The 6th International Coding Theory Seminar (6th ICTS)

Singapore (online)

28 March 2025 from 14:00 to 17:30 SGT

Zoom: https://ntu-sg.zoom.us/j/83773225198?pwd=O4iLQhwbmK9gjrADufWuG6JYKV7R5H.1

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SPMS @ Nanyang Technological University &
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Program

All times listed are in Singapore Local Time (GMT+8) on March 28,2025.

Zoom Link:
`https://ntu-sg.zoom.us/j/83773225198?pwd=O4iLQhwbmK9gjrADufWuG6JYKV7R5H.1`
Meeting ID: 837 7322 5198
Passcode: 458749

Time	Activities	
13:00–14:00	Committee Discussion (by Invitation)	
14:00–14:45	**VU Van Khu** Department of Industrial Systems Engineering and Management, National University of Singapore	Permutation Codes in Levenshtein, Ulam, and Generalised Kendall-tau Metrics
14:45–15:00	Discussion	
15:00–15:45	**Lin SOK** School of Physical and Mathematical Sciences, Nanyang Technological University	On the Hulls of Algebraic Geometry Codes
15:45–16:00	Discussion	
16:00–16:30	Break	
16:30–17:15	**DAO Duc Tu** Genome Institute of Singapore	Efficient Encoding of Binary Constant-Weight Codes: Variable-Length Balancing Schemes à La Knuth
17:15–17:30	Discussion	

Description

Permutation Codes in Levenshtein, Ulam, and Generalised Kendall-tau metrics

VU Van Khu

Department of Industrial Systems Engineering and Management, National University of Singapore

Our main goal in this work is to study permutation codes in the Levenshtein metric which can correct multiple deletions. Permutation codes in the Levenshtein metric are known to have a close relationship with those in Ulam and generalized Kendall-tau metrics. In this work, we present a new connection between different kinds of distances over two permu-tations' including Hamming, Levenshtein, Ulam, and generalized Kendall-tau distance. From this new connection and some known permutation codes in the Hamming metric, we obtain new permutation codes in Levenshtein, Ulam, and generalized Kendall-tau metrics with better size. We also extend our results to multi-permutation codes correcting multiple deletions.

This talk is based on
S. Wang, Y. M. Chee and V. K. Vu, "Permutation Codes in Levenshtein, Ulam and Generalized Kendall-Tau Metrics," 2024 IEEE International Symposium on Information Theory (ISIT), Athens, Greece, 2024, pp. 43-48, doi: 10.1109/ISIT57864.2024.10619128.

The extended version of it is on arXiv `https://arxiv.org/pdf/2406.16656`.

Short Bio: VU Van Khu is currently a Senior Research Fellow at National University of Singapore. Prior to this, he was a Research Fellow at Nanyang Technological University from 2018-2019 and was a Lecturer at Vietnam National University, Hanoi from 2010-2012. He received the bachelor degree in mathematics from Vietnam National Univeristy, Hanoi in 2010 and the PhD degree in mathematics from Nanyang Technological University in 2018. His ultimate research goal is to study and develop mathematical tools in combinatorics, algebra, probability and statistic to invent original coding techniques and new algorithms to solve real world problems. In particular, his research currently concentrates on using combinatorics in coding theory with applications in several data storage systems and communication systems.

On the Hulls of Algebraic Geometry Codes

Lin SOK

School of Physical and Mathematical Sciences, Nanyang Technological University

The hull of a linear code C is the intersection of C with its dual $C^{\perp}$, where the dual is defined with respect to some inner product. The hull dimension of a linear code has been used to compute some parameters of entanglement-assisted quantum error-correcting codes (EAQECCs), a generalization of quantum stabilizer codes.

In this talk, we study linear codes, using tools from algebraic function fields. We explicitly determine the hulls of one-point and two-point algebraic geometry codes. By using the Euclidean or Hermitian method, we derive new EAQECCs with good parameters.

Short Bio: Lin SOK received the B.Sc. degree in mathematics from the Royal University of Phnom Penh, Phnom Penh, Cambodia, in 2003, the M.Sc. degree in discrete mathematics and fundamentals of computer sciences from Université de la Méditerranée-Aix Marseille II, Marseille, France, in 2008, and the Ph.D. degree from Telecom ParisTech, Paris, France, in 2013. From 2013 to 2014, he was a Post-Doctoral Fellow with the Department of Communications and Electronics, Telecom ParisTech. He was a Post-Doctoral Fellow with the School of Mathematical Sciences, Anhui University, China, from 2016 to 2018, and an Assistant Professor from 2018 to 2022. He has been a Senior Researcher with the School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore, since 2023. His research interests include coding theory (codes over rings, algebraic geometry codes, and lattice codes), quantum information theory, and cryptography (bent Boolean functions).

Efficient Encoding of Binary Constant-Weight Codes: Variable-Length Balancing Schemes à la Knuth

DAO Duc Tu

Genome Institute of Singapore

We study and propose schemes that map messages onto constant-weight codewords using variable-length prefixes. We provide polynomial-time computable formulas that estimate the average number of redundant bits incurred by our schemes. In addition to the exact formulas, we also perform an asymptotic analysis and demonstrate that our scheme uses $\frac{1}{2}\log_2(n) + \mathcal{O}(1)$ redundant bits to encode messages into length-n words with weight $\frac{n}{2} + \mu$ for constant μ. We also propose schemes that map messages into balanced codebooks with error-correcting capabilities. For such schemes, we provide methods to enumerate the average number of redundant bits.

This talk is based on
D. T. Dao, H. M. Kiah and T. T. Nguyen, "Efficient Encoding of Binary Constant-Weight Codes: Variable-Length Balancing Schemes à la Knuth," in IEEE Transactions on Information Theory, vol. 70, no. 7, pp. 4731-4746, July 2024, doi: 10.1109/TIT.2024.3351991.

Short Bio: DAO Duc Tu received the Ph.D. degree in mathematics from Nanyang Technological University (NTU), Singapore, in 2023. He is currently a Scientist with the Genome Institute of Singapore. His research focuses on applying combinatorics to genomic data analysis.