Analog quantum computing for combinatorial optimization

Record number : OPR-1397

Overview

RESEARCH DIRECTION

Victor Drouin-Touchette, Professeur sous octroi de recherche - Department of Electrical and Computer Engineering

INFORMATION

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ADMINISTRATIVE UNIT(S)

Faculté de génie
Département de génie électrique et de génie informatique

LEVEL(S)

3e cycle

LOCATION(S)

Campus de Sherbrooke

Project Description

Context
The team of professors Victor Drouin-Touchette and Yves Bérubé-Lauzière has received NSERC Alliance funding for the Quantum Quick Route (QQR) project and is looking to add a member to the research team. Carried out as part of a partnership between the company Pasqal and the Université de Sherbrooke, this project aims to develop new approaches and algorithms to solve combinatorial optimization problems — and more specifically, vehicle routing problems (the well-known "Vehicle Routing Problem," or VRP, which is an advanced version of the Traveling Salesman Problem, or TSP) — using neutral-atom quantum computers as developed and manufactured by Pasqal. These NP-hard problems, where exact approaches require exponential time, are often tackled with classical heuristic methods such as simulated annealing or genetic algorithms. It has been proposed that quantum computers could accelerate the solution of several combinatorial problems such as the VRP and TSP, but generic approaches have so far offered no advantage for these problems.

Project Description
The goal of the QQR project is to develop new hybrid algorithms compatible with the quantum computing platform of industrial partner Pasqal, to solve various combinatorial optimization problems, with particular attention to routing problems such as the Traveling Salesman Problem and the Vehicle Routing Problem. The so-called "analog" quantum computing mode will form the basis of the algorithms to be developed, though other types of algorithms will also be explored, notably those harnessing the combination of digital and analog protocols. These hybrid approaches, which combine insights from quantum algorithms with methods from operations research, take advantage of the ability to reprogram neutral-atom registers as well as the high-fidelity global control of quantum states to implement analog quantum algorithms. In addition to contributing to the development of algorithms and a Python library for the QQR project, the selected doctoral candidate will be expected to develop new analog approaches — based in part on Bayesian optimization, optimal control, and machine learning — to optimize the performance of Pasqal's quantum computer in solving the many sub-problems arising from the hybrid algorithm.

Candidate Profile
The project involves concepts from quantum computing (analog algorithms, neutral atoms, hybrid quantum/classical optimization techniques), numerical and applied mathematics (numerical methods, combinatorial optimization, and operations research), and Python programming. The candidate must hold a master's degree (in physics, engineering, mathematics, or computer science) related to the project, be comfortable with these various concepts, and demonstrate a strong interest in them. A solid academic record is also required.

We welcome and encourage applications from all qualified individuals, particularly those who identify as women, members of underrepresented communities, and people from diverse backgrounds.

Environment

The candidate will have access to both parallel and sequential supercomputers available at the Université de Sherbrooke (http://ccs.usherbrooke.ca/). A PC and the software tools necessary for the work will also be provided. They will be part of a growing research group currently comprising three other doctoral students. In addition, we are part of the dynamic research environment of the Institut Quantique, a research institute that includes more than 30 research groups from the Faculty of Science, the Faculty of Engineering, the Faculty of Letters and Human Sciences, and the School of Management, 25 technical and professional staff members, and more than 200 student and postdoctoral trainees. They will thus benefit from the warm living and working environment of the Université de Sherbrooke, including the facilities of the Institut Quantique, where numerous conferences and social events are held.

Financial Support

The selected candidate will be awarded competitive funding of $32,000 per year for a maximum period of 36 months.

Application

Interested individuals must provide the following:
1) A cover letter;
2) A CV including (i) a list of publications and (ii) the names and contact details of two references.
3) An up-to-date transcript.

Please send an email to victor.drouin-touchette@usherbrooke.ca with the subject “Candidature - QQR”.

Discipline(s) by sector

Sciences naturelles et génie

Génie électrique et génie électronique

Funding offered

Yes

$ 32 000

Partner(s)

Pasqal Canada Inc.

The last update was on 23 April 2026. The University reserves the right to modify its projects without notice.