

Turning the Tables in Hybrid Classical-Quantum Systems—Classical Optimization of Quantum Algorithms

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Abstract: Spurred by recent technical advances that have brought us closer to integrating many qubits, quantum technologies promise to revolutionize computation and communication. The applications that capitalize on quantum computing's superior power are vast: quantum communications (with quantum key distribution as the only protocol that guarantees unconditionally secure key growth and quantum teleportation as the driving force of the future quantum internet), quantum algorithms (providing polynomial solutions to NP problems in classical computation), quantum simulation (with accurate molecular quantum dynamics delivering a massive boost in fields such as drug design), and quantum sensors (offering support for gravimetry, seismology, and civil engineering). This talk will present the specificity of quantum computation and stress what makes it more powerful than classical computation, particularly in algorithms; at the same time, it will present the technological limitations that call for hybrid classical-quantum solutions. The primary approach in designing such hybrid algorithms is to bring a quantum optimization or speedup to a classical method. This presentation argues for a different strategy, namely the classical optimization of a quantum algorithm, and illustrates this concept with an application of Grover's algorithm.

Bio: Mihai Udrescu is a computer engineering professor at the Politehnica University of Timișoara with research interests in quantum computing, design automation, computer reliability and testing, complex systems analysis, and machine learning in physiological signals and the Internet of Medical Things (IoMT). He published around 80 papers in these areas.

He has also coordinated 7 research projects and leads the UPT partner in the RoNaQCI project, which will implement Romania's first quantum communication infrastructure. He is an editor of *Frontiers in Network Physiology* (section Fractal Physiology) and *Frontiers in Medical Engineering*. Dr. Udrescu was also a PC member of the International Conference on Hardware/Software Codesign and System Synthesis

(CODES+ISSS) and IEEE Congress on Evolutionary Computation. From September 2019 to February 2020, he was a visiting professor at the Department of Electrical and Computer Engineering at Carnegie Mellon University.