Matrix Theory
Théorie matricielle

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ADA SZE SZE CHAN, York University

Complex Hadamard matrices and distance regular graphs

Let A be the adjacency matrix of a graph X on n vertices. The continuous-time quantum walk on a graph X is given by the transition operator e^{-itA}. We say the continuous-time quantum walk on X is instantaneous uniform mixing at time τ if

$$|e^{-i\tau A}|_{uv} = \frac{1}{\sqrt{n}}, \qquad \text{for all vertices } u \text{ and } v.$$

This condition is equivalent to $\sqrt{n}e^{-i\tau A}$ being a complex Hadamard matrix. Hence, if a graph admits instantaneous uniform mixing then its adjacency algebra contains a complex Hadamard matrix. In this talk, we search for complex Hadamard matrices in the adjacency algebra of distance regular graphs.

SHAUN FALLAT, University of Regina

The Rank of Principal Submatrices and a Principal Rank Property

We discuss problems related to the rank of the principal submatrices of a given matrix. Specifically, what properties matrices possess to ensure that their rank can be obtained as the order of the largest invertible principal submatrix. Such a property has been called a principal rank property and is known to hold for symmetric matrices among other classes. In addition to identifying properties of such a matrix, we also obtain a construction in order identify these maximal invertible principal submatrices. This work represents joint research with Dr. Ryan Tifenbach.

DOUGLAS FARENICK, University of Regina

Isometric linear maps of the space of Toeplitz matrices

The structure of linear isometries of the operator system of Toeplitz matrices is determined. This is joint work with M. Mastnak and A. Popov.

JOHN HOLBROOK, U of Guelph

Triply generated matrix algebras

An old result, often called Gerstenhaber's Theorem, states that the algebra of polynomials in two commuting nxn matrices has dimension at most n. Here we discuss the possibility of extending this result to algebras generated by THREE commuting matrices.

HADI KHARAGHANI, University of Lethbridge

(0,1)-matrices arising from Generalized Hadamard matrices

Let G be a group of order n. A $(n,k;\lambda)$-*difference matrix* over G is a $k \times n\lambda$ matrix $D = (d_{ij})$ with entries from G, so that for each $1 \le i < j \le k$, the multiset

$$\{d_{i\ell}d_{j\ell}^{-1} : 1 \le \ell \le n\lambda\}$$

contains every element of the group λ times. The multiplication table in any finite field $\mathbb{F}_n$ forms an $(n,n;1)$-difference matrix. An $(n,n\lambda;\lambda)$-difference matrix over the group G is said to be a *generalized Hadamard matrix*, over the group G. Concentrating on generalized Hadamard matrices arising from finite fields, some very interesting applications which lead to symmetric designs and commutative association schemes will be discussed. This is a joint work with Sara Sasani and Sho Suda.

STEPHEN KIRKLAND, University of Manitoba
On Random Walk Centrality

We consider a notion of random walk centrality for undirected graphs that has been proposed in the literature on complex networks, and show how this notion is naturally related to an accessibility index for the states of a discrete-time, ergodic, homogenous Markov chain on a finite state space. We provide several characterisations of this accessibility index, and establish upper and lower bounds on the accessibility index in terms of the eigenvalues and eigenvectors of the transition matrix for the associated Markov chain. We also investigate the behaviour of the accessibility index under perturbation of the transition matrix, and describe some examples that exhibit counterintuitive behaviour.

ILIAS KOTSIREAS, Wilfrid Laurier University
Goethals-Seidel difference families with symmetric or skew base blocks

We introduce a class of difference families that we call Goethals-Seidel (GS) difference families. They consist of four subsets (base blocks) of a finite abelian group of order v, which can be used to construct Hadamard matrices via the well-known Goethals-Seidel array. We consider the special class of these families in cyclic groups, where each base block is either symmetric or skew. The case where all four blocks are symmetric (Williamson matrices) has been studied extensively and we focus on the remaining three cases. By extending the previous computations by several authors, we complete the classification of GS-difference families of this type for odd $v < 50$.

Joint work with Dragomir Z. Djokovic.

VERN PAULSEN, University of Waterloo
Numerical Ranges and Spectral Sets

We give a new proof of a result of Drury and extend it to the case of matrix-valued polynomials. This talk is based on joint work with K. Davidson and H. Woerdeman.

RAJESH PEREIRA, University of Guelph
Matrix methods for bounding products of zeros of polynomials.

We look at some recent matrix techniques for bounding the products of zeros of polynomials. We give a generalization of the Cauchy and Fujiwara bounds on the zeros of polynomials found using compound matrices and explore possible applications of the weak majorization order to Mahler measure and Lehmer's conjecture.

KEVIN VAN DER MEULEN, Redeemer University College
Polynomial root bounds using intercyclic companion matrices

Using matrix norms, the Frobenius companion matrix has been used to provide bounds on the roots of a monic polynomial. More recently, Fiedler companion matrices have been explored as a source of sharper bounds on the root of a polynomial. We extend some of these results to the larger class of intercyclic companion matrices and compare the new bounds with the old. We include indirect techniques involving the inverse matrix and the monic reversal polynomial.

Joint work with Trevor Vanderwoerd

PETER ZIZLER, Mount Royal University
On Non-stationary Cyclic Convolution and Combination

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We provide results on matrices arising in the non-stationary cyclic convolution and combination and its Fourier Transform. Spectral properties for these matrices, along with results on the non-stationary frequency filtering, are given.