



Offer #2024-07851

PhD Position F/M Algorithmic aspects of quantum communication

Contract type : Civil Servants Mobility (EU) or Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria research centre in Lyon (previously the Lyon branch of the Inria centre in Grenoble) is the 9th Inria research centre, formally created in December 2021. It brings together approximately 270 people (including 110 Inria employees) in 15 research teams and research support services.

Its staff are distributed at this stage on 2 campuses: in Villeurbanne La Doua (Centre / INSA Lyon / UCBL) on the one hand, and Lyon Gerland (ENS de Lyon) on the other. A third site should be opened in the course of 2022. The teams are mainly hosted with our partners. The centre's teams work closely with research and higher education institutions (ENS de Lyon, UCBL, INSA Lyon, etc.), their laboratories, and other research organisations in Lyon (CNRS, INRAE, competitiveness clusters, etc.), but also with Lyon and regional economic players. Many international collaborations are also underway.

The Lyon centre is active in the fields of software, distributed and high-performance computing, embedded systems, quantum computing and privacy in the digital world, but also in digital health and computational biology.

Context

This project is at the intersection of the fields of quantum information theory, approximation algorithms and optimization. Its objective is to leverage tools from optimization theory in order to build an algorithmic theory of communication that would go beyond the current approach founded by Shannon's paper "A Mathematical Theory of Communication". The goal is to establish efficient algorithms that determine the optimal method for reliable communication using a noisy medium. This approach is particularly appealing in the context of quantum information theory for two reasons : Shannon's approach turned out to be much less successful in the quantum setting and the asymptotic definition of communication rates has less practical relevance as we only have access to small quantum systems.

Assignment

The PhD student will design algorithms to find good coding strategies for a given quantum noise model.

Main activities

The first question to study would be the setting of classical communication over a classical-quantum channel. For any (classical) input x , the output is represented by a positive semidefinite matrix $W(\cdot|x)$. Even though this case is only partly quantum, it does present some technical difficulties that are not present in the classical case. Understanding this case will naturally lead to the more general setting of studying classical communication over a fully quantum channel. The next problem to consider is quantum communication over a fully quantum channel. For all these problems, handling the symmetries to obtain a concise representation will be crucial.

Skills

The applicants should hold a Master degree in theoretical computer science, mathematics or a related field. Familiarity with the basics of quantum information is a requirement.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (90 days / year) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage under conditions

Remuneration

1st and 2nd year: 2 051 euros gross salary /month

3rd year: 2 158 euros gross salary / month

General Information

- **Theme/Domain** : Algorithmics, Computer Algebra and Cryptology
Scientific computing (BAP E)
- **Town/city** : Lyon
- **Inria Center** : [Centre Inria de Lyon](#)
- **Starting date** : 2024-10-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2024-08-02

Contacts

- **Inria Team** : [QINFO](#)
- **PhD Supervisor** :
Fawzi Omar / omar.fawzi@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

The PhD will work under the supervision of Omar Fawzi at Lyon and Mario Berta in Aachen.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

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Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.