



Philosopher in Residence Fellowship Program (Prof. Roberto Giuntini) Focus Group: Quantum Logic and the Second Quantum Revolution

Seminar Series Quantumness: from Logic to Engineering and back



Venue:

Institute for Advanced Study Lichtenbergstraße 2a Room 0.004 (ground floor)

For any question, contact roberto.giuntini@tum.de **Zoom link on request**

Wednesday, July 03rd 2024, 15:00-16:30

15:00-15:45 Dr. Federico Holik (University of La Plata)

Geometrical aspects of resources distribution in quantum random circuits

15:45 – 16:30 Prof. Martin Schulz (TUM)

Bringing together HPC and QC: it is mainly a software challenge!

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Dr. Federico Holik (University of La Plata)

Geometrical aspects of resources distribution in quantum random circuits

Abstract - In this talk we consider different quantifiers of how quantum a quantum state is [1,2]. We present a numerical study of how entanglement and non-locality are distributed in states generated using quantum random circuits for different sets of elementary gates. We analyze the geometrical aspects of the problem. We also present a brief discussion about how this study could serve as the basis for developing certification protocols, by assessing a quantum computer's ability to produce relevant resources for quantum advantage. Finally, we compare universal vs non-universal sets of elementary quantum gates, in order to achieve a better understanding of the reasons for the speed-up of quantum computers.

[1] A. C. Granda Arango, F. H. Holik, G. Sergioli and R. Giuntini, "Geometrical Aspects Of Resources Distribution In Quantum Random Circuits", arXiv:2405.01650 [quant-ph] (2024).

[2] E. Monchietti, C. Massri, J. A. de Barros, F. H. Holik, "Measure-theoretic approach to negative probabilities", arXiv:2302.00118 [quant-ph]

Short bio - Federico Holik has a degree in physics from the University of Buenos Aires and a Ph.D. in physics from the University of Buenos Aires. He did postdoctoral studies at the Institute of Physics La Plata, and Universite Paris Diderot in Paris. He is currently an "Adjoint Researcher" at the Institute of Physics La Plata, CONICET, and is carrying out a research stay at the University of Cagliari. His work is focused on quantum information theory and the foundations of quantum mechanics.

Prof. Martin Schulz (TUM) *Bringing together HPC and QC: it is mainly a software challenge!*

Abstract - As Quantum Computing systems continue their maturation, their addition to the spectrum of HPC accelerators slowly becomes more viable. For them to be usable, though, we require substantial efforts to integrate the quantum and the HPC ecosystem. On the hardware side, the needed efforts seem straightforward - integrating the quantum control system with lowest possible latency into the HPC network. That's only half of the story though. We must also connect the needed software stacks by bridging their radically different workflows, programming approaches and user expectations.

This talk will highlight how we can achieve these goals and will present the Munich Quantum Software Stack (MQSS), developed as part of the Munich Quantum Valley (MQV) initiative. This software effort aims at providing efficient usage and integration of the quantum systems developed in the MQV and/or hosted at the Leibniz Supercomputing Centre. Beyond that it aims at setting a standard for the integration of HPC and QC as part of the EuroHPC QC efforts.

Short bio - Martin Schulz is a Full Professor and Chair for Computer Architecture and Parallel Systems at the Technische Universität München (TUM), which he joined in 2017, as well as a member of the board of directors at the Leibniz Supercomputing Centre. Prior to that, he held positions at the Center for Applied Scientific Computing (CASC) at Lawrence Livermore National Laboratory (LLNL) and Cornell University. He earned his Doctorate in Computer Science in 2001 from TUM and a Master of Science in Computer Science from UIUC.

Martin's research interests include parallel and distributed architectures and applications; performance monitoring, modeling and analysis; memory system optimization; parallel programming paradigms; tool support for parallel programming; power-aware parallel computing; and fault tolerance at the application and system level, as well as quantum computing and quantum computing architectures and programming, with a special focus on HPC and QC integration.

Martin has published over 250 peer-reviewed papers and currently serves as the chair of the MPI Forum, the standardization body for the Message Passing Interface, one of the dominating standard in High-Performance Computing. He was a recipient of the IEEE/ACM Gordon Bell Award in 2006 and an R&D 100 award in 2011. He served on many conference and workshop organizing and program committees, including as program chair for ISC 2021, general chair of EuroMPI 2021, and Tech-Program Chair of SC25.