Funded Internship / PhD offer

Location : Inria Saclay, Ecole Polytechnique, Palaiseau (Paris), France
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Funded internship (~550€/month) & PhD

Quantum Distributed Computing

The basic situations in which Quantum Information Theory and quantum bits (qubits) of information allow for more efficient distributed algorithms than classical ones are mostly unknown. In particular, it is not known if:
1. quantum strategies outperform classical ones for the pragmatic synchronous distributed computing problem of finding a proper coloring of a loop of N processors. While the best classical solution is in time log*(N), the potential existence of a quantum solution in constant time is an open problem (arXiv:2403.01903, arXiv:2307.09444).
2. it is known that quantum strategies can speed up byzantine agreement protocols, yet no distributed quantum advantage allowing to tolerate more faulty processors is known (arXiv:2409.01707).

The project will be to study the limits of Quantum Information Theory for Distributed Computing. Several directions will be explored:
- Look for proof of existence or inexistence of quantum advantages in the local model, notably focusing one question 1 above.
- Look for proof of existence or inexistence of quantum advantages for byzantine agreements problems

Potential approaches (among many) are new methods using noncommutative polynomial optimization theory (related to Lasserre-Parrilo hierarchy) and C*/Operator algebras, and non convex/ML optimization tools to explore potential quantum strategies.

In case of continuation with a PhD, it may include collaborations with:
- Quantum Distributed Computing: Collaborations with Jukka Suomela (Aalto, Finland), Pierre Fraigniaud, Frédéric Magniez (Paris), Cyril Gavoille, Gilles Zémor (Bordeaux).
- Quantum Info Theory, Polynomial Optimization, C*/Operator Algebra: Nicolas Gisin (Geneva), Antonio Acin (Barcelona), David Gross (Cologne), Omar Fawzi (INRIA Lyon), Victor Magron (Toulouse), Igor Klep (Ljubljana)

In particular, the PhD could involve several 3-months long visits of the group of Jukka Suomela (Aalto, Finland).