
AARMS-CMS Student Poster Session
Présentations par affiches des étudiants - AARMS-SMC
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LIU ANKAI, Queens University

A Generalization of the Compression Cone Method for Integral Equations with Changing Sign Green's Functions

A new class of cone is proposed as a generalization to the compression cone techniques in studying existence of solutions for integral equations using fixed-point index. As a result, the method is shown to be more adaptable particularly in dealing with integral equations with changing sign Green's functions. We prove new results for semi-linear integral equations. Applications are illustrated by examples. Limitations of such new method are also discussed.

MEHWISH ANWAR, University of Regina

A Connection Between Graphs and the Quantum Group $U_q(\mathfrak{sl}_2(\mathbb{C}))$

We will explore a connection between certain graphs and the quantum group $U_q(\mathfrak{sl}_2(\mathbb{C}))$, as well as applications of this to representation theory. Given a distance-regular, bipartite, and dual bipartite graph, we construct its Terwilliger algebra. We will see how to map $U_q(\mathfrak{sl}_2(\mathbb{C}))$ onto the Terwilliger algebra, which lets us understand the algebraic structure of the latter. A simple example of this involves the cube graph, which we shall consider in detail.

JACK DING, University of Toronto

The Atiyah-Bott Fixed Point Theorem for the Based Loop Group

The Atiyah-Bott fixed point theorem for elliptic complexes is a powerful tool to compute the Lefschetz number of an elliptic operator in terms of data around the fixed points of a compact Lie group action. It has various applications in geometry and representation theory, including a new way to prove the Weyl character formula for semisimple Lie algebras. In that case, the rational functions one multiplies at each fixed point is given by the Weyl denominator.

The based loop group of a compact group K has a natural action by its maximal torus T and a rotation action by the circle S^1 , these two actions commute. We extend the Atiyah-Bott formula to the based loop group of $\Omega SU(2)$ and provide a formula for the rational functions one must multiply at each fixed point of the $T \times S^1$ action. This is done by applying the Atiyah-Bott theorem on a filtration of $\Omega SU(2)$ comprised of finite-dimensional spaces and taking a limit.

FARID GASSOUMOV, York University

Osmotic Pressure of Confined Square Lattice Self-Avoiding Walks

Flory-Huggins theory is a mean field theory for modelling the free energy of dense polymer solutions and polymer melts. In this poster presentation, we use the Flory-Huggins theory as a model of a dense two-dimensional self-avoiding walk confined to a square in the square lattice. The theory described the free energy of the walk well, and we estimate the Flory interaction parameter of the walk $\chi = 0.32$

FARRAH HUNTINGHAWK, Brandon University

Exploring positive operator-valued measures

Positive operator-valued measures (POVMs) arise naturally in quantum mechanics. Here, we study them from a mathematical point of view, employing techniques from operator theory and measure theory.

ROGHAYEH MALEKI, University of Regina
Maschke's Theorem for Table Algebras

We give a generalization of the averaging argument for Maschke's theorem in the setting of table algebras (aka. fusion rings). Table algebras are algebras with involution over \mathbb{C} with finite basis B that contains 1, is $*$ -closed, has non-negative real structure constants $\{\lambda_{bcd} : b, c, d \in B\}$ given by $bc = \sum_d \lambda_{bcd}d$, and satisfies the *pseudo-inverse condition*: $\lambda_{bc1} > 0 \iff c = b^*$, and $\lambda_{b^*b1} = \lambda_{bb^*1}$. When F is a field with (possibly trivial) involution $\bar{\cdot}$ containing the structure constants $\{\lambda_{bcd} : b, c, d \in B\}$, then FB becomes an F -algebra with involution defined by

$$\left(\sum_{b \in B} \alpha_b b \right)^* = \sum_{b \in B} \bar{\alpha}_b b^*.$$

This version of Maschke's theorem gives sufficient conditions on the characteristic of the field F for FB to be a semisimple algebra, in terms of arithmetic properties of the table algebra basis B .

COMFORT MINTAH, University of Guelph
Operator structures and conditions for quantum one-way LOCC

We study the physical description of Quantum Local Operations and Classical Communications (LOCC) and its schematics. We restrict ourselves to one-way LOCC (one of the schemes of LOCC) and discuss detailed analysis in quantum information of recently derived operator relations. We indicate how operator structures such as operator systems and operator algebras naturally arise from these settings and make use of these structures to derive new result and new derivations of some established results in one-way LOCC. We compare perfect distinguishability of one-way LOCC versus arbitrary quantum operations and show the equivalence relation for several families of operators that appear jointly in matrix and operator theory and quantum information theory.

MARIIA SOBCHUK, University of Waterloo
Quantum chromatic number

Chromatic number of the graph is the minimum integer t such that each vertex is assigned one of the t colours, but adjacent vertices receive different colours. Recently, there has been interest in its quantum analogue. Published between 2007 and 2016, papers of Cameron, Mancinska, Roberson and Scarpa provide most of what is known to date about quantum chromatic number, which turns out to be defined in terms of quantum measurements, or a specific set of projections. Interestingly, we will see examples when quantum chromatic number is strictly less than chromatic number of the graph and outline directions of further research.

SUDAN XING, Memorial University of Newfoundland
The general dual-polar Orlicz-Minkowski problem

In this poster, I will present the general dual-polar Orlicz-Minkowski problem, which is "polar" to the recently initiated general dual Orlicz-Minkowski problem and "dual" to the newly proposed polar Orlicz-Minkowski problem. The problem states as follows:

Under what conditions on a nonzero finite Borel measure μ defined on the unit sphere, continuous functions $\varphi : (0, \infty) \rightarrow (0, \infty)$ and $G : (0, \infty) \times S^{n-1} \rightarrow (0, \infty)$ can we find a convex body K (with the origin in its interior) solving the following optimization problems

$$\inf / \sup \left\{ \int_{S^{n-1}} \varphi(h_Q(u)) d\mu(u) : Q \in \tilde{\mathcal{B}} \right\},$$

where $\tilde{\mathcal{B}} = \{Q \in \mathcal{K}_{(o)}^n : \tilde{V}_G(Q^\circ) = \tilde{V}_G(B^n)\}$ with B^n the unit ball and \tilde{V}_G the general dual volume. In particular, we will present the existence, continuity and uniqueness of the solutions for the general dual-polar Orlicz-Minkowski problem. This poster is based on a joint work with Deping Ye and Baocheng Zhu.