



The 3rd International Coding Theory Seminar (3rd ICTS)

Thailand (online)

June 21, 2024

Department of Mathematics, Faculty of Science
Silpakorn University Sanam Chandra Palace Campus, Nakhon Pathom, Thailand

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Organizing committee

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Xiawang Cao (Nanjing University of Aeronautics and Astronautics)

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Hongwei Liu (chair, Central China Normal University)

Gaojun Luo (Nanjing University of Aeronautics and Astronautics)

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Anuradha Sharma (IIIT-Delhi)

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(TBA)

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International advisors

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Patrick Sole (Aix-Marseille Universite, France)

Hong-Yeop Song (Yonsei University, Korea)

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Sawanya Sakuntasathien (Silpakorn University, Thailand)

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Chalermpong Worawannotai (Silpakorn University, Thailand)

Program

All times listed are in Bangkok Time (GMT+7).

Date: June 21, 2024

Time	Activities
11:30 – 11:50 AM	ICTS Committee Discussion
11:50 – 11:59 AM	Inauguration Jon-Lark Kim <i>Sogang University, South Korea</i>
12:00 – 12:45 PM	Characterization of Nearly Self-Orthogonal Quasi-Twisted Codes and Related Quantum Codes Martianus Frederic Ezerman <i>Nanyang Technological University, Singapore</i>
12:45–1:00 PM	Discussion/Break
1:00–1:45 PM	Hulls of Codes, Generalizations, and Applications Somphong Jitman <i>Silpakorn University, Thailand</i>
1:45–2:00 PM	Discussion/Break
2:00–2:45 PM	Polycyclic and serial codes over rings: A transform approach Edgar Martínez-Moro <i>University of Valladolid, Spain</i>
2:45–3:00 PM	Discussion/Break
3:00 PM	Closing Seminar

Talk 1: Characterization of Nearly Self-Orthogonal Quasi-Twisted Codes and Related Quantum Codes

*Martianus Frederic Ezerman*¹ HJ

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Biography

M. F. Ezerman received the double B.A. in philosophy and B.Sc. in mathematics degrees in 2005, and the M.Sc. degree in mathematics in 2007, all from Ateneo de Manila University, Philippines. He obtained the Ph.D. degree in mathematical sciences from Nanyang Technological University (NTU), Singapore, in 2011. He is currently an Adjunct Assistant Professor at NTU and manages a company that develops core cryptographic products. He also advises agencies and corporations on designs, architecture and product assurances. His research interests include coding theory, cryptography, holographic data representations, and quantum information theory.

Abstract

Quasi-twisted codes are used here as the classical ingredients in the so-called Construction X for quantum error-control codes. We refine and generalized Lisonek-Singh construction, more commonly known as Quantum Construction X, by providing a complete treatment on nearly self-orthogonal quasi-twisted codes, covering the Euclidean, Hermitian, trace Hermitian, and symplectic inner products. By examining the algebraic structure of quasi-twisted codes in combination with the respective inner products, we show how to design the hulls. We use the insights gained to apply Quantum Construction X and devise randomized search. We gladly report that the search has found hundreds of record-breaking q -ary quantum codes for $q \in \{2, 3, 4, 5, 7, 8\}$. The codes, upon application of propagation rules, lead to many more record-breaking codes.

Bibliography

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¹A joint work with Markus Grassl (ICTQT, Gdansk, Poland), Ling San (NTU, Singapore), Ferruh Özbudak (Sabanci, Istanbul) and Buket Özkaya (METU, Ankara)

Talk 2: Hulls of Codes, Generalizations, and Applications

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Biography

S. Jitman received the B.Sc. degree from Prince of Songkla University, Thailand, in 2005 and the M.Sc. and Ph.D. degrees in mathematics from Chulalongkorn University, Thailand, in 2007 and 2011, respectively. He was a Research Fellow at the Division of Mathematical Sciences, School of Physical and Mathematical Sciences, at Nanyang Technological University in Singapore for two years prior to returning to Thailand in May of 2013 to become a Lecturer with the Department of Mathematics, Faculty of Science, Silpakorn University. Currently, he is an associate professor at the Department of Mathematics, Faculty of Science, Silpakorn University, Thailand. His research interests cover algebra, number theory, and their applications in classical and quantum coding theory.

Abstract

The hull of a linear code is defined to be the intersection of the code and its dual. Hulls of linear codes have been of interest and extensively studied due to their rich algebraic structures and wide applications. In this talk, characterizations of hulls of linear codes and abelian codes over finite fields are given as well as their existence and constructions. Behaviors of the average dimension of the hulls of cyclic and abelian codes are presented. A generalization of hulls in terms of linear intersection pairs of codes will be briefly discussed. Finally, a brief discussion on their applications in constructions of entanglement-assisted quantum error correcting codes is given together with some illustrative examples. Some open problems will be discussed.

Bibliography

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Jitman, S.: Correction to: Good integers and some applications in coding theory, *Cryptography and Communications*, 10:1203–1203, 2018.
- [4] K. Guenda, S. Jitman, T. A. Gulliver, Constructions of good entanglement-assisted quantum error correcting codes, *Des. Codes Cryptogr.*, 86:121–136, 2018.
- [5] S. Thipworawimon, S. Jitman, Hulls of linear codes revisited with applications, *J. Appl. Math. Comput.*, 62: 325–340, 2020.

Talk 3: Polycyclic and Serial Codes over Rings: A Transform Approach

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Biography

E. Martínez-Moro received the B. Sc. and M. Sc. degree in mathematics at University of Valladolid (Spain) in 1995 and 1997 respectively. He awarded his Ph.D. in Science in 2001 also at University of Valladolid. He was the Vernon Wilson Endowed Chair at the Department of Mathematics and Statistics at Eastern Kentucky University (2013) and currently he is Associate Professor at the Institute of Mathematics at University of Valladolid (Spain). His research interests include subjects related to algebraic coding theory, algebraic geometry, polynomial codes over rings, gradient descent like decoding methods, minimal codewords in codes and post quantum cryptography related to hard coding problems.

Abstract

In this talk, I will review a series of works related to the study polycyclic codes over rings via their Mattson-Solomon transform domain. First, we will tackle the case of codes over finite local rings in the case that the defining polynomials have no multiple roots. This allows us to study them in terms of linear algebra and invariant subspaces as well as understand the duality in terms of the transform domain. We also make a characterization of when two polycyclic ambient spaces are Hamming-isometric. In a second part of my talk, I will show a Generalized Mattson Solomon polynomial for repeated-root polycyclic codes over local rings that gives an explicit decomposition of them in terms of idempotents. This will show some structural properties of repeated-root polycyclic codes over finite fields in terms of matrix product codes. We will not fully cover it in the talk, but just mention that these previous constructions can be also generalized to polycyclic codes in Ore extensions over rings. Finally, as an application we will see how polycyclic codes over serial rings can help in designing quantum codes via the annihilator CSS construction.

Bibliography

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- [2] M. Bajalan, E. Martinez-Moro, Polycyclic codes over serial rings and their annihilator css construction, 2024.
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