RANDOM MATRIX TEHNIQUES IN QUANTUM INFORMATION THEORY (RMTQIT)

Goal of the project

The field of Quantum Information Theory (QIT) attracted lately the interest of scientific community due to the its ambitious goals meant to create new technologic systems (quantum computers) and more secured methods to transmit the information. Nowadays, QIT is a multi-faceted field, with large connections in the subfields of Mathematics, such as Functional Analysis, Operator Theory, Linear Algebra, Probability Theory. The project RMTQIT purposes to give answers to open questions from QIT, using techniques from random matrix theory.

Short description of the project

The project RMTQIT focuses on a systematic exploration of theoretical questions in QIT about random quantum states and random quantum channels. These problems have attracted the attention lately in a very naturally connection to fundamental issues of QIT theory, such as entanglement theory and classical (or quantum) capacities for channels.

Project implemented by

- The Department of Mathematics, University Politehnica Timişoara, Romania
- Laboratoire de Physique Théorique de Toulouse, Université Paul Sabatier Toulouse III, France

Implementation period

1st March 2013-31st August 2016

Main activities

The activities developed within the project RMTQIT in 2016 mainly focused on completing the tasks proposed initially as well as to formulate new issues. It is relevant to mention that the team of the project submitted a joint paper with new results related to the decomposition of an arbitrary operator as a symmetric sum of positive semidefinite operators, focusing mostly on questions about the possible values of the symmetry parameters. The questions we asked are of interest from purely mathematical point of view as well as for its applications in the theory of SIC-POVMs or equiangular tight frames. Our results hold in the most general setting existing for decompositions of positive operators and prove to be useful also for classical set up; for example, for POVM case, we show that extremal decompositions for qubits exist iff the operator (the sum of the decomposition) is scalar. These results have been presented (by M.A. Jivulescu) with several occasions at international conferences and workshops, such as

1. Decomposition of positive operators with applications in Quantum Information Theory, School on Stochastic Methods in Quantum Mechanics, Autran, Franța, July 2016
2. On some decomposition of positive semidefinite operators by symmetric families of operators, Theodor Angheluta Seminar, The 15th International Conference on Applied Mathematics and Computer Science, Cluj-Napoca, July 5-7, 2016
3. Some decomposition of positive semidefinite operators, 26th Conference on Operator Theory, Timisoara, June 2016
4. Sisteme dinamice in teoria informatiei cuantice, Conferința Diaspora, Cercetarea Ştiințifică şi Invățământul Superior din Romania - Diaspora şi prietenii săi, Timisoara, 25-28 April 2016

Results

The main results of the project RMTQIT were resumed in the papers listed below

1. Maria Anastasia Jivulescu, Ion Nechita, Pasc Gavruta-On symmetric decompositions of positive operators-arXiv:1609.05060
2. Maria Anastasia Jivulescu, Nicolae Lupa, Ion Nechita - Thresholds for reduction-related entanglement criteria in quantum information theory- Quantum Information and Computation, vol 15, no 13&14 (2015), pp 1165–1184 (arXiv: 1503.08008)
3. Maria Anastasia Jivulescu, Nicolae Lupa, Ion Nechita, David Reeb - Positive reduction from spectra - Linear Algebra and its Applications 469 (2015) 276–304 (http://arxiv.org/abs/1406.1277arXiv:1406.1277)

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