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OFFICE OF NAVAL RESEARCH

PUBLICATIONS/PATENTS/PRESENTATIONS/HONORS REPORT

for

1 October 1989 through 30 September 1990

for

Grant NO0014-90-J-1341

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"MATHEMATICAL METHODS OF COMMUNICATION SIGNAL DESIGN"

Principal Investigator: Dr. SOLOMON W. GOLOMB

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Department of Electrical Engineering/Systems  
University of Southern California  
Los Angeles, CA 90089-0272

EXEMPT FROM PATENTING  
As required by 35 USC 262  
35 USC 262

## PROGRESS REPORT, 1 October 1989 - 30 September 1990

### a. Papers submitted to refereed journals (and not yet published):

- i. Paul Erdos, Ronald L. Graham, Imre Ruzsa, and H. Taylor, "Bounds for Arrays of Dots with Distinct Slopes or Distinct Differences," to appear in *Combinatorica*.
- ii. H. Taylor, "Florentine Rows or Left-Right Shifted Permutation Matrices with Cross Correlation Values  $\leq 1$ ", accepted for publication in the special issue of Graph Labelling of *Discrete Mathematics*, 1989-90.
- iii. H. Taylor, "A Distinct Distance Set of 9 Nodes in a Tree of Diameter 36," accepted for publication in the Special Issue on Graph Labelling of *Annals of Discrete Math.*, 1989-90.
- iv. T. Etzion, S.W. Golomb, and H. Taylor, "Polygonal Path Constructions for Tuscan-k Squares," submitted to *Ars Combinatoria*, December 1986. (Accepted for publication.)
- v. T. Etzion, "Combinatorial Designs with Costas Arrays' Properties,": to appear in the Special Issue on Graph Labellings of *Annals of Discrete Math.*, 1989-1990.
- vi. T. Etzion, "An Algorithm for Realization of Permutations in a Shuffle-Exchange Network," submitted to *Information Processing Letters*, January 1987.
- vii. T. Etzion, "Constructions and Complexity Distributions of de Bruijn Sequences," submitted to the *Siam Journal on Computing*.
- viii. H. Taylor, "The Ungracefulness of an Extended Pentagon for a Problem Posed by Knuth," to be submitted for publication.
- ix. S.W. Golomb, R.E. Peile, and H. Taylor, "Non-Linear Shift Registers that Produce all Vectors of Weight  $< t$ ," to appear in *IEEE Transactions on Information Theory*.
- x. S.W. Golomb and N. Zhang, "On the Cross Correlation of Generalized Barker Sequences," *IEEE Transactions on Information Theory*, vol. IT-36, no. 6, November 1990, pp. 1479-1480.
- xi. S.W. Golomb and Gregory Mayhew, "Reciprocal Recursions for Modified de Bruijn Sequences," submitted to the *IEEE Transactions on Information Theory*.
- xii. S.W. Golomb and Gregory Mayhew, "Reducing Upper Bounds on de Bruijn Weight Classes," submitted to the *IEEE Transactions on Information Theory*.
- xiii. S.W. Golomb, Karl Dahlke, and H. Taylor, "An Octomino of High Order," accepted by *Journal of Combinatorial Theory, Series A*.

- xiv. H.Y. Song, H. Taylor and S.W. Golomb, "Progressions in Every Two-Coloration of  $Z_n$ ," submitted to the *Journal of Combinatorial Theory*, July 1990.
- xv. S.W. Golomb, "Two Valued Sequences with Perfect Periodic Autocorrelation," accepted for publication in the *IEEE Transactions on Aerospace and Electronics Systems*.

**b. Papers published in referred journals:**

- i. Ning Zhang & S.W. Golomb, "Sixty-Phase Generalized Barker Sequences," *IEEE Transactions on Information Theory*, vol. 35, no. 4, July-August 1989, pp. 911-912.
- ii. S.W. Golomb, "Polyominoes which Tile Rectangles," *Journal of Combinatorial Theory, Series A*, vol. 51, no. 1, May 1989, pp. 117-124.
- iii. Herbert Taylor, "Fragments of Symmetry in Circular Rows," *Advances in Applied Mathematics*, vol. 10, pp. 131-136, 1989.
- iv. S.W. Golomb and N. Zhang, "A Limit Theorem for n-phase Barker Sequences," *IEEE Transactions on Information Theory*, vol. IT-36, no. 4, July 1990, pp. 863-866.
- v. S.W. Golomb and N. Zhang, "Uniqueness of the Generalized Barker Sequence of Length 6," *IEEE Transactions on Information Theory*, vol. IT-36, no. 5, September 1990, pp. 1167-1170.
- vi. S.W. Golomb and Gregory Mayhew, "Linear Spans of Modified de Bruijn Sequences," *IEEE Transactions on Information Theory*, vol. IT-36, no. 6, September 1990, pp. 1166-1167.
- vii. S.W. Golomb and N. Zhang, "On the Cross Correlation of Generalized Barker Sequences," *IEEE Transactions on Information Theory*, vol. IT-36, no. 6, November 1990, pp. 1479-1480.

**c. Books (and sections thereof) submitted for publication:**

NONE

**d. Books (and sections thereof) published:**

NONE

**e. Patents filed/granted:**

NONE

**f. Ph.D. Theses completed:**

**g. Invited Presentations at Scientific Conferences, Colloquia, etc.:**

- i. Dr. S.W. Golomb was invited to the *University of Tel Aviv, Israel* January 1990, to give a series of talks:
  - (a) "Construction of Costas Arrays for Radar and Sonar".
  - (b) "Tuscan Squares, Florentine Squares, and Frequency Hop Communications."
  - (c) "Shift Register Sequences."
- ii. Dr. S.W. Golomb travelled to Bergen, Norway, Fredrickshavn & Copenhagen, Denmark, and London England, June 10-July 6, 1990. He attended the *4th Nordic Symposium on Discrete Mathematics* where he presented a talk entitled, "Constructions for Costas Arrays." He also lectured at the University of Bergen (on Shift Register Sequences), and at the Polytechnic of the South Bank (London) on Finding Costas Arrays.
- iii. Dr. H. Taylor presented a talk at the University of California, Berkeley, July 24, entitled: "Two nxn Costas Arrays Must Have Cross-Correlation  $\geq 2$  if  $n \geq 4$ ."
- iv. Dr. H. Taylor presented a talk entitled, "Gagliardi Matrices for Temporal/Spatial CDMA", August 1990, at the *USC/JPL Mini Summer Topical Meeting on Code Division Multiple Access*.

**h. Contributed Presentations at Scientific Conferences, Colloquia, etc.:**

**i. Honors/Awards/Prizes:**

**j. Technical Reports Published in Non-Refereed Journals:**

**k. Personnel Supported During Year Ended 30 September, 1990:**

- i. **Principal Investigator:** Dr. Solomon W. Golomb, Professor of Electrical Engineering and Mathematics.
- ii. **Associate Investigator:** Dr. Herbert Taylor, Research Associate Professor of Electrical Engineering.
- iii. **Graduate Student:** Mr. Hong-Yeop Song.

Dist. "A" per telecon Dr. Mark Lipman.  
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