IEEE 信息论学会广州分会季报

IEEE INFORMATION THEORY SOCIETY

GUANGZHOU CHAPTER NEWSLETTER

第三期, 2021 年 2 月 No. 3, Feb 2021

主编序语

各位学者：

本期《分会季报》回顾了 ALOHA 多址接入技术的源起、发展并指出新挑战，同时，介绍了优化局部修复码在理论界和设计等方面的最新进展。分会在 2020 年 12 月举办了“中山大学数学与编码国际研讨会”，回顾编码基础、展望编码未来。分会喜讯连传，侯韩旭博士、李聪端博士获得电子学会信息论分会颁发的“信息论青年新星”奖，邢炯跃博士获得“优秀博士学位论文”奖，另外，多名学者获国自然等科研基金资助。

陈立

From the Editor-in-Chief

Dear Chapter Members,

The current issue revisits the beginning and development of ALOHA multiple access technique and its new challenges. Meanwhile, theoretical bounds and design of optimised locally reparable codes are also introduced. In Dec. 2020, the Chapter hosted the SYSU International Workshop on Mathematics and Coding, which revisited the foundation of coding and envisioned its future. Hanxu Hou, Congduan Li were acknowledged with the Chinese Young Information Theory Researcher Award, and Jiongyue Xing was presented the Annual Excellent PhD Dissertation Award, all by the Chinese Institute of Elecronics (CIE) Information Theory Society. Moreover, several scholars of the Chapter won grants from the NSFC and others.

Li Chen

来稿请包含中英文题目、联系人、联系方式、拟投稿栏目，正文可以是中文或英文，不超过 800 字。

The submission should include the title in both Chinese and English, author contacts, and the column that the article belongs to. Content of the article can be both in Chinese or English, and is limited to 800 words.

投稿邮箱/Submission email：

itguangzhou@163.com

目录 •Table of Content •

最新结果 • RECENT RESULTS •

从 ALOHA 随机多址协议谈起

Massive Radio Access & Grant-free Communications.....3

极小距离为 5 和 6 的最优局部修复码理论界的改进与最优构造

Improved Bounds and Singleton-Optimal Constructions of Locally Repairable Codes with Minimum Distance 5 and 6.....6

交流活动 • RESEARCH ACTIVITIES •

“中大数学与编码国际研讨会”成功举办

SYSU International Workshop on Mathematics and Coding.....8

中山大学信息编码与智能传输实验室 ISITA 2020 学习研讨班

ISITA 2020 Seminar of ICIT Lab at SYSU.....10

喜讯 • GOOD NEWS •

中国电子学会信息论分会青年新星和优秀博士论文奖

CIE Information Theory Society Young Researcher Awards and Excellent PhD Dissertation Award.....11

获资助基金

Newly Approved Funds.....12

新书出版

New Book.....14

机会信息 • OPPORTUNITIES •

副教授/助理教授/博士后/博士生招聘

AP/Postdoc/Doctor Positions Opening.....15

新锐风采 • NEW TALENTS •

吕善翔 Shanxiang Lyu.....18

叶旻 Min Ye 19

潘志鹏 Zhipeng Pan.....20

悼念 • EULOGY •

张建康教授 (1960 - 2021) – 绅士、学者

Prof. Jiankang Zhang (1960 – 2021) – A Gentleman and a Scholar.....21

最新结果 • RECENT RESULTS •

从 ALOHA 随机多址协议谈起
Massive Radio Access and Grant-free Communications

Kenneth Shum, The Chinese University of Hong Kong (Shenzhen)
沈颖祺，香港中文大学（深圳）
wkshum@cuhk.edu.cn

The ALOHAnet was developed in the early seventies by a team of faculty and students led by Norman Abramson and Franklin Kuo. It connected the computer terminals in the campuses of University of Hawaii through a wireless radio link. The random access protocol used in ALOHAnet, which is now commonly known as ALOHA, was the model of modern computer networks such as Ethernet and Wifi. One of the design principles behind the ALOHA protocol is simplicity. When a terminal has some data to send, it just sends the data packets at will. If two packet transmissions overlap in time, the collided packets are considered erased, and they are re-transmitted after some random time. Norman Abramson passed away recently in San Francisco at the age of 88. In this article we discuss some recent developments related to ALOHA.

In machine-type communications (MTC) or machine-to-machine (M2M) communications, we want to connect a large number of devices. For example, in a smart manufacturing applications, sensors are deployed to collect data at various locations in a factory, in order to better automate the production process. In healthcare application, we have wearable sensors that continuously measure body temperature and heart rate. Although Wifi 6 (802.11ax) or 5G technologies are able to support a large number of user equipments, they may not be suitable choice in these scenarios, because the devices may not have sufficient computational capability to support the operations in Wifi 6 and 5G standards. Also, in the abovementioned applications, we are not aiming at communication with high throughput. A sensor is designed to be idle for most of the time in order to save power. It becomes active from time to time, and sends a few short packets when it is active.

This type of device activity model is similar to that in the ALOHA channel, namely, at any given time, only a small fraction of the devices is active. Nevertheless, we cannot apply ALOHA directly, because of the absence of a feedback channel from the base station. A wearable sensor may not have enough power to listen to the channel and receive any acknowledgement from the base station. As a result, there is no acknowledgement and re-transmission. A collided packet is simply dropped. It is a challenging task to achieve reliable massive wireless communications with these sort of constraints in hardware and computing power. We consider some research problems in grant-free communications below. The research problems are divided into two types: sourced random access and unsourced random access.

Before we continue the discussion, we first distinguish three different synchronization models.
• Asynchronous system. A transmitter can send a packet at any time. This model is the same as in the original ALOHAnet.
• Slot-synchronous system. Time is divided into slots. The packets are transmitted within the boundary of the slots.
• Frame-synchronous system. A frame consists of N slots for some constant N, and a transmitting pattern is a sequence of N zeros and ones. An active user transmits packets within a frame, according to the assigned zero-one pattern.

In sourced random access, the base station wants to decode the content of the data packet and the identity of the sender. For example, in a fire alarm system consisting of smoke detectors and temperature detectors, we only need to send 1-bit of information – indicating a detected anomaly – but it is important to know the location of the transmitting detector. One solution is to put a unique identifier in the header of each packet. This approach needs not be the best, because the total number of devices could be large, and as a result the identifier is much longer than the payload. Another method is to pre-assign a unique transmitting pattern to each device. An active device then transmits several short packets according to the assigned pattern in a shot-synchronous system. The base station can detect whether a slot is idle or not idle, and tries to identify the senders from the channel activity pattern. The idea is similar to time-division code-division multiple access (TD-CDMA), but with a much larger time scale in comparison to ultra-wideband TD-CDMA.

In a frame-synchronous system, we can use methods from non-adaptive group testing to solve the user identification problem. In a group testing, say, of COVID-19, we collect the blood of T people and put them in N test tubes, in a specially designed manner. The result of a particular test is negative if and only if the subset of people whose blood are in the test are not infected. The objective of a non-adaptive group testing is to identify the infected persons, provided that the total number of infected persons is less than a threshold. It turns out that this problem is very similar to the user identification problem in the frame-synchronous case.

The second type of grant-free multiple access is unsourced communications. The problem formulation was proposed by Polyanskiy in 2017. The salient features in this models are: (i) the receiver is only interested in the data messages but not the identity of the senders; (ii) the users in the system all use the same codebook; and (iii) any permutation of the decoded messages is irrelevant. The design objective is thus very different from the convention multiple-access model. In comparing to the random access protocols described in the previous paragraphs, the system operation in unsourced communications can be fully uncoordinated, because there is no need to pre-assign anything to the devices, which is not an easy task in massive machine-type communications. Slotted ALOHA certainly serves as a benchmark system. We can improve upon slotted ALOHA by using techniques such as successive interference cancellation, message passing algorithms, compressed sensing, irregular repetition slotted ALOHA, etc.

The simple idea in ALOHA random access protocol is not sufficient in massive MTC. More sophisticated coding and signal processing are required to satisfy the requirements in sourced and unsourced communications. This is a very challenging research direction. We list some reference papers below.

References:

[1] N. Abramson, “The ALOHANET – surfing for wireless data” *IEEE Commun. Mag.*, pp.119-123, Dec, 2009.
[2] R. Calderbank and A. Thompson, “CHIRRUP: a practical algorithm for unsourced multiple access,” *Inform. and Infer.: A Journal of the IMA*, no. 9, pp.875-897, 2020.
[3] X. Chen, D. W. K. Ng and W. Yu and E. G. Larsson, “Massive access for 5G and beyond,” *arXiv:2002.03491v2 [cs.IT]*, pp.1-22, Aug, 2020.
[4] H. A. Inan, S. Ahn and A. Ozgur, “A group testing approach to random access for short-packet communication,” *Proc. IEEE Int. Symp. Inf. Theory*, pp.96-100, 2019.
[5] O. Ordentlich and Y. Polyanskiy, “Low complexity schemes for the random access Gaussian channel,” *Proc. IEEE Int. Symp. Inf. Theory*, pp.2528-2532, 2017.
[6] Y. Polyanskiy, “A perspective on massive random access,” *IEEE Trans. Inf. Theory*, pp.2523-2527, 2017.

[7] E. Sandgren, A. Graell i Amat and F. Brannstrom, “On frame asynchronous coded slotted ALOHA: asymptotic, finite length and delay analysis,” *IEEE Trans. Commun.*, vol. 65, no. 2, pp.691-704, Feb 2017.

最新结果 • RECENT RESULTS •

极小距离为 5 和 6 的最优局部修复码的理论界的改进与最优构造
Improved Bounds and Singleton-Optimal Constructions of Locally Repairable Codes with Minimum Distance 5 and 6

Bin Chen, Weijun Fang and Shu-Tao Xia, Tsinghua University
陈斌，方伟军，夏树涛，清华大学
cb17@tsinghua.org.cn, nankaifwj@163.com, xiast@sz.tsinghua.edu.cn

Repair locality has been an important metric in a distributed storage system (DSS). Erasure codes with small locality are more popular in a DSS, which means fewer available nodes participating in the repair process of failed nodes. Locally repairable codes (LRCs) as a new coding scheme have given more rise to the system performance and attracted a lot of interest in the theoretical research in coding theory. The particular concern among the research problems is the bounds and optimal constructions of LRCs. The problem of optimal constructions of LRCs includes the most important case of Singleton-optimal LRCs whose minimum distance achieves the Singleton-like bound. Constructing Singleton-optimal codes with longer length and deriving an upper bound on the maximal code length of such codes has been a hot research topic in coding theory. For example, constructions of the known MDS codes and the famous MDS conjecture belong to this category, which has not been fully solved until now. However, the problem of the maximal code length of a Singleton-optimal LRC is different from the MDS conjecture since the maximal code length of LRC heavily relies the value of its minimum distance. Therefore, many researchers have tried to determine the maximal code length of Singleton-optimal LRC and constructed codes with longer code length. One of the most important work by Guruswami *et al*. have derived a concrete upper bound on n according to the remainder of d module 4. However, known construction of Singleton-optimal LRCs can not exactly achieving this upper bound, which leaves a gap between the lower bound and the upper bound.

In [1], the authors first of all derive an improved and general upper bound on the code length of Singleton-optimal LRCs with minimum distance $d = 5, 6$, some known constructions are shown to exactly achieve our new bound, which verifies its tightness. Note that Singleton-optimal LRCs with locality $r = 2$ and distance $d = 6$ are widely adopted in some real DSS, e.g., Windows Aruze, etc. The authors of [2] have constructed three new Singleton-optimal LRCs whose code length $n = 3(q+1)$, $n = 3(q + \sqrt{q} + 1)$ and $n = 3(2q - 4)$, respectively. Moreover, they obtain a complete characterization for Singleton-optimal LRCs with $r = 2$ and $d = 6$. Such characterization has established an important connection between the existence of Singleton-optimal LRCs and that of a special subset of lines of finite projective plane PG(2, q), thus provides a methodology for constructing LRCs with longer length based on any advance on finite projective plane PG(2, q). In the end, we employ the well-known line-point incidence matrix and Johnson bounds for constant weight codes to derive tighter upper bounds on the code length. These new bounds further help us to prove that some of the previous Singleton-optimal constructions or their extensions achieve the longest possible code length for $q = 3, 4, 5, 7$. Details of construction and comparisons of different bounds were recently published by the authors in [3].

Table I shows the comparisons of upper bounds and lower bounds on n for Singleton-optimal (n, k, 6; 2) LRCs. Here **G** denotes the upper bound proposed by Guruswami *et al.* Note that × denotes the correspond upper bound is not applicable for the specific value of q, * denotes the corresponding

bound is the tightest under the same parameters, and the bold numbers indicates the optimality of n, i.e, the largest possible value of n. Fig. 1 shows that the bounds (44) and (45) are always tighter than the bounds (38) and (39).

Table I Comparisons of Bounds on n for Singleton-optimal (n, k, 6; 2) LRCs

Upper Bound / F_q	**G**	(16)	(38)	(39)	(44)	(45)	(9)	Lower bound on $n_{max}(q, 6, 2)$
$q = 3$	60	12	12	12*	×	×	×	**12** ([3, Theorem 4])
$q = 4$	128	21	18	15	15	15*	15	**15** ([3, Theorem 4])
$q = 5$	234	30	24	21	21	21*	21	**18** ([3, Theorem 4])
$q = 7$	600	57	45	42	39	36*	36	**36** ([3, Theorem 12])
$q = 8$	877	72	57	54	48	45*	45	36 ([3, Theorem 7])
$q = 9$	1230	90	72	66	60	54	51*	42 ([3, Theorem 7])
$q = 11$	2196	132	105	99	84	72	69*	54 ([3, Theorem 7])

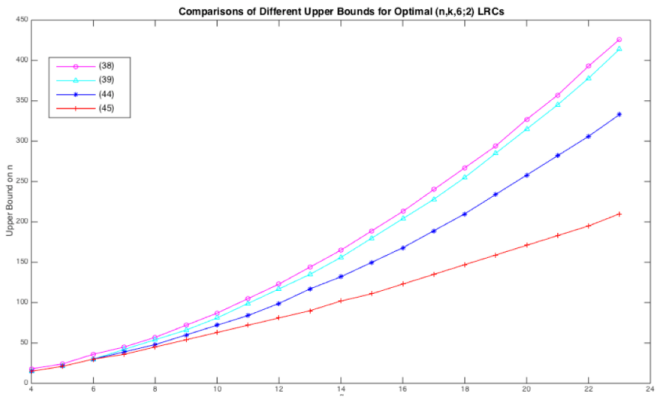


Fig. 1 Comparisons of different upper bounds on optimal (n, k, 6; 2) LRCs.

References:

[1] Bin Chen, Shu-Tao, Xia and Jie Hao, "Improved bounds and Optimal Constructions of Locally Repairable Codes with distance 5 and 6," *Proc. IEEE Int. Symp. Inf. Theory (ISIT)*, Paris, France, Jul. 2019, pp. 2823–2827.

[2] Weijun Fang, Bin Chen, Shu-Tao Xia, and Fang-Wei Fu, "Complete characterization of optimal LRCs with minimum distance 6 and locality 2: improved bounds and constructions," *Proc. IEEE Int. Symp. Inf. Theory (ISIT)*, Jun. 2020, virtual conference, pp. 595–599.

[3] Bin Chen, Weijun Fang, Shu-Tao Xia, Jie Hao and Fang-Wei Fu, "Improved Bounds and Singleton-Optimal Constructions of Locally Repairable Codes with Minimum Distance 5 and 6," *IEEE Trans. Inf. Theory*, , vol.67, no. 1, pp. 217–231, Jan. 2021

交流活动 • RESEARCH ACTIVITIES •

“中大数学与编码国际研讨会”成功举办
SYSU International Workshop on Mathematics and Coding

The Sun Yat-sen University (SYSU) International Workshop on Mathematics and Coding went well during Dec. 2-3 in the University’s Guangzhou South Campus. This workshop was organized by the University and the IEEE Information Theory Society Guangzhou Chapter. More than 80 scholars and industrial partners from mainland China participated the workshop onsite, and more than 50 oversea scholars participated online due to travel restrictions.

Information coding is the key for modern communications, and coding is founded on mathematics. For example, classic channel codes were founded on linear algebra, while modern channel codes had been facilitated by probability and graph theories. The understanding of network coding requires both linear algebra and graph theory. This workshop aims to look back at the mathematics that we have used for designing and practicing codes, so that we can better look forward. It is also hoped that such an event can provide an opportunity for scholars at home and abroad to exchange knowledge and establish collaborations. Pingzhi Fan and Li Chen are the co-chairs of the workshop. The two-day workshop spanned four sessions chaired by Li Chen, Pingzhi Fan, Baoming Bai, and Bazhong Shen, respectively.

The workshop invited fifteen talks. In the morning session of Dec. 2, Alexander Barg of University of Maryland presented his recent results on Stolarsky’s invariance principle for the Hamming space and energy maximization. Jun Chen of McMaster University introduced the duality between Slepian-Wolf coding and channel coding. Li Chen of Sun Yat-sen University presented his recent comprehension on the Gröbner bases in decoding of Reed-Solomon codes, and Paul Siegel of University of California, San Diego, showed the coding technique for efficient DNA synthesis. The afternoon session of the day started with the talk of Erdal Arıkan of Bilkent University, which focused on the polarization adjusted convolutional (PAC) codes. Martin Bossert of Ulm University then presented the information set decoding of BCH codes over binary symmetric channel. The last talk of the day was presented by Bob Li of University of Electronic Science and Technology, China, who gave an intuitive explanation on the commutative algebra in network coding.

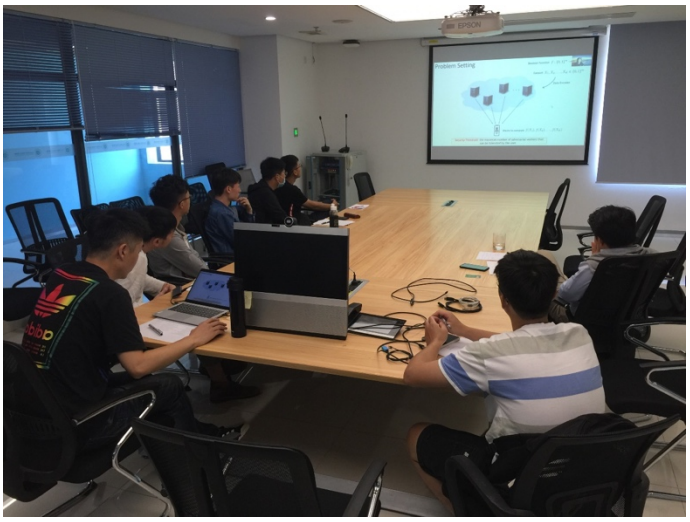
In the morning session of Dec. 3, Frank Kschischang of University of Toronto presented the art and some recent results of zipper codes. Dmitry Trukhachev of Dalhousie University introduced braided block codes, and its structural relation to zipper codes. Hamid Ebrahimzad of Huawei later introduced concatenated polar-zipper codes for optical communications. The last talk of the morning session was given by Kai Niu of Beijing University of Post and Telecommunications, who showed his recent work on characterizing the polar spectrum. The afternoon session of the day started with the talk of Peter Trifonov of Saint Petersburg Polytechnic University, which focused on the trellises, BCH codes, finite fields and successive cancellation decoding. Pingyi Fan of Tsinghua University then presented interpretable generative adversarial networks with exponential function. Fangwei Fu of Nankai University presented optimal cyclic (r, δ) locally repairable codes with unbounded length. The last talk of the workshop was given by Raymond Leung of Huawei, who unwrapped more possibilities by pointing out that coding is not only mathematics.

This has been a successful workshop, especially in face of the pandemic challenge, its hybrid model has tested a new way of conferencing and proliferating research in information theory and coding. The Guangzhou Chapter continues its mission on serving its research community.

交流活动 • RESEARCH ACTIVITIES •

中山大学信息编码与智能传输实验室 ISITA 2020 学习研讨班
ISITA 2020 Seminar of ICIT Lab at SYSU

10 月 28 日，由陈立教授带领的中山大学信息编码与智能传输实验室举办了一场研讨活动，对会议 ISITA 2020 的部分文章进行了集体学习和讨论。ISITA 是由 IEICE 主办、IEEE 协办的会议，与信息论领域密切相关。本次会议采取了线上的方式，文章作者通过视频报告的方式来向参会者分享成果。按照安排，上午实验室团队听取了五场报告，其中两场是针对卷积码的研究，包括其突发错误的理论估计和误帧率的上下界分析。此外，团队还探讨学习了有关于 Coded Computing 和 Mismatch Decoding 等方向的研究工作。



下午，团队集中研讨了两方面的内容，分别是 LDPC 码和 Polar 码。其中有不少与实验室团队工作相关的研究成果，例如对 PAC 码的低复杂度 Fano 译码方案。本次研讨班巩固了实验室团队内良好的学术氛围，保持了对信息论领域新进展的良好嗅觉。我们从会议报告中挖掘了不少新知识，有助于团队发现新的研究思路。

喜讯 • GOOD NEWS •

中国电子学会信息论分会青年新星和优秀博士论文奖
CIE Information Theory Society Young Researcher Awards and Excellent PhD Dissertation Award

2020 年中国电子学会信息论分会颁发了年度“青年新星奖”和“优秀博士论文奖”，本分会的侯韩旭博士、李聪端博士获得本年度“青年新星奖”，邢炯跃博士获得本年度“优秀博士论文奖”，祝贺各位获奖者。

- **侯韩旭博士**

侯韩旭，香港中文大学信息工程系和北京大学电子科学与技术双博士学位，现任东莞理工学院高层次骨干人才，特聘教授，华为理论实验室兼职研究员；主要研究方向包括分布式存储编码，信道编码，网络编码等。侯韩旭博士此次获奖，是由于他在分布式存储编码领域做出的开创性工作。随着大数据时代的到来，分布式存储是存储海量数据的主流存储方式。其中的核心问题就在于如何保障数据的可靠性和可用性。分布式存储编码正是用于解决数据可靠性和可用性的核心理论，因此受到了学术界和工业界的高度关注。目前该理论已被成功应用于华为、Windows Azure 和 Facebook 等分布式存储系统。

- **李聪端博士**

李聪端，中山大学“百人计划”副教授。研究方向包括信息论、网络编码、通信网络、信息安全、车联网等。2015 年博士毕业于美国德雷塞尔大学。曾任德雷塞尔大学讲师，香港中文大学网络编码研究所博士后研究员，香港城市大学计算机科学系博士后研究员。李聪端博士此次获奖，是由于他在多信源网络编码容量域刻画方面做出了贡献。现代通信技术的快速发展是建立在信息理论的基础研究之上的。李博士以香农信息论和计算机辅助为主要研究手段，对通信系统的基础理论开展了重点研究，包括网络信息论以及其在分布式存储，缓存，无线网络以及社交网络的应用等。目前相关研究在多信源多信宿通信系统的通信容量极限、最优编码、安全传输容量和最优安全编码等方面取得了重要学术贡献。

- **邢炯跃博士**

邢炯跃，广东揭阳人，2020 年 6 月获中山大学博士学位，曾在 2018 至 2019 年赴德国 Ulm 大学，访问 Martin Bossert 教授并开展合作研究。他目前就职于华为香港研究所理论实验室。其获奖学位论文题目为《基于模和对偶码字的 Reed-Solomon 码代数软译码》。在导师陈立教授的指导下，邢炯跃博士通过研究模基约简技术和对偶码字的表征特性，结合重编码变换、渐进译码和 Chase 译码等思想提出了若干种高性能低复杂度的新型代数译码算法，通过理论分析和实验仿真等手段揭示算法的性能和复杂度，有效推动了 RS 译码的发展，以期促进其工业化进程。

喜讯 • GOOD NEWS •

获资助基金
Newly Approved Funds

陈立教授、刘凌博士分别获得本年度的国家自然科学基金(NSFC)资助，陈翔副教授团队也获多个 5G 研发项目资助，各项目介绍如下。

- **陈立教授课题组获国家自然科学基金资助面上项目《椭圆码的高效代数译码与应用》**
  The research group led by Li Chen is granted a new NSFC general project titled "Efficient Algebraic Decoding of Elliptic Codes and its Applications"

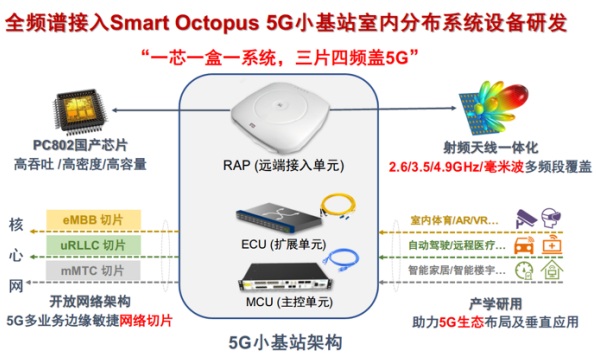
中文摘要： Reed-Solomon (RS)码广为应用在数字通信和存储系统，但它的码长无法超越有限域大小，纠错能力受限。本项目拟研究一套崭新的编码机制 – 椭圆码，它具备更大的码长和更强的纠错能力，获得纠错能力、纠错效率和译码复杂度之间的最佳平衡，可望在将来取代 RS 码。利用椭圆码进行结构性编码，我们还可获得性能优异的中短码，为下一代无线通信网络从"超高可靠"迈向"超低时延"提供技术条件。本项目将以椭圆码的设计、代数译码和应用为主线开展研究，刻画椭圆码的最小汉明距离和重量谱等代数特性，提出基于模最小化插值、渐进插值和重编码变换等前沿技术的高效代数译码，利用椭圆码进行结构性编码，为无线通信、深空通信、光纤通信和数据存储等系统提供新型编码"武器"。由于椭圆曲线广泛应用于数据加密系统，本项目的研究实现了数据加密和编码传输共享代数基础，为未来通信系统内部架构的融合创造条件。

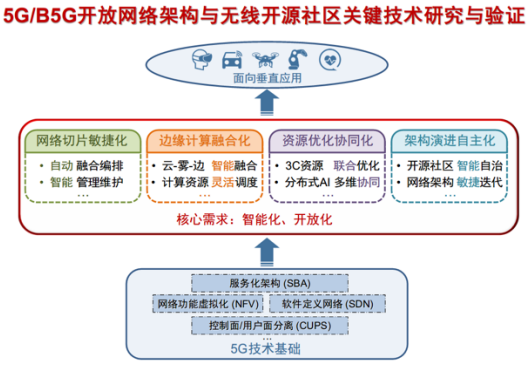
- **刘凌博士获国家自然科学基金资助青年项目《面向高斯网络的极化格码研究》**
  Dr. Ling Liu is granted a new NSFC young scholar project titled "On the Design of Polar Lattices for Gaussian Networks"

中文摘要: 建立高效和可靠的网络数据传输方案是现代网络通信中的热点需求。相较于传统的点对点数据传输模型，网络传输系统模型更为复杂。同时，日益增长的用户数量以及传输速率需求使得对多终端通信系统形成更成熟的理论分析和更完善的传输方案越来越具有现实意义。新兴的极化格码作为极化码和格码的结合，适用于连续信道模型且可逼近其信道容量。本项目拟将极化格码应用于高斯网络，主要包括高斯广播信道、高斯多址接入信道、以及高斯双向中继信道，并实现以上信道模型下的最优容量区域，从理论和仿真两方面验证结果。拟采用的技术包括信道极化技术、信源极化技术、分层格码构造以及离散高斯分布塑性等。极化格码以其对偶的信道信源编码特性、丰富的线性结构、以及灵活的分层设计理念，为研究现代高斯网络编码，尤其高斯双向中继信道下逼近香浓极限的计算转发(compute-and-forward)方案提供了必要的设计思路和分析手段。

- **陈翔副教授带领的中山大学 I3C 实验室获多个 5G 科研项目资助**
  The SYSU I3C Lab led by Xiang Chen is granted several 5G research projects

2019 年起，全球 5G 开始进入商用部署的关键期和技术发展的快速期。中山大学陈翔老师带领的集成智能信息与通信（Integrated Intelligent Information and Communication, I3C）实验室长期致力于 5G 领域研究，紧跟前沿技术发展，近两年牵头或参与联合申报的多个 5G 相关项目先后获得立项！





2019 年底，由超讯通信牵头、I3C 实验室代表中山大学参与申报的 2019 年广东省重点领域研发计划项目“全频谱接入 Smart Octopus 5G 小基站室内分布系统设备研发”入选立项，获批广东省科技厅项目资金扶持。该项目以构建具备自主知识产权的 5G 小基站生态建设为目标，围绕“一芯一盒一系统，三片四频盖 5G”的研发思路，重点研究 5G 小基站国产芯片设计研发、5G 多业务边缘敏捷网络切片等系列关键技术。

2020 年中，陈翔老师牵头申报的国家重点研发计划——政府间/港澳台专项“5G/B5G 开放网络架构与无线开源社区关键技术研究与验证”顺利通过评审，并于 11 月份正式获批立项，参与单位包括清华大学、北京大学、北京邮电大学、北京理工大学、西安电子科技大学、FuTURE 论坛六家陆方单位及台湾交通大学、台湾科技大学两家海峡对岸合作单位。该项目将立足于两岸始于 2016 年的 Open 5G 无线开源社区研究基础，重点推进智能化 5G/B5G 开放网络架构技术研究及原型样机研制和示范系统构建，打破各自封闭的技术体系，朝 B5G/6G 开放、智能无线网络框架体系迈进，并希望带动无线开源协同创新环境建设，促进两岸 ICT 产业在 5G/B5G 时代的进一步深度融合。

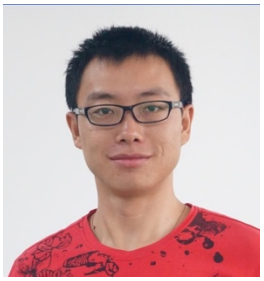
2021 年 1 月，由广东移动牵头、I3C 实验室代表中山大学参与申报的 2020 年广东省重点领域研发计划项目“面向垂直行业的 5G 关键技术研究与系统验证”也顺利获批立项。该项目将重点研究 5G 分布式定位增强服务、智能裁剪技术和云网边协同智能化等技术，以期推进 5G 先进技术在垂直行业中的落地和持续演进。

目前，I3C 实验室已经完成从省级到国家级研发项目在 5G 系统技术研发方面的全面布局，未来 3 年将全力投入相关核心技术攻关，并深度参与 5G 研发与产业化进程，立足于广东省在 5G 领域的技术发展优势，助力 5G 的全面商用！

喜讯 • GOOD NEWS •

新书出版
New Book

2020 年 12 月，由赵山程、马啸和白宝明三位学者合著的《多元 LDPC 码及其应用》由西安电子科大学出版社正式出版，三位作者分别来自暨南大学、中山大学和西安电子科技大学。本书总共包含六章，总结了三位作者近十年在多元 LDPC 码领域的主要研究成果。本书详细介绍了多元 LDPC 码的基础，多元 LDPC 码的经典构造方法，多元 LDPC 码的低复杂度译码算法以及多元 LDPC 码在编码调制与复杂通信系统中的应用，可作为通信专业研究生的参考教材和相关领域从业人员的参考材料。



赵山程
Shancheng Zhao

马啸
Xiao Ma

白宝明
Baoming Bai

机会信息 • OPPORTUNITIES •

副教授/助理教授/博士后招聘，暨南大学
AP/Postdoc Positions Opening, Jinan University

Jinan University is a key comprehensive university which is listed in '211 Project' and jointly constructed by Overseas Chinese Affairs Office of the State Council, Ministry of Education of the People's Republic of China and Guangdong Province.

The College of Cybersecurity of Jinan University, founded in 2015, is aggressively recruiting associate professors/assistant professors/postdoc at home and abroad, and sincerely invites young talents to join.

1. Recruit Fields

Information theory and coding, Cybersecurity, Cryptography, Computer Science, etc.

2. Recruit Positions

- *Associate Professor:* The applicant should have a PhD degree from a well-recognized University or research institute, a strong independent research capability and high academic achievements. Applicants should demonstrate their potential in academia. The applicant should not exceed 40 years old.

- *Assistant Professors:* The same as above but the applicant should not exceed 35 years old.

- *Postdoc:* The applicant should have a PhD degree and an appropriate amount of publications. They should not exceed 35 years old.

3. How to Apply

- Applicants submit their CV (including date of birth, education history, working experience, publications, awards, etc.) to Mrs. Zhu at the following Email address: oxky@jnu.edu.cn. Tel: 020-85220448/ 85224493

- The College will review the applications and if suited, the applicants will be contacted. They will be sent the application form, and guided the preparation of other application materials, including references.

We remain dedicated to widely recruiting excellent teachers and equipping the College of Cybersecurity with advanced teaching conditions. Jinan University carries out the mission of continuing distingue spirits for past sages along with establishing best disciplines as well as a top university for all future generations so that it be entitled with one of the prestigious universities in China or even in Asia.

机会信息 • OPPORTUNITIES •

博士生招聘，俄亥俄州立大学
Research Assistant Openings, The Ohio State University

Prof. Xinmiao Zhang is looking for highly-motivated Ph.D. students to join her lab (vlsiArc.engineering.osu.edu) at the Department of Electrical & Computer Engineering of The Ohio State University. Our graduate program is ranked at 22nd in the most recent US News ranking.

In particular, 2 RA positions are available in Fall 2021 for error-correcting codes, cryptography, and their hardware accelerator design. These projects are in collaboration with high-tech companies. Internships may also be available through the project. Good math and analytical background is required. Prior experience on error-correcting coding, digital communications, or related topics is preferred. These research does NOT require advanced knowledge on circuit design. Basic understanding of digital logic design from a sophomore course is sufficient.

The research of our group spans the areas of coding schemes and system architecture design for next-generation memories and digital communications, hardware security, post-quantum cryptography, and machine learning. Our research translates theoretical advancements to highly efficient practical implementations through integrated algorithmic and architectural optimizations. Students interested in these research areas are also encouraged to apply.

Interested students may send the CV and transcripts in PDF to Prof. Zhang (zhang.8952@osu.edu). Applications to our Ph.D. program can be submitted through

https://gpadmissions.osu.edu/apply/grad.html, and the deadline can be extended.

机会信息 • OPPORTUNITIES •

副教授/助理教授/博士后招聘，中山大学
AP/Postdoc Positions Opening, Sun Yat-sen University

Li Chen, Sun Yat-sen University
陈立，中山大学
chenli55@mail.sysu.edu.cn

The Information Coding and Intelligent Transmission (ICIT) Laboratory of the School of Electronics and Information Engineering, Sun Yat-sen University is recruiting associate professors/assistant professors/postdoc at home and abroad, and sincerely invites young talents to join. The lab is directed by Prof. Li Chen.

1. Recruit Field

Information theory and coding, *Computation for information theory*, *Intelligent networks*

2. Recruit Positions

- *Associate Professor:* The applicant should have a PhD degree from a well recognized University or research institute, a strong independent research capability and high academic achievements. Applicants should demonstrate their potential in academia, and have at least 3 years working experience at home or abroad. In general, the applicant should not exceed 40 years old.

- *Assistant Professors:* The same as above but the applicant should not exceed 35 years old.

- *Postdoc:* The applicant should have a PhD degree and an appropriate amount of publications. They should not exceed 35 years old.

3. How to Apply

- Applicants submit their CV (including date of birth, education history, working experience, publications, awards, and etc.) to Prof. Li Chen, with email subject specifying the type of job position.

- The lab and the School will review the applications and if suited, the applicants will be contacted. They will be sent the application form, and guided the preparation of other application materials, including references.

- A School interview will be further arranged. If approved, a University interview will be needed for AP applicants.

新锐风采 • NEW TALENTS •

Shanxiang Lyu (吕善翔) received the B.S. and M.S. degrees in electronic and information engineering from South China University of Technology, Guangzhou, China, in 2011 and 2014, respectively, and the Ph.D. degree from the Electrical and Electronic Engineering Department, Imperial College London, UK, in 2018. He is currently a lecturer with the College of Cyber Security, Jinan University. He is the PI of 5 projects (Total Funding Amount: CNY 1M). He has authored 8 papers in the IEEE Transactions, which have been cited in IEEE T-IT, CRYPTO etc. He has given invited talks in Oxford University, Tsinghua University, etc. He received the superstar supervisor award of the National Crypto-Math Challenge of China in 2020. He serves as the Inscrypt 2020 organizing chair, IJCAI 2020 PC member, and the reviewers of IEEE Trans. Information Theory, IEEE Trans. Signal Processing, IEEE Trans. Communications, IEEE Trans. Wireless Communications, IEEE CL, IEEE Access, ISIT, ISITA, etc. His research interests are in lattice theory, algebraic number theory, and their applications.

[1] **Lyu Shanxiang**, Antonio Capello, Ling Cong, "Ring Compute-and-Forward over Block Fading Channels," *IEEE Transactions on Information Theory*, vol. 65, no. 11, pp. 6931-6949, Nov. 2019.

[2] **Lyu Shanxiang**, Ling Cong, "Hybrid Vector Perturbation Precoding: The Blessing of Approximate Message Passing," *IEEE Transactions on Signal Processing*, vol. 67, no. 1, pp. 178-193, Jan. 2018.

[3] **Lyu Shanxiang**, Ling Cong, "Boosted KZ and LLL Algorithms," *IEEE Transactions on Signal Processing*, vol. 65, no. 18, pp. 4784-4796, 2017.

[4] **Lyu Shanxiang**, Wen Jinming, Weng Jian, Ling Cong, "On Low Complexity Lattice Reduction Algorithms for Large-Scale MIMO Detection: The Blessing of Sequential Reduction," *IEEE Transactions on Signal Processing*, vol. 68, pp. 257-269, 2020.

[5] **Lyu Shanxiang**, Christian Porter, Ling Cong, "Lattice Reduction over Imaginary Quadratic Fields," *IEEE Transactions on Signal Processing*, 2020, to appear.

新锐风采 • NEW TALENTS •

Min Ye (叶旻) received his B.S. in Electrical Engineering from Peking University, Beijing, China in 2012, and his Ph.D. in the Department of Electrical and Computer Engineering, University of Maryland, College Park in 2017. He then spent two years as a postdoctoral researcher at Princeton University. Since 2019, he has been an assistant professor in the Data Science and Information Technology Research Center, Tsinghua-Berkeley Shenzhen Institute, Tsinghua Shenzhen International Graduate School, Shenzhen, China. He received the 2017 IEEE Data Storage Best Paper Award. His research interests include coding theory, information theory, differential privacy, and machine learning. He taught the graduate course "Probability Theory" at TBSI. His recent research interests include statistical estimations, applying machine learning techniques to decoding problems, community detection, and some long-standing coding theoretic problems.

The main publications are listed as below.

[1] **Min Ye** and A. Barg, "Explicit constructions of high-rate MDS array codes with optimal repair bandwidth," *IEEE Transactions on Information Theory*, vol. 63, no. 4, pp. 2001–2014, April 2017.

[2] **Min Ye** and A. Barg, "Explicit constructions of optimal-access MDS codes with nearly optimal sub-packetization," *IEEE Transactions on Information Theory*, vol. 63, no. 10, pp. 6307–6317, Oct. 2017.

[3] **Min Ye** and A. Barg, "Optimal Schemes for Discrete Distribution Estimation under Locally Diffffferential Privacy," *IEEE Transactions on Information Theory*, vol. 64, no. 8, pp. 5662–5676, Aug. 2018.

[4] **Min Ye** and E. Abbe, "Communication-Computation Effiffifficient Gradient Coding", *Proceedings of the 35th International Conference on Machine Learning (ICML)*, Stockholm, Sweden, 2018, pp. 5610–5619.

[5] I. Tamo, **Min Ye**, and A. Barg, "Optimal repair of Reed-Solomon codes: Achieving the cut-set bound," *Proc. 58th Annual IEEE Symposium on Foundations of Computer Science (FOCS)*, Berkeley, CA, 2017, pp. 216–227.

新锐风采 • NEW TALENTS •

Zhipeng Pan（潘志鹏） received the B.S.，M.S. and Ph.D degree in information and communication engineering from the National University of Defence Technology (NUDT), Changsha, China, in 2014，2016 and 2020, respectively. His research interests include advanced multiple access techniques, channel coding and iterative decoding. During his Ph. D. studies, he proposes two joint iterative detection and decoding (JIDD) algorithms (JIDD-MPA and JIDD-SD) which are based on the message propagation algorithm (MPA) and the soft input and soft output MBQR-SD algorithm, respectively. For the spatial multiplexing MIMO-SCMA system, he proposed a block-wise sorted QR decomposition algorithm (BQR) that is suitable for SCMA multi-dimensional codeword detection. For spatial modulation system, the design of SCMA based on spatial modulation (SM-SCMA) is studied and a message passing detection algorithm (MPA) that can jointly detect antenna index and symbol index is proposed by him.

[1] **Pan Z**, Li E, Zhang L, et al., "Design and Optimization of Joint Iterative Detection and Decoding Receiver for Uplink Polar Coded SCMA System," *IEEE Access*, vol. 6, pp. 52014-52026, 2018.

[2] **Pan Z**, Li E, Wen L, et al., "Joint Iterative Detection and Decoding Receiver for Polar Coded SCMA System," 2018 *IEEE International Conference on Communications Workshops (ICC Workshops)*, 2018, pp. 1-6.

[3] **Pan Z**, Luo J, Lei J, et al., "Uplink Spatial Modulation SCMA System," *IEEE Communications Letters*, vol. 23, no. 1, pp. 184-187, Jan. 2019.

[4] **Pan Z**, Liu W, Lei J, et al., "Multi-dimensional Space Time Block Coding Aided Downlink MIMO-SCMA," *IEEE Transactions on Vehicular Technology*, vol. 68, no. 7, pp. 6657-6669, Jul. 2019.

[5] **Pan Z**, Lei J, Liu W, et al., "Grant-Free Rateless SCMA for Cellular Internet of Things Networks," *IEEE Access*, vol. 7, pp. 147954-147961, 2019.

悼念 • EULOGY •

张建康教授 (1960 - 2021) – 绅士、学者
Prof. Jiankang Zhang (1960 – 2021) – A Gentleman and a Scholar

Kon Max Wong, McMaster University, Zhengzhou University
黄斡，麦克马斯特大学，郑州大学
wongkm@mcmaster.ca

Prof. Jiankang Zhang was found dead in his sleep on 17 January, 2021, apparently suffering from a severe heart attack. He left his widow Ms. Xiaoyan Liu and their son Shuai Zhang. With a heavy heart, I grieve the loss of a very close colleague and a very close friend.

Jiankang came to work for me as a post-doctoral fellow at McMaster in late 1999, being highly recommended by his PhD supervisor Prof. Bao Zheng, who was one of the most eminent scholars in Signal Processing. Jiankang came to McMaster very well equipped with mathematical tools and analytical techniques. I was particularly impressed with his mathematical modelling skills and his physical interpretations of mathematical operations and analytic outcomes. His ceaseless creativity quickly brought a refreshing atmosphere to my research group. While initially he was assigned to work on wavelets, very soon Jiankang also became involved with some of the on-going PhD research projects in my group. Inspired by his rigorous analytic approach, my research students, one after another, produced excellent results and their theses were all awarded prizes. I was amazed at how students worked so well under his influence and gradually let him carry out more and more tasks of co- supervision, meanwhile grooming him to be a possible faculty member of our department by first improving his command of the English language, both spoken and written. Jiankang responded well to my initiative by working very hard at it. Our first joint paper on adaptive filtering took multiple iterations of writing and re-writing, even though he was only responsible to write one section. The paper finally appeared in 2002. Like with many other things, Jiankang was a good learner. The writing of the second paper was a bit easier, and subsequent papers were easier still.

Meanwhile, Jiankang was offered a similar position at Harvard working with Alex Kavcic. I could not deny him such an opportunity and allowed him to take a leave of absence from my research group. Jiankang returned to McMaster a year later and right away dove into his old job again. Together with some of my students, we turned the prize-winning theses into a series of papers published in top- notched journals (two of them actually received IEEE awards). Then, it was time for me to recommend Jiangkang to become a faculty member of the department. It was not an easy job either, for there were strong competitions, but Jiankang prevailed, and joined our department as a faculty in 2007.

For a good career at McMaster, a junior faculty member must be able to show independent development of his research. Thus, the direct collaboration between Jiankang and I was greatly reduced. While he continued his relentless pursuit on MIMO wireless communications, I focused my attention on other issues of signal processing. However, that did not stop us consulting or exchanging research ideas with each other, nor did it curb the cross-fertilization between our two groups of students. Jiankang's subsequent development on his own was no less than astounding, and, after some years of persistent hard-work, he became widely recognized as an international authority in

wireless communications and was invited to join the editorial boards of several prestigious learned journals.

Jiankang was a scholar and a gentleman in the true sense of the words. A scholar because he was utterly dedicated to his research and teaching, and he would fiercely fight to overcome any hurdle on his way to scientific truth. A gentleman because he would carry out his duties to the utmost and would passionately defend the integrity of his work. He treated his colleagues with great respect and genuine sincerity and was ready to lend a hand of assistance whenever needed. His students to him were like his own children, on whom he showered love and care, and yet his strictness to them was unbending when it came to their work. As a co-worker, he never complained about his share of work, no matter how tedious it might be, and as a research fellow, he never asked for any reward, financial or otherwise, in return for his hard work. His sudden passing away is not only a great shock to everybody, but represents a huge loss to many of us --- the loss of a great researcher, the loss of a fatherly supervisor, the loss of an ideal collaborator, and above all, the loss of a true friend and a good person!

Early last year, I invited him to join our newly formed quantum technology research group, to which he enthusiastically agreed. We started very well, working together even through the excruciating circumstances of COVID'19, and beginning to see fruitful results. I am afraid that this group will just have to continue without Jiankang's participation from now on.

May he rest in peace!