

Recent Interests and Progress

Hung-Lin Fu (傅恒霖)

Department of Applied Mathematics
National Chiao Tung University, Taiwan
30010

1. Constructing Special Codes

Conflict-avoiding code $CAC(n,k)$

- Length n
- Hamming weight k
- Inner product of arbitrary **cyclic shift** of any two distinct codewords is either 0 or 1.

$$(1\ 0\ 0\ 1\ 0)$$

$$(1\ 1\ 0\ 0\ 0)$$

Objective

Given n and k , maximize M .

- **Optimal** CAC : a CAC with maximum size
- $M(n, k)$: the size of an optimal CAC(n, k)

We are interested in **odd** n and $k = 3$, and $k = 4$.

Optimal CACs for prime power

Theorem

Let $p > 3$ be a non-**Wieferich** prime. Then
for $r \geq 1$,

$$M(p^r, 3) = \frac{1}{4}(p^r - pr + r - 1) + rM(p, 3).$$

On weight 4

- If $n = 3^d$, then $M^e(n) = (n - 1)/8$ provided d is even and $M^e(n) = (n - 3)/8$ provided d is odd.
- If $n = 2 \cdot 3^d$, then $M^e(n) = (n + 2)/8$ provided d is even and $M^e(n) = (n - 2)/8$ provided d is odd.
- For general $n = 6k$, extra effort is needed!
Keep working. (Preprints)

Progress

- M. Mishima, H. L. Fu and S. Uruno, Optimal conflict-avoiding codes of length $n \equiv 0 \pmod{16}$ and weight 3, Des. Codes Cryptogr., 2009.
- H. L. Fu, Yi-Hean Lin and M. Mishima, Optimal conflict-avoiding codes of even length and weight 3, IEEE Trans. Inf. Theory, 2010.
- H. L. Fu, Yi-Hean Lin and M. Mishima, Errata to “ Optimal conflict-avoiding codes of even length and weight 3, IEEE Transaction Information Th., Vol. 57, No. 8, Aug. 2011, 5572.
- H. L. Fu, Y. H. Lo and K. W. Shum, Optimal conflict-avoiding codes of odd length and weight three, Des. Codes Cryptogr., 2012, to appear.
- S. L. Wu and H. L. Fu, Optimal tight equi-difference conflict-avoiding codes of length $2^q \pm 1$ and weight three, JCD, 2012, to appear.
- H. L. Fu, Yi-Hean Lin and Y. H. Lo, Optimal tight equi-difference conflict-avoiding codes with weight 4, in preprints.

2. Constructing Pooling Designs

- We focus on **non-adaptive algorithms** for various models, but adaptive or 2-stage algorithms are also considered for special type of **group testings**. Mainly, special disjunct matrices are utilized for non-adaptive algorithms.

Progress:

- An upper bound of the number of tests in pooling designs for the **error-tolerant complex model** (with H. B. Chen and F. K. Hwang), Optimization Letters, 2(2008), no. 3, 425-431.
- Nonadaptive algorithms for **threshold** group testing (with H. B. Chen), Discrete Applied Math., 157(2009), 1581-1585.

Continued ...

- Identification and classification problem on pooling designs for **inhibitor** models (with Hui-Lan Chang and Hong-Bin Chen), J. Comput. Biology, Vol. 17 (2010), No. 7, 927-941.
- **Reconstruction of hidden graphs and threshold** group testing (with Hui-Lan Chang, Hong-Bin Chen and Chi-Huai Shih), J. Combin. Optim., 22(2011), no. 2, 270 – 281.
- Group testing with **multiple mutually-obscuring positives** (with Hong-Bin Chen), LNCS, to appear.
- Threshold group testing on **inhibitor** model (Huilan Chang and Chie-Huai Shih), in preprints.

3. Find the Average Information Ratio of Perfect Secret Sharing Schemes Whose Access Structures Are Graph Based

- We mainly apply the idea of covering a graph with complete multipartite graphs to tackle this problem. Of course, knowing the graph structure is also essential.

Progress:

- The exact values of the average information ratio for **tree-based** access structures of perfect secret sharing schemes (with Hui-Chuan Lu), Des. Code Crypt., to appear.

Continued ...

- New bounds on the average information rate of secret sharing schemes for graph-based **weight threshold access structures** (with Hui-Chuan Lu), in preprints.
- The optimal average information ratio of perfect secret sharing schemes for the access structures based on **bipartite graphs** (with Hui-Chuan Lu), in preprints.

Others

We have some results on decycling sets and edge-colorings:

- Feedback vertex set of **planar graphs** (with Hong-Bin Chen and Chie-Huai Shih), TJM, to appear.
- The decycling number of **outerplanar graphs** (with Huilan Chang and Min-Yin Lien), J. Combin. Optim., to appear.
- The decycling number of **$P_m \square P_n$** (with Min-Yin Lien and Chie-Huai Shih), in preprints.
- Edge chromatic critical **graphs with high maximum degree** (R. Lou and Y. Zhao), in preprints.