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A Gate-Based Quantum Genetic Algorithm for Real-Valued Global Optimisation

Prof Renato Portugal (National Laboratory of Scientific Computing of the Ministry of Science, Technology, and Innovation, Brazil)

Friday, 5 December 2025 | 14h00 – 15h00 SAST

Venues: NITheCS Seminar Room, Merensky Building, Stellenbosch University; and Online

ABSTRACT

We introduce a gate-based Quantum Genetic Algorithm (QGA) for real-valued global optimisation. Solutions are encoded as quantum circuits, with outcomes mapped to real vectors. Evolutionary operators act on circuit structures, supporting fixed- and variable-depth variants. Fitness is evaluated via quantum sampling. Simulations on benchmark functions show that superposition and entanglement improve convergence, reduce fitness values, and enhance robustness. These findings highlight the potential of gate-based QGAs for quantum-enhanced optimisation.

BIOGRAPHY

Prof Renato Portugal is a full researcher at the National Laboratory of Scientific Computing (LNCC) of the Ministry of Science, Technology, and Innovation (MCTI) in Brazil. His research expertise lies in the field of quantum computing, with a strong emphasis on quantum algorithms, quantum walks, and quantum error correction. He has made significant contributions to both the theoretical foundations and the practical development of algorithms that leverage the principles of quantum mechanics to achieve computational advantages. His work ranges from the design and analysis of quantum search algorithms to the mathematical modeling and simulation of quantum walks, which serve as fundamental tools in quantum information processing. He is currently also conducting research in quantum machine learning. In addition, he has advanced studies in algebraic computing and cryptography, bridging classical and quantum paradigms. With over 100 scientific publications, several textbooks, and the widely cited book *Quantum Walks and Search Algorithms*, he has established himself as a leading figure in quantum computing research, recognised for both his theoretical innovations and his mentorship of graduate and postdoctoral researchers in the field.

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