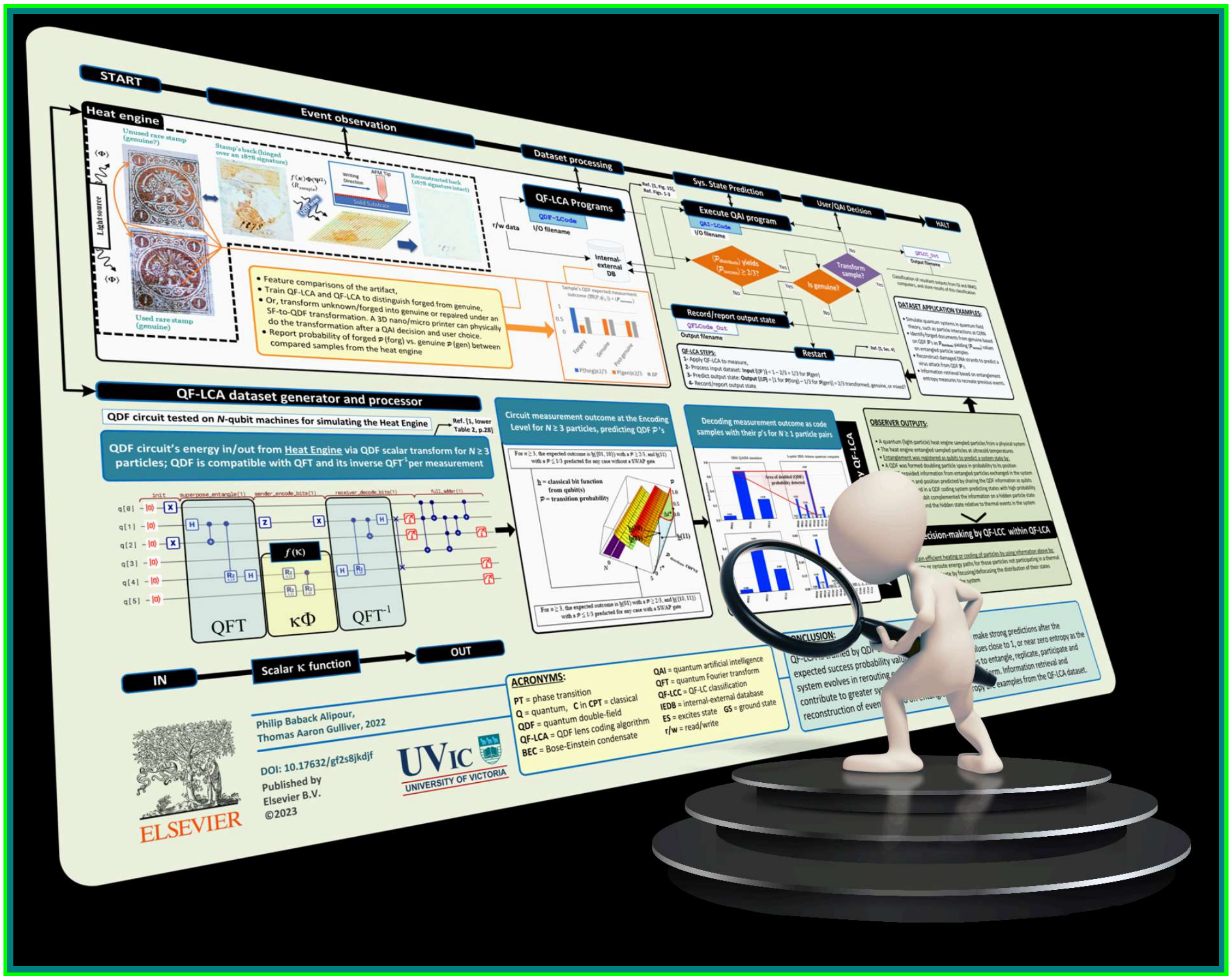
QFLCA Abstract, Highlights and Interests



This page presents a collection of quantum field lens coding algorithm (QFLCA) project abstracts, interests and highlights. The goal is to bridge between different fields of science in advances made in research and technology dependent on datasets, their analysis and application.

The expected outcome of this project is to make strong predictions of thermodynamic states of proposed systems on any scale. QFLCA simulates the system tio discover inefficient energy paths and suggests new energy paths to reroute, improving system efficiency and performance using a quantum double field (QDF) method with quantum scalar field properties. The algorithmic method produces datasets used for simulating new thermodynamic system models measured by quantum circuits, here defined as QDF circuits.

The main objective of the QFLCA model is proposing the application of QDF circuits that simulate systems using quantum computing such as, quantum AI, and entropy measurements to address uncertainties in the system under observation. From quantum computers to industrial, medical, physical and global economic solutions, by applying a QFLCA model for system state classification and measurements, presents datasets that can train the algorithm to map efficient energy paths for the system user/observer as presented in recent publications of its proposed system model and datasets.

For more project information, its progress and objectives, visit the About page

Abstract

Summary of progress and application: Prediction of combustion events as a phase transition occurring in the system, is detected by using photonic probes and sensors once atoms are sampled within a quantum heat engine. The engine incorporates a quantum double-field (QDF) lens function [1], as a new function which focuses/defocuses probability distribution values in the system. In major, system efficiency such as cooling vs. heating, symmetry, equilibrium can be measured by employing this quantum field distance metric into a system as one determines input/output states by sensors and predict their distances to reduce uncertainty (entropy) over time for an event occurrence (state transition) on any system scale. Its distance metrics makes accurate event predictions (data sampling and analysis from a quantum atomic/molecular scale) on a macro (large) scale in any heat engine built as a final product in numerous industries e.g. medicine (prediction on e.g., cells prone to cancer as a dynamical phase

transition), aviation, automobiles, processors, meteorology, etc. The algorithm predicts events as an intelligent decision (support) simulator/solution (IDSS) [2], suggesting alternative energy paths to the user by visualizing (image-based map) real-time data with feedback addressing atomic (non)-interactions from one point to another. This is all about assuring quality in terms of maximizing system efficiency and performance.

Highlights

- `QDF and QFLCA Highlights:`
    - A pending event in a system is predicted by knowing all the information about prior events to it.
    - Two physical systems are simulated by a double-field computation (DFC) model to predict events.
    - Replicate the DFC method from the model to compute the next system state on a quantum level.
    - Superposition is a quantum (light-particle) behavior simulated by the DFC model.
    - A quantum double-field (QDF) by DFC doubles the particle space in probability to its position.
    - The DFC provides information on the possibility to entangle with a particle within its QDF.
    - Particle position is predicted by sharing the QDF information as quantum bits (qubits).
    - Collect QDF data from the models to represent energy states and transitions in the system.
    - Qubits are counted in a QDF coding system or DFC to predict states with high probability.
    - Add an extra qubit from the QDF via DFC to complement the qubit information for a target state.
    - DFC simulator generates the QDF circuit's dataset to compare with other datasets.
    - QFLCA compares datasets to classify energy states based on profiling them and their probability distances (correlation length). This is the QFLCC method.
    - Quantum artificial intelligence (QAI) is used to classify QDF states by this profiling method.
    - From the circuit state readout, the next system state is predicted through the QAI classification.

- `QDF Game Highlights:`
    - A game with a hidden prize run by a host can be won by altering its uncertain state.
    - Superposition is a quantum (light-particle) behavior by the host to hide the prize as a target state.
    - A quantum double-field (QDF) doubles the prize space in probability to its position.
    - A QDF provides information on the possibility to entangle with the prize and find it.
    - Prize position is predicted by sharing the QDF information as quantum bits (qubits).
    - Qubits are counted in a QDF coding system to predict states with high probability.
    - Adding an extra qubit from the QDF, complements the information on the prize qubit.
    - A QDF circuit achieves the target state 100% as the prize relative to any event in the universe.

- `QFLCA Dataset Highlights:`
    - A simulated quantum (light-particle) heat engine samples particles from a physical system.
    - Sampled particles from subsystem(s) are entangled at heat engine's ultracold temperatures.
    - Entanglement is registered as qubits to predict a system state as a QDF dataset:
    - Dataset shows a QDF was formed doubling particle space in probability to its position.
    - QDF data provides information from entangled particles exchanged in the system.
    - Particle spin and position are predicted by sharing the QDF information as qubits.
    - QDF circuit counts the qubits as its dataset to predict states with high probability, Eqs. (1)-(2b) [4].
    - The QDF circuit design and configuration associated with the dataset counts how many states have been predicted as the sum of successful hits by the IDS user/simulator (IBM QDF circuit simulator).
    - Dataset shows a QDF extra qubit complements the information on a hidden particle state.
    - QDF circuit simulator finds the hidden particle state relative to thermal events in the system.

Keywords

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Quantum field lens coding algorithm (QFLCA), quantum double-field (QDF), quantum computer, quantum artificial intelligence (QAI),
quantum bit (qubit), command line interface (CLI), QDF transformation, QDF lens coding, DF computation (DFC), entanglement entropy
(EE), N-qubit machines, quantum Fourier transform (QFT), quantum lens coding classification (QFLCC), QDF Python game
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QFLCA Abstract Collection

QFLCA Model Abstract

Extracted from:

[1] Quantum field lens coding and classification algorithm to predict measurement outcomes
Philip B. Alipour and T. Aaron Gulliver

This study develops a method to implement a quantum field lens coding and classification algorithm for two quantum double-field (QDF) system

models:

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1. a QDF model, and
2. a QDF lens coding model by a DF computation (DFC).
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This method determines entanglement entropy (EE) by implementing QDF operators in a quantum circuit. The physical link between the two system models is a quantum field lens coding algorithm (QF-LCA), which is a QF lens distance-based, implemented on real N-qubit machines. This is with the possibility to train the algorithm for making strong predictions on phase transitions as the shared objective of both models. In both system models, QDF transformations are simulated by a DFC algorithm where QDF data are collected and analyzed to represent energy states and transitions, and determine entanglement based on EE. The method gives a list of steps to simulate and optimize any thermodynamic system on macro and micro-scale observations, as presented in this article:

- The implementation of QF-LCA on quantum computers with EE measurement under a QDF transformation.
- Validation of QF-LCA as implemented compared to quantum Fourier transform (QFT) and its inverse, QFT^{-1}.
- Quantum artificial intelligence (QAI) features by classifying QDF with strong measurement outcome predictions.

QFLCA AI Abstract

Extracted from:

[2] Quantum AI and hybrid simulators for a Universal Quantum Field Computation Model

Philip B. Alipour and T. Aaron Gulliver

Quantum field theory (QFTh) simulators simulate physical systems using quantum circuits that process quantum information (qubits) via single field (SF) and/or quantum double field (QDF) transformation. This review presents models that classify states against pairwise particle states $|ij\rangle$, given their state transition (ST) probability $P_{|ij\rangle}$. A quantum AI (QAI) program, weighs and compares the field's distance between entangled states as qubits from their scalar field of radius $R \geq |r_{ij}|$. These states distribute across $\langle R\rangle$ with expected probability $\langle P_{\text{distribute}}\rangle$ and measurement outcome $\langle\mathfrak{M}(P_{\text{distribute}})\rangle = P_{|ij\rangle}$. A quantum-classical hybrid model of processors via QAI, classifies and predicts states by decoding qubits into classical bits. For example, a QDF as a quantum field computation model (QFCM) in IBMQE, performs the doubling of $P_{|ij\rangle}$ for a strong state prediction outcome. QFCMs are compared to achieve a universal QFCM (UQFCM). This model is novel in making strong event predictions by simulating systems on any scale using QAI. Its expected measurement fidelity is $\langle\mathfrak{M}(\mathcal{F})\rangle \geq 7\,/\,5$ in classifying states to select 7 optimal QFCMs to predict $\langle\mathfrak{M}\rangle$'s on QFTh observables. This includes QFCMs' commonality of $\langle\mathfrak{M}\rangle$ against QFCMs limitations in predicting system events. Common measurement results of QFCMs include their expected success probability $\langle P_{\text{success}}\rangle$ over STs occurring in the system. Consistent results with high $\mathcal{F}$'s, are averaged over STs as $\langle P_{\text{distribute}}\rangle$ yielding $\langle P_{\text{success}}\rangle \geq 2\,/\,3$ performed by an SF or QDF of certain QFCMs. A combination of QFCMs with this fidelity level predicts error rates (uncertainties) in measurements, by which a $P_{|ij\rangle} = \langle P_{\text{success}}\rangle \lesssim 1$ is weighed as a QAI output to a QFCM user. The user then decides which QFCMs perform a more efficient system simulation as a reliable solution. A UQFCM is useful in predicting system states by preserving and recovering information for intelligent decision support systems in applied, physical, legal and decision sciences, including industry 4.0 systems.

QDF Abstract

Extracted from:

[3] Quantum Double-field Model and Application

Philip B. Alipour and T. Aaron Gulliver

A universal quantum double-field (QDF) model is introduced to predict particle states by doubling their probability outcome. These states are $i = 0$ as ground state (GS), 1 as excited state (ES), $|2\rangle$ as 0 and 1 denoting quantum superposition. A GS particle (Bob) interacts with particles over distance d to attain a target state (TS) with mode m as $|i_m\rangle$ e.g., a particle obeying Bose-Einstein condensate (BEC) or Fermi-Dirac statistics. A scalar κ is used to identify the \emph{effect} caused by light-matter interactions based on its value under a QDF transformation. A transition density matrix via κ provides state transition probabilities between the GS and ES particle fields. The information on the magnitude of the quantum particle position $|\mathfrak{r}|$ between three traps is gathered by a superposing particle, Alice or Eve, on a spatial magnitude of $|\kappa^2|\varrho \leq 2$, where ϱ is the probability density function for a given state $|2\rangle$. This state is projected by Alice or Eve onto the quantum particle field interacting with Bob's field forming a QDF.The QDF information shared with Bob in a QDF circuit, doubles in probability to occupy space on any scale of $\mathfrak{r}$. If Bob's field entangles with a GS field within the QDF, the TS 1 field is predicted (expected) for Bob to obtain, and viceversa. Here, the κ field probability doubles as the correlation length λ_c between states is measured relative to κ, $\mathfrak{r}$ and d, given the transition density matrix values obtained \emph{prior} to a phase transition. This gives a quantum information transmission via QDF on any scale to simulate BEC, heat engines and quantum communication models. For example, in refrigeration, an efficient cooling of atoms is obtained by sharing the quantum information to reroute atoms that weren't participating in the cooling event to participate.

QFLCA Dataset Abstract

Extracted from:

[4] QF-LCA dataset: Quantum field lens coding algorithm for system state simulation and strong predictions

Philip B. Alipour and T. Aaron Gulliver

Quantum field lens coding algorithm (QF-LCA) dataset is useful for simulating systems and predict system events with high probability. This is achieved by computing QF lens distance-based variables associated to event probabilities from the dataset produced by field lenses that encode system states on a quantum level. The probability of a state transition (ST), doubles in prediction values at the decoding step, e.g., ST probabilities of $P \geq 1/3$ into $P \geq 2/3$ based on a single field (SF) transform into a quantum double-field (QDF). This transformation doubles the ST probability space* via the field's scalar κ, in a published QDF method article [1]. A QDF, as a double-field computation (DFC) model, simulates thermodynamic systems in predicting events by producing datasets from a QF-LCA, using laser cooling methods relative to high energy systems. The dataset can be used to, e.g., train quantum algorithms via quantum artificial intelligence (QAI) for a QF-LCA user. The user then makes a decision after the algorithm predicts and suggests an efficient energy path for the system to choose. For example, an N-particle system simulated as a heat engine, by QAI classifier(s), predicts and reroutes particle energy paths on a logarithmic input-output scale. To determine system's energy change, the QDF lens code (DFC) measures entanglement entropy (EE). The algorithm's classification of EE values distinguishes entangled states in the system. The QF-LCA program employs the dataset to achieve an automated prediction and classification method, rather than dataset's manual use and analysis by the user. As the system evolves in its distribution of states, those particles not reaching a desired energy state (a target state or TS), i.e., the probability of observing a ground or excited state (GS or ES) outcome at the decoding step, can be rerouted by the heat engine to satisfy a TS outcome. This establishes a GS or ES energy profile to access and classify states by a classifier. The data points (qubits) in this profile are inverse distance-based, and labelled for a specific class. After learning the profile, the classifier decodes and predicts the next system state. A QDF AI game "Alice & Bob's Quantum Doubles," is developed to validate the dataset as the P's map for a classical/quantum prediction where the P's of states and the user's P's correlate in their value difference, ΔP. Dataset validation results are mapped to an intelligent decision simulator (IDS) as a QAI map. This maximizes system efficiency on a TS by EE measure of the distributed energy states. Future additions to the dataset from the QAI map program can improve quantum algorithms to determine which particles of the system participate in a phase transition after state prediction. QF-LCA applications are in data science, security, forensics, particle physics, etc., such as retrieving or reconstructing information by distinguishing particle states from an evidence sample. Examples are, reconstruct damaged DNA strands of cells to predict a virus's TS, or cancer cell, its spread and growth against healthy cells, identify forged documents from genuine based on QDF's P values, and so on.

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* A probability space is a measure space such that the measure of the whole space is = 1.
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QFLCA Software Abstract

Extracted from:

[5] Quantum field lens coding software for system state simulation, strong prediction and game application

Philip B. Alipour and T. Aaron Gulliver

A quantum field lens coding algorithm (QF-LCA) software is presented on a high-level end-user application run by $\mathrm{CLI} \longleftrightarrow \mathrm{GUI}$ with custom commands input by user to process, analyze, validate QF-LCA datasets in a QF-LCA and quantum game Python program. On the low-level system software, measurement data are acquired from quantum computers. The datasets contain these measurement data, processed and classified according to QF-LCA circuit design and steps to determine system states and their prediction. This software impacts advances made in applied sciences, statistics, law and physics, where data validation of samples including system simulation projecting and predicting events are achieved.

Sustainable Global Environment UQFCM Abstract

Extracted from:

[6] A Universal Quantum Field Computation Model for a Sustainable Global Environment and Society

Philip B. Alipour and T. Aaron Gulliver

A quantum double-field (QDF) algorithm is useful for simulating physical systems and predict events with high probability. The probability of a state transition (ST), doubles in prediction values at ST probabilities of $P \geq 1/3$ into $P \geq 2/3$ from a QDF. A QDF dataset is used to make strong predictions via quantum artificial intelligence (QAI). The QAI program from the dataset, classifies and predicts energy states to see which particles can participate in the next system state. For example, in medicine, reconstruct damaged DNA strands to predict a virus, cancer cell target, its spread and growth against healthy cells. In law, identify forged documents from genuine based on QDF's P values. A QDF as a quantum field computation model (QFCM) in IBMQE, can perform the doubling of P's for a strong prediction. A universal QFCM (UQFCM), from our co-publication, makes strong event predictions by simulating systems using QAI. A UQFCM is useful in predicting system states by preserving and recovering information for intelligent decision support systems (IDSS) in applied, physical, legal and decision sciences, including industry 4.0 systems. In this paper, societal impacts, goals and examples, are briefly discussed to propose a sustainable global environment by the UQFCM application.

QFLCA Interests for OA platforms

Quantum AI and hybrid simulators for a Universal Quantum Field Computation Model answer for a range of open access (OA) platforms for researchers. Among which, you may find the key research groups active within the fields below:

Physicists

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How can quantum field theory (QFTh) simulators be utilized to predict system states and improve
measurement fidelity?
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According to the abstract of [2],

- for QFTh simulators utilization to predict system states, the solution is given [2, p. 4]:
- for QFTh simulators improving measurement fidelity, the solution is given on [2, pp. 4-7] as:
- QFTh simulators are discussed in [2, Sec. 1.2] onwards.

In a QDF model [2, Sec. 1.2], the field's scalar component κ is associated with a particle field Ψ by a sum (factor) of doubles of the speed of light c through superposition and entanglement. The scalar is used to identify the effect caused by light-matter interactions based on its value under [a QDF transformation]. This doubles the probability and distance correlation between a particle pair in their pairwise fields $\Psi\Phi$ which can be measured with the assumption of having at least one superposed qubit between an input state and output state with an energy change needed to cause a phase transition.

Data Scientists

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How can quantum AI be used to classify and predict states by decoding qubits into classical bits?
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According to the abstracts of [1], [2] and [4], qubit measurement data as QDF datasets are acquired according to the QDF model via its algorithm QFLCA from quantum computers and simulators e.g., $\{\mathrm{QiskitAer}, \mathrm{IBMQproviders}\}$. The quantum double-field (QDF) [3] datasets [4] are generated based on a QDF circuit design and κ scalar field transformation from a single field (SF) to a QDF, which doubles the probability and distance correlation between a particle pair in their pairwise fields of a QDF. The datasets contain qubit measurement data simulating a thermodynamic system. The data are processed and classified according to QFLCA circuit design and steps to determine system states and their prediction. This determination is based on profiling system's energy states as classical bits once the quantum data points are analyzed according to QFLCA, Step #3 of Algorithm 2. From [1], the QDF transformation method is validated by profiling and weighing energy states. After profiling, a QAI map is generated to train the QFLCA for a system state prediction based on where less efficient energy paths are (previously recorded and profiled energy states) and suggest new efficient paths with high probability to choose as a desired Hamiltonian for the system.

Engineers

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How can quantum-classical hybrid models of processors be applied to simulate systems on
any scale and achieve strong event predictions?
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According to the abstract of [1, 2] and the answer provided for data scientists, a system's energy states are simulated to measure the Hamiltonian and observe energy paths where particles interact. Classical bits are computed once the quantum data points from the simulation over energy paths are analyzed according to QFLCA steps from [1]. Upon profiling and weighing energy states, a QAI map is generated to train QFLCA for a system state prediction based on where less efficient energy paths are (previously recorded and profiled energy states) and suggest new efficient paths with high probability to choose as a desired Hamiltonian for the system. This is achieved by entanglement between the interacting particles and shuffling their superposition within their QDF where the expect P of their energy states is doubled in its measurement outcome. Hence the prediction of the energy states and paths to reroute for a more efficient system in e.g. a combustion vs. refrigeration thermodynamic event.

Project abstract sources, content and website affiliations:

University of Victoria

ELSEVIER

MethodsX

Data in Brief

Software Impacts

Societal Impacts

MENDELEY