Recent progress in matrix, graph and operator theory / Progrès récents dans la théorie des matrices, graphes et opérateurs
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Matrix convexity and unitary dilations of Toeplitz-contractive d-tuples

A well-known theorem of P.R. Halmos concerning the existence of unitary dilations for contractive linear operators acting on Hilbert spaces is recast as a result for d-tuples of contractive Hilbert space operators satisfying a certain matrix-positivity condition. Such operator d-tuples satisfying this matrix-positivity condition are called, herein, Toeplitz-contractive, and a characterisation of the Toeplitz-contractivity condition is presented. The matrix-positivity condition leads to definitions of new distance-measures in several variable operator theory, generalising the notions of norm, numerical radius, and spectral radius to d-tuples of operators (commuting, for the spectral radius) in what appears to be a novel, asymmetric way. Toeplitz contractive operators form a matrix convex set, and a scaling constant c_d for inclusions of the minimal and maximal matrix convex sets determined by a stretching of the unit circle S^1 across d complex dimensions is shown to exist.

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Non-Commutative Majorization

The notion of majorization of one self-adjoint $n \times n$ matrix by another is a very useful concept in matrix/operator theory. For example, a classical theorem of Schur and Horn states that a diagonal matrix D is majorized by a self-adjoint matrix B if and only if a unitary conjugate of B has the same diagonal as D. Some equivalent characterizations of A being majorized by B include there existing a doubly stochastic matrix that maps the vector or eigenvalues of B to the the vector or eigenvalues of A, tracial inequalities involving convex functions of A and B, and there exists a mixed unitary quantum channel that maps B to A.

Given the prevalence of qunatum information theory, the following is an interesting question in the context of matrix/operator theory: given m-tuples A_1, ..., A_m and B_1, ..., B_m of $n \times n$ matrices, can a mathematical condition be given for when there exists a unital quantum channel Φ such that $\Phi(B_k) = A_k$ for all k. In this talk, we answer this question using non-commutative Choquet Theory as developed by Davidson and Kennedy.

This talk is based on joint works with Kennedy.

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