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Willard Miller, Jr.

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The view, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

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FIELD	GROUP	SUB-GROUP

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Stochastic Control Theory, Nonlinear Structural Mechanics, Applied Combinatorics

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This grant helped finance Periods of Concentration (in particular, workshops) in each of three year-long programs at the IMA, 1985-1988. The Periods were: Stochastic Control Theory with Applications in Electrical/Computer Engineering and Operations Research; Scientific Computation and Nonlinear Structural Mechanics; and Applications from Mathematical Combinatorics. Details about these programs and workshops, researchers supported, and results obtained can be found in this report.

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ARO 23305.1-MA

STOCHASTIC CONTROL THEORY, NONLINEAR STRUCTURAL MECHANICS AND APPLIED COMBINATORICS

FINAL REPORT

WILLARD MILLER, JR.

May 12, 1989

U.S. ARMY RESEARCH OFFICE

DAAL03-86-K-0044

INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS
514 Vincent Hall
University of Minnesota
Minneapolis, Minnesota 55455

TABLE OF CONTENTS

Foreword:

This grant helped finance Periods of Concentration (in particualr, workshops) in each of three year-long programs at the IMA, 1985–1988. The Periods were: Stochastic Control Theory with Applications in Electrical/Computer Engineering and Operations Research; Scientific Computation and Nonlinear Structural Mechanics; and Applications from Mathematical Combinatorics. Details about these programs and workshops, researchers supported, and results obtained can be found in the following pages, as well as in the IMA Annual Reports for the years 1985–86, 1986–87 and 1987–88 (which have already been sent to the Army Research Office).

II. SUMMARY OF THE MOST IMPORTANT RESULTS.

INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

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IMA NEWSLETTER #118

June 17 - July 1, 1988

1987-88 Program
APPLIED COMBINATORICS

1988 Summer Program
SIGNAL PROCESSING

NEWS AND NOTES

Workshop on DESIGN THEORY

June 20 - 25, 1988

Organizer: Dijen Ray-Chaudhuri

During this workshop there will be lectures and informal exchanges and discussions on recent advances in Design Theory and Difference sets (t- designs without repeated blocks, (s, r, μ)- nets and their automorphisms, quasi-symmetric designs, Fourier transforms of difference sets, Designs on partially ordered sets etc.). Interactions between Design Theory and Coding Theory will be emphasized.

SCHEDULE FOR JUNE 17 - JULY 1

Friday, June 17 (Revised Schedule)

All talks today will be in **Vincent Hall 16**

9:00 am — **Stewart Hoggar**, Ohio State University — Tight 4- and 5- Designs on Projective Spaces

Abstract: Bannai and Hoggar proved that tight t- designs on projective spaces over reals, complex numbers, quaternions and Cayley numbers satisfy $t \leq 5$. Here we prove that the case $t = 4$ is impossible.

10:00 am — **Coffee Break**

11:00 am — **Mohan Shrikhande**, Central Michigan University — A Survey of Some Recent Results on Quasi-symmetric Designs

Abstract: Quasi-symmetric designs are designs having two block intersection cardinalities. We survey some recent results such as the classification of quasi-symmetric 3-designs with smaller intersection number one and quasi-symmetric 2-designs having intersection numbers 0 and 2 with an extra geometric property.

2:00 pm — **K.T. Arasu**, Wright State University — Recent Results on Difference Sets

Abstract: An update on current results on difference sets will be given. The current status of Lander's table on difference sets will also be reported.

3:00 pm — **H. Janwa**, California Institute of Technology — Some Optimal Codes from Algebraic Geometry and Their Covering Radii

Abstract: Let X be a non-singular (smooth) absolutely irreducible projective curve of genus 1 over $GF(q)$ with $n+1$ rational points over $GF(q)$. It is well known that such a curve exists iff $|n-q| \leq 2\sqrt{q}$. If m is an integer satisfying $0 < m < n$, then a recent result of V.D. Goppa implies that one can use X to construct an $[n, n-m, d \geq m]$ linear code, $\Gamma(m,q)$, over $GF(q)$. We show that for $m > q$, the $\Gamma(m,q)$ have $d = m$. Furthermore, for $m > q$, we also show that these codes are optimal in the sense that, they have the largest minimum distance among all $[n,k]$ linear codes over $GF(q)$, with $k = n-m$.
We use our upper bound on the covering radius and the well known super code lemma to show that the covering radius of $\Gamma(m,q)$, $R[\Gamma(m,q)] = m-1$, provided $m > q$. For $m \leq q$, if $d = m+1$, then these code are MDS codes and we show that $R[\Gamma(m,q)] = m$. Some such codes have already been shown to be MDS by Kumar et. al.

Working Group in

Mathematical Aspects of Computer Graphics

4:45 pm — **Vincent Hall 570** — The Group meets weekly

This is an open discussion group on topics of interest to the participants. For example, software environments for geometry and graphics, implementation of rendering semi-algebraic sets, synthetic holography, using physical (or non-physical !) laws to automate animation ... We hope to produce pictures.

Workshop on
DESIGN THEORY
June 20 - 25, 1988
Organizer: Dijen Ray-Chaudhuri

Monday, June 20

All talks are in Vincent Hall 16

Vincent Hall 16 is in the basement.. Most of the offices of the participants and the mailboxes are located in the IMA facilities on the 5th floor of Vincent Hall.

8:30 am **Dieter Jungnickel**, Justus-Liebig University — Nets and Groups

Abstract: We discuss (s, r, μ) -nets and various types of automorphism groups of such structures –in particular translation groups, class regular groups and Singer groups.

9:30 am **David Gluck**, Wayne State University — Affine Planes and Permutation Polynomials

Abstract: We prove a result (obtained independently by Y. Hiramine) on polynomials over $GF(p)$ which implies that every transitive affine plane of prime order is Desarguesian.

10:30 am **Coffee Break**

11:00 am **A. Blokhuis**, Eindhoven — Failed Affine and Projective Planes

Abstract: We characterize the failed projective and affine planes introduced by Baker. It is shown that no non-trivial FPP exists, and that a non-trivial FAP is either of Baer-type, or related to certain Bhaskar-Rao Designs, of which probably only one example exists.

Tuesday, June 21

All talks are in Vincent Hall 16

8:30 am **C. F. J. Wu**, University of Waterloo — Construction of Orthogonal Arrays through Difference Sets and other Techniques

9:30 am **Jim Davis**, Lafayette College — Character Theory Applied to Difference Sets

Abstract: If a group is abelian, or a direct product of abelian with nonabelian, the idea of a difference set can exploit the character theory of the abelian part. This leads to easy existence and nonexistence theorems for difference sets and divisible difference sets.

10:30 am **Coffee Break**

11:00 am **J.N. Srivastava**, Colorado State University, Fort Collins — Search Designs

Abstract: A review of search design theory, recent results of S. Aurora and J.N. Srivastava and some open problems will be presented.

This Symposium on Statistical Theory of Experimental Designs talk will be held in Vincent Hall 16.

2:00 pm	D.K. Ray-Chaudhuri Ohio State University	q- analog of t- designs and their existence for large λ

Abstract: A $t-[v,k,\lambda]$ design in a vector space of dimension v over a finite field is a family of k- subspaces such that each t- subspace is contained in exactly λ elements of the family. N.M. Singhi and D.K. Ray-Chaudhuri prove that for given t,v,k a $t-[v,k,\lambda]$ design exists for all sufficiently large λ provided the necessary parametric conditions are satisfied. We also prove that for fixed v,k,t (and the finite field), the function $S^v_{k,t}(\lambda)$ (= the number of distinct $t-[v,k,\lambda]$ designs) is a quasipolynomial in λ .

4:00 pm	IMA Tea (and more!)	Vincent Hall 502 (The IMA Lounge)

—

Wednesday, June 22

All talks are in Vincent Hall 16

8:30 am	Eric Moorhouse University of Oregon	Reconstructing Projective Planes from Semibiplanes
9:30 am	Eiichi Bannai Ohio State University	Character Tables of Commutative Association Schemes

Abstract: This talk gives a survey of the determination of the character tables of (some of) the known families of commutative association schemes.

10:30 am	Coffee Break	
11:00 am	Esther Lamken IMA and Georgia Institute of Technology	Generalized Balanced Tournament Designs

Abstract: Generalized balanced tournament designs (GBTDs) are introduced and their connections to several other types of combinatorial designs are described. In particular we show how GBTDs can be used to construct resolvable and doubly resolvable BIBDs.

2:00 pm	Paul Terwilliger University of Wisconsin, Madison	Some Problems of Algebraic Combinatorics

Abstract: To be announced.

—

Thursday, June 23

All talks are in Vincent Hall 16

8:30 am	Curt Lindner Auburn University	Perpendicular Arrays and Graph Decompositions

Abstract: This is an elementary survey on some connections between perpendicular arrays and graph decompositions. More specifically: $\binom{n}{2} \times 3$ PAS and Steiner triple systems; $\binom{n}{2} \times 4$ PAS and Steiner triple systems which can be nested; and $\binom{n}{2} \times 5$ PAS and Steiner pentagon systems.

9:30 am	Zhe-Xian Wan Academia Sinica, Beijing	Nonlinear Feedforward Sequences of m-sequences

Abstract: Let $\mathrm{a} = (a_0, a_1, \ldots)$ be an n-stage m-sequence and $\phi(x_0, x_1, \ldots, x_{n-1})$ be a Boolean function of n variables. Define a sequence

$$\phi(\mathrm{a}) = (\phi(a_0, a_1, \ldots, a_{n-1}), \phi(a_1, a_2, \ldots, a_n), \ldots),$$

and call it a feedforward sequence of the m-sequence a . The degree of the minimal polynomial of $\phi(\mathrm{a})$ is investigated and some synthesis algorithms to solve ϕ from a and $\phi(\mathrm{a})$ are obtained.

10:30 am **Coffee Break**

11:00 am **R. Kackar**, National Bureau of Standards — Taguchi's Orthogonal Array Tables: Construction and Uniqueness

Abstract: Dr. Kackar will discuss application of design theory in industrial situations, particularly from the point of view of quality improvement.

This Symposium on Statistical Theory of Experimental Designs talk will be held in Vincent Hall 16.

2:00 pm **J.H. Dinitz**, University of Vermont — Indecomposable 1-factorizations of λK_n

Abstract: A 1-factorization of λK_n is indecomposable if no subset of its 1-factors contains each edge exactly λ' times where $\lambda' < \lambda$. In this talk we will show that for all even $n \geq 8\lambda + 8$ there exist an indecomposable 1-factorization of λK_n with no repeated 1-factors. We will also discuss orthogonal indecomposable 1-factorizations of λK_n .

Friday, June 24

All talks are in Vincent Hall 16

8:30 am **A.A. Bruen**, University of Western Ontario — On the p-rank of incidence matrices (Joint with U.Ott)

Abstract: Let X denote a finite linear space. For p a prime we examine the p-rank x for an incidence matrix M of X. We introduce a new technique for obtaining bounds on x. Our main result involves the dimensions of a certain tensor product space and the space of "circuits" in X. Some applications are described.

9:30 am **Akos Seress**, Hungarian Academy of Sciences & Ohio State University — Some Characterizations of Type-1 λ-Designs

Abstract: A λ-design is a family $B_1, B_2, \ldots, B_v$ of subsets of $X = \{1, 2, ..., v\}$ such that $|B_i \cap B_j| = \lambda$ for all $i \neq j$ and not all blocks are of the same size. Ryser's and Woodall's λ-design conjecture states that each λ-design can be obtained from a symmetric block design by a certain complementation procedure. It is known that in λ-designs the replication numbers of the points can take only two different values and, if there are e_1, e_2 points with the same replication number, $e_1 + e_2 = v$, then $e_1 e_2 \leq \lambda(v-1)$. We give new characterizations of λ-designs. In particular, we prove that the conjecture is true for a design D if and only if $e_1 e_2 = \lambda(v-1)$ holds in D and obtain new structural conditions equivalent to the conjecture, thereby strengthening previous results by Woodall, Kramer, and Bridges.

10:30 am **Coffee Break**

11:00 am **Subir Ghosh**, University of California, Riverside — Characterizations of Arrays for Estimating Dispersion Effects in Replicated Factorial Experiments

Abstract: The problem of estimation of dispersion effects of factors in replicated factorial experiments under a general dispersion model is considered. Characterizations of arrays (like orthogonal arrays, B-arrays) is presented for the estimation of dispersion effects.

This Symposium on Statistical Theory of Experimental Designs talk will be held in Vincent Hall 16.

2:00 pm Tatsuro Ito — Designs in Coset Geometrics
Joetsu University of Education

Abstract: I will discuss the algebraic and geometric aspects of designs which are defined in coset geometrics in a very general setting. This treatment enables us to understand some classical geometric properties of designs well in terms of group characters and to construct multiply transitive sets from classical designs, etc.

CURRENT IMA PARTICIPANTS

POSTDOCTORAL MEMBERS FOR 1987-88 YEAR

Lynne Butler	Princeton University
Laura Chihara	St. Olaf College
Francis G. Garvan	University of Wisconsin, Madison
Laurent Habsieger	Université Louis-Pasteur
Esther Lamken	Georgia Institute of Technology
Tomasz Luczak	Adam Mickiewicz University, Poland
David Magagnosc	Dartmouth College
John Stembridge	University of California, Los Angeles
Bernd Sturmfels	University of Washington
Sheila Sundaram	University of Michigan
Michael Trick	Georgia Institute of Technology
Michael Werman	Brown University

LONG-TERM VISITORS IN RESIDENCE
One Month or More

Assmus, Edward	Lehigh University	May 1 - Jun 30
Averbuch, Amir	Tel Aviv University	Jun 26 - Aug 5
Brannan, James	Clemson University	Jun 26 - Jul 15 Jul 31 - Aug 5
Bridges, W. D.	University of Wyoming	May 1 - June 25
Clayton, Richard	Ohio State University	May 1 - Jun 30
Deza, Michel Marie	University of Tokyo	May 24 - Jun 25
Dillon, John	National Security Agency	May 22 - Jun 25
Doerschuk, Peter	MIT	Jun 27 - Jul 24
Doedel, Eusebius	Concordia University, Montréal	Apr 18 - Jun 30
Drake, David	University of Florida	May 1 - Jun 25
Edelman, Paul	University of Minnesota	
Fassler, Albert	Ecole d'Ingenieurs Biene	Feb 1 - Jul 30
Friedman, Avner	IMA	

Fristedt, Bert	University of Minnesota	
Gader, Paul	University of Wisconsin	Jun 27 - Jul 24
Games, Richard	MITRE Corp	Jun 27 - Aug 5
Hasenfeld, A.	Princeton U.	Jun 26 - Aug 6
Hedayat, A.S	University of Illinois, Chicago	May 1 - Jun 25
Heden, Olaf	Royal Inst. of Tech.-Sweden	May 26 - Jun 26
Isakov, Victor	Courant Institute	Jun 17 - July 16
Ito, Tatsuro	Joetsu University, Japan	May 1 - Jun 25
Itzikowitz, Samuel	Tel Aviv University	Jun 27 - Aug 5
Jerison, Meyer	Purdue University	Jun 26 - Jul 23
Johnson, Robert	Ctr. for Large Scale Comput.	Jun 27 - Jul 28
		Aug 1 - Aug 5
Joichi, James	University of Minnesota	
Kadell, Kevin W.J.	Arizona State University	Sept 14 - Jun 25
Kaveh, Mostafa	U. of Minnesota	Jun 27 - Aug 5
Khargonekar, Pramod	U. of Minnesota	Jun 27 - Aug 5
Key, Jennifer	Univ. of Birmingham/Bryn Mawr	May 1 - Jun 25
Lemke, Paul	Rensselaer Polytechnic Institute	Sep 14 - Jun 25
Lin, Shao-Shiung	National Taiwan University	Jun 15 - Aug 30
van Lint, J.H.	Tech University, Eindhoven	May 15 - June 29
Ma, Siu Lun Leo	Hong Kong Polytechnic	May 2 - Jun 25
Miller, Willard	IMA	
Mitter, Sanjoy	MIT	Jun 26 - Jul 23
Mugler, Dale	Santa Clara University	Jun 26 - Aug 5
Naevdal, Geir	University of Trondheim	Jun 24 - Aug 7
Ray-Chaudhuri, Dijen	Ohio State University	Apr 1 - Jun 30
Reed, Todd	University of Minnesota	Jun 15 - Aug 5
Rocha, Ana Paula	U. Do Porto, Portugal	Jun 26 - Aug 5
Rocha, Maria Paula	U. of Groningen, Netherlands	Jun 26 - Aug 5
Sell, George	University of Minnesota	
Simion, Rodica	George Washington University	Jan 13 - Jul 31
Singhi, Navin	Tata Institute, Bombay	May 1 - Jun 25
Smith, Jonathan D.H.	Iowa State University	Jan 18 - Jun 25
Stanton, Dennis	University of Minnesota	
Teirlinck, Luc	Auburn University	May 1 - Jun 25
Wan, Zhe-Xian	Academia Sinica	May 25 - Jun 25
White, Dennis	University of Minnesota	
Wierman, John	Johns Hopkins University	Sep 1 - Jun 30
Wilson, Richard	Caltech	May 1 - Jun 25
Witten, Matthew	ETA Systems	Jun 19 - Jul 31
Yin, George	Wayne State U.	Jun 26 - Aug 6

SHORT TERM AND WORKSHOP VISITORS IN RESIDENCE

Allen, Jonathan	MIT	Jun 29 - Jul 10
Arasu, K.T.	Wright State University	Jun 11 - 25
Auslander, Louis	CUNY	Jun 26 - Jul 1
		Jul 31 - Aug 5
Bailey, R. A.	Rothamsted Exper. Sta.	Jun 2 - Jun 25
Bannai, Eiichi	Ohio State University	Jun 1 - 25
Bernfeld, Marvin	Raytheon Co.	Jun 27 - Jul 10
Blokhuis, A.	Tech. U., Eindhoven	Jun 11 - 28
Bruen, Aiden A.	University of Western Ontario	Jun 12 - 25
Calderbank, Robert	AT&T Bell Labs	Jun 5 - Jun 19

Cheng, Ching-Shui	University of Calif., Berkeley	Jun 5 - Jun 25
Choi, Sul-Young	Lemoryne College	Jun 11 - 17
Connor, Michael	City College of New York	Jun 27 - Jul 8
		Aug 1 - Aug 5
Davis, James	Layfayette College	Jun 19 - 26
Dinitz, Jeffrey	University of Vermont	Jun 5 - 30
Eastman, Willard	MITRE Corp.	Jun 12 - 18
Ghosh, Subir	UC, Riverside	Jun 18 - 25
Gluck, David	Wayne State University	Jun 18 - 24
Godsil, Chris	University of Waterloo	Jun 19 - 26
Gohberg, I.C.	Tel Aviv U.	Jun 27 - Jul 2
		Aug 1 - Aug 5
Grunbaum, Alberto	U. of California-Berkeley	Jun 26 - Jul 1
		Aug 1 - Aug 6
Gustafson, Karl	University of Colorado, Boulder	Jun 27 - Jun 30
Hall, Marshall Jr.	Emory University	Jun 12 - 22
Helton, William	U. of Calif.-San Diego	Jun 27 - Jul 2
		Jul 17 - Jul 30
Ho, Chat Yin	University of Florida	Jun 10 - 25
Hobart, Sylvia	University of Wyoming	May 31 - Jun 26
Hoggar, Stuart G.	Glasgow University/Ohio State U.	Jun 10 - 19
Hong, Yiming	Wright State University	Jun 11 - 18
Huang, Tayuan	Nat. Chiao Tung Univ., Taiwan	Jun 1 - 25
Huang, Thomas	U. of Illinois-Urbana	Jun 27 - Jul 1
Hughes, Daniel R.	Queen Mary College, London	Jun 11 - 25
Janwa, H. L.	Caltech	Jun 12 - 25
Job, Vanessa	University of Illinois, Chicago	Jun 13 - 25
Jungnickel, D.	Justus-Liebig University	May 29 - Jun 24
Kacker, Raghu	National Bureau of Standards	Jun 18 - 25
Kailath, Tom	Stanford U.	Jun 27 - Jul 2
		Jul 10 - Jul 15
		Jul 18 - Jul 23
Kantor, William	University of Oregon	Jun 13 - Jun 24
Kestenband, B.	New York Institute of Technology	Jun 19 - 25
Kreher, Donald L.	Rochester Institute of Technology	Jun 12 - 25
Lau, Brian	Caltech	Jun 12 - 25
Leonard, Douglas A.	Auburn University	Jun 12 - 26
Lindner, Charles	Auburn University	Jun 19 - 26
Magliveras, Spyros	University of Nebraska, Lincoln	Jun 18 - 25
Mandrekar, V.S.	Michigan State U.	Jun 27 - Jul 10
Marr, Robert	Brokkhaven Nat'l Lab	Jun 27 - Jul 10
Mazorow, Moya	Caltech	Jun 12 - 25
McFarland, Robert L.	University of Minnesota, Duluth	Jun 12 - 25
Muder, Douglas J.	MITRE Corp.	Jun 12 - 18
Mullen, Gary	Pennsylvania State University	Jun 16 - 20
Nonay, Gillian	Wilfred Laurier U., Canada	Jun 19 - 26
Pott, Alexander	Justus-Liebig University	Jun 1 - 25
Pu, K.	University of Illinois, Chicago	Jun 18 - 25
Rees, Rolf	Mt. Allison University, Canada	Jun 11 - 25
Roth, Robert	Emory University	Jun 11 - 26
Roy, Richard	Stanford U.	Jun 27 - Jul 10
Rushanan, Joseph J.	MITRE Corp.	Jun 19 - 25
Saidi, Samira	UCLA	Jun 13 - 18

Schram, Erin	Ohio State University	Jun 12 - 25
Seress, Akos	Ohio State University	Jun 12 - 25
Shrikhande, Mohan	Central Michigan University	Jun 19 - 25
Solé, Patrick	Syracuse University	Jun 19 - 25
Speed, T. P.	CSIRO, Australia	May 29 - Jun 25
Srivastava, J.N.	Colorado State University	Jun 12 - 25
Stinson, Douglas	University of Manitoba	Jun 12 - 25
Sun, T. C.	Wayne State University	Jun 26 - Jul 8
Tallini, Giuseppe	U. delgi Studi di Roma	Jun 12 - 18
Tallini, M. Scafati	U. delgi Studi di Roma	Jun 12 - 18
Terwilliger, Paul	University of Wisconsin	Jun 20 - 23
Tolmieri, Richard	Ctr. for Lg. Scale Computer	Jun 27 - Jul 8
		Aug 1 - Aug 5
Tsao, Anna	AT& T Bell Labs	Jun 26 - Jul 10
		Jul 31 - Aug 5
Tyagi, Vinod	India	Jun 10 - 20
Wertheimer, Michael A.	DOD, Ft. George Meade	Jun 19 - 25
Wood, Jay	Bowdoin College	Jun 12 - 26
Wu, C.F.J.	University of Wisconsin	Jun 19 - 24
Zhao, W.	University of Illinois, Chicago	Jun 18 - 25

May 12, 1989

CODING THEORY AND DESIGN THEORY

Two Volumes

May 1 – June 25, 1988

List of papers to appear (to date) in the Coding Theory and Design Theory Proceedings Volumes.

AUTHOR	Title
Arasu, K.T.	"Recent Results on Difference Sets"
Assmus, Ed with J.D. Key	"Baer Subplanes, Ovals and Unitals"
Bailey, R.A.	"Automorphism Groups of Block Structures with and without Treatments"
Blokhuis, A.	"Characterization Theorems for Failed Projective and Affine Planes"
Bridges, S.A. & W.G. Bridges	"Remarks on $2-(15,5,4)$ Designs"
Brualdi, Richard A. & Vera Pless	"On the Length of Codes with a Given Covering Radius"
Calderbank, R.	"The Differential Encoding of Coset Codes by Algebraic Methods"
Chakravarti, I.M.	"Families of Codes with Few Distinct Weights from Singular" and Non-Singular Hermitian Varieties and Quadrics in Projective Geometries and Hadamard Difference Sets and Designs Associated with Two-Weight Codes"
Cheng, Ching-Shui	"Optimal Properties of Balanced Incomplete Block and Other Designs"
Davis, Jim	"Difference Sets in Nonabelian 2-groups"
Deza, Michel	"Loops of Clutters"
Deza, M., D.K. Ray-Chaudhuri & N. Singhi	"Positive Independence and Enumeration of Codes with the Given Distance Pattern"
Dinitz, J.H.	"Orthogonal 1-Factorizations of the Complete Multigraph"
Drake, David	"Bounds on the Number of Pairs of Unjoined points in a Partial Plane"
Eastman, Willard L.	"Inside Euclid's Algorithm"
Ghosh, Subir	"Influential Observations Under Robust Designs"
Gluck, David	"Affine Planes and Permutation Polynomials"
Hall, Marshall	"Construction of Designs"
Hedayat, A.S.	"The Theory of Trade-off for t-Designs"
Ho, Chat Yin	"Totally Irregular Collineation Groups and Finite Desarguesian Planes"
Hoggar, Stuart G.	"t-Designs in Delsarte Spaces"
Jungnickel, Dieter	"Latin Squares, Their Geometries and Their Groups. A Survey"
Kreher, Donald	"A 4-(15,5,5) design" "Design Theory Toolchest - User Manual and Report"
Lamken, Esther	"Constructions for Resolvable and Near Resolvable $(v,k,k-1)$-BIBDs"
Ma, S.L.	"Polynomial Addition sets and Symmetric Difference Sets"
Moorhouse, Eric	"Reconstructing Projective Planes from Semibiplanes"
Pott, Alexander & Sanjay Arora	"On Multiplier Theorems" Plans for the 2^4 Factorial Experiment"

AUTHOR	Title
Seress, Akos	"On λ-designs with $\lambda = 2P$"
Shrikhande, Mohan	"Designs, Intersection Numbers, and Codes"
Smith, Jonathan	"Combinatorial Characters of Quasigroups"
Sole, Patrick	"Self-dual Codes and Self-dual Designs"
Speed, T.P.	"Invariant Moments and Cumulants"
Srivastava, Jaya	"The Minimal Resolution $3 \cdot k(k = 1, 2)$
Teirlinck, Luc	"Generalized Idempotent Orthogonal Arrays"
van Lint, J.H.	"A New Design"
	"Algebraic Geometric Codes"
Wan, Zhe-Xian	"Nonlinear Feedforward Sequences of m-sequences Pi"
Wood, J.A.	"Self-Orthogonal Codes and the Topology of Spinor Groups"

INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

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IMA NEWSLETTER #108

January 16 - 31, 1988

1987-88 Program
APPLIED COMBINATORICS

NEWS AND NOTES

Workshop on Applications of COMBINATORICS and GRAPH THEORY to the BIOLOGICAL and SOCIAL SCIENCES

January 18-22, 1988
Organizers: J. Cohen and F. Roberts

Combinatorial and graph-theoretical methods are increasingly important in the social sciences. This workshop will emphasize mathematical techniques and open mathematical problems arising in such fields as anthropology, economics, political science, psychology, and sociology.

Combinatorial models and methods also play a fundamental role in modern biology. A major portion of this workshop will focus on the combinatorics of sequence analysis. The presentations will emphasize open mathematical questions arising from biological modeling in the hope of enriching both mathematics and biology.

The two parts of the workshop dealing with the biological and the social sciences will be closely related.

The Monday lectures will be given in **Vincent Hall 16** (in the basement) and the registration desk for the IMA Workshop will be set up in the hallway next to the lecture room. The Workshop lectures Tuesday - Friday mornings will be given in **Mayo Memorial Auditorium, 455 Dartmouth Street.** The lectures Tuesday - Friday afternoons will be in **Vincent Hall 16.** In addition, throughout the Workshop most participants will have office space and can avail themselves of the IMA secretarial, computer, seminar and mail facilities on the 5th floor of Vincent Hall.

The detailed schedule and abstracts for most of the talks can be found on the following pages.

PARTICIPATING INSTITUTIONS:Indiana University, Iowa State University, Michigan State University, Northern Illinois University, Northwestern University, Ohio State University, Purdue University, University of Chicago, University of Cincinnati, University of Illinois (Chicago), University of Illinois (Urbana), University of Iowa, University of Michigan, University of Minnesota, University of Notre Dame, Wayne State University
PARTICIPATING CORPORATIONS:Cray Research, Eastman Kodak, Honeywell, 3M

SCHEDULE FOR JANUARY 16-31

Workshop on Applications of COMBINATORICS and GRAPH THEORY to the BIOLOGICAL and SOCIAL SCIENCES

January 18-22, 1988
Organizers: J. Cohen and F. Roberts

Monday, January 18

All lectures today will be in Vincent Hall 16

9:00 am — **Fred Roberts**, Rutgers University — OVERVIEW

Abstract: This will be a brief introduction and overview of the topics of the Workshop.

10:15 am — Coffee Break

Three talks on: Proteins, Enzymes, DNA and RNA

10:45 am — **Michael S. Waterman**, University of Southern California — MAPPING DNA

Abstract: DNA sequences are finite sequences over a four letter alphabet. Molecular biologists have available restriction enzymes which cut the DNA sequence at short specific patterns, specific to the enzyme. By using restriction enzymes singly and in combination, the biologist constructs a map of the location of the enzyme cut sites. We show that the simplest such problem is in the class of NP complete problems, and we study a simulated annealing algorithm for restriction mapping. Under a simple probability model, the mapping problem is shown to have an exponentially increasing number of solutions.

2:15 pm — **Peter H. Sellers**, The Rockefeller University — COMBINATORIAL ASPECTS OF ENZYME KINETICS

Abstract: "a more explicit title (would be) Path algorithms for graphs, hypergraphs and chemical networks".

3:45 pm — **Eric Lander**, Whitehead Inst. for Biomed. Res. — APPLICATIONS OF COMBINATORICS TO THE HUMAN GENOME

Abstract: To be announced.

Tuesday, January 19

The morning lectures will be in Mayo Memorial Auditorium

Three talks on: Population Dynamics/Ecology and Immunology

9:30 am — **Charles M. Newman**, University of Arizona — A RANDOM GRAPH MODEL OF FOOD WEBS

Abstract: The cascade model is a fairly simple random directed graph model of community food webs introduced by Cohen and Newman and tested against data from real webs by Cohen, Briand and Newman. The S species are ordered in a linear hierarchy (or cascade) with species i feeding on species j with probability $p(S)$, independently for different pairs but only when $i < j$; and $p(S)$ is asymptotic to c/S with c approximately 2.0. In this talk we will focus on the distribution of typical and maximal food chain length for large S.

10:30 am — Coffee Break

11:00 am | **J. Richard Lundgren**
University of Colorado at Denver | COMPETITION GRAPHS, DOUBLE COMPETITION GRAPHS AND NICHE GRAPHS

Abstract: To be announced.

The afternoon lecture will be in Vincent Hall 16

2:15 pm | **Jerome Percus**
Courant Institute | TREE STRUCTURES IN MATHEMATICAL IMMUNOLOGY

Abstract: Tree development, spatial or temporal, is a common determinant of interacting cell systems. Some models in mathematical immunology will be discussed, including stem cell control of cell proliferation, inception of antibody diversity, and stationary states of immune networks. Generating function and inverse techniques, as well as continuous to discrete expansions, will be developed for the analysis of these systems.

3:30 pm | **IMA Tea (and more!)** | In Vincent Hall 570 (The IMA Lounge)

Wednesday, January 20

The morning lectures will be in Mayo Memorial Auditorium

Two talks on: **Qualitative Stability**

9:30 am | **Victor Klee**
University of Washington | QUALITATIVE STABILITY OF LINEAR SYSTEMS

Abstract: Stimulated by the prevalence of qualitative reasoning in economics, and more specifically by a 1947 suggestion of Paul Samuelson, economists were the first to study the qualitative stability of linear systems. They were later joined by some ecologists, chemists, and mathematicians. One direction of study has recently been completed. By means of cycle conditions and coloring conditions in certain graphs, digraphs, and signed digraphs associated with an $n \times n$ real matric A, it is now possible to characterize the *sign-patterns* of A that guarantee either of the following:
(a) stability of the system $\dot{x} = Ax$, in the sense that all positive trajectories converge to the origin (equivalently, each eigenvalue of A has negative real part)
(b) quasistability of the system $\dot{x} = Ax$, in the sense that all positive trajectories are bounded (equivalently, each eigenvalue of A has nonpositive real part, and each eigenvalue with zero real part is a simple root of A's minimum polynomial.)

It is also possible to characterize the sign-patterns of (A, b) that guarantee:
(c) viability of the system $\dot{x} = Ax + b$, in the sense that there is a constant stable attractor trajectory in the positive orthant (corresponding, in this linearized model, to nonvanishing of species).

Some of the characterizations are fairly simple and others are very complicated, but all lead to very fast algorithms for recognizing the mentioned properties. The algorithms are all of time-complexity

$$O(n + \text{number of nonzero entries of } A).$$

10:30 am | **Coffee Break**

11:00 am | **John S. Maybee**
University of Colorado/Department of Energy | QUALITATIVE MATRICES AND STABILITY

Abstract: We review the various qualitative stability problems and discuss some of the relationships between them. In addition, we establish some properties of qualitatively stable matrices including new results on inverses. These enable us to relate qualitatively convergent matrices to qualitatively stable matrices and to 2-minor stable matrices. We also discuss the current status of the perfect stability problem.

The afternoon lectures will be in Vincent Hall 16

Two talks on: **Social Networks**

2:15 pm — Eugene C. Johnsen, Univ. of California, Santa Barbara — STRUCTURE AND PROCESS: THE MICRO-MACRO CONNECTION

Abstract: We present an analytic method for determining structure and process corresponding to a given social relation in a human group. It is cast in terms which clearly show its applicability to any network representing a relation in a group, human or otherwise. In principle it is extendable to networks in which there is more than one relation.

Various micro- and macrolevel models for affect structure in groups have been studied in terms of certain two-valued relations on the group, principally by Davis, Holland, Leinhardt and the author. These models are defined in terms of permitted and forbidden triad types at the microlevel which imply and are implied by specific ordered clique structures at the macrolevel. These models have been tested against collections of empirical group sociomatrices to find that some of these models are in fact exact fits to this data for various ranges of group size. What is of substantive interest is that the particular macromodel structures implied by the empirical data are typically not evident from a straightforward examination of the data, only becoming apparent after further network analysis.

In a direct approach, the author has studied the relationship between certain specified social microprocesses for affect structure formation and the micro- and macrostructures they generate in a social group or network. These structures were compared to the exact fit empirical models mentioned above to find that some of these specified microprocesses generate models which are reasonably close, sufficiently so to explain a significant amount of the micro- and macrostructure in these empirical models. In addition, the relative closeness of these generated structures to the empirical ones allows a comparison of the corresponding microprocesses to see which of them most accounts for the observed micro- and macrostructures. These microprocesses usually permit a smooth micro- to macrolevel transition in interpretation when used to explain and describe macrolevel structure and process over time.

The author has recently obtained an analytic method for finding one or more incipient triadic microprocesses which exactly generate the set of permitted triads in a social structural micromodel at equilibrium. Since a triadic micromodel typically determines a macromodel of possible exact macrostructures, this gives a way of producing candidate microprocesses which completely account for known social macrostructures. These processes are given in terms of the full dyads, rather than the individual directed relations, between members of a triad. This method has been applied to find triadic microprocesses which account for the generic macrostructures of the Hierarchial Cliques, Transitivity, and Ranked Clusters of Cliques macromodels as well as two "friendship induces agreement" macromodels previously studied by the author. One principal benefit of this method is in obtaining a clear and exact processual conceptualization and characterization of cliquing and ranking in the Hierarchical Cliques model, the macromodel which exactly fits the total empirical sociometric data sets of Davis-Leinhardt and Hallinan. Thus, in particular, the method produces a processual solution to the corresponding structural question for groups arising from the discussions of Homans in *The Human Group*.

3:45 pm — Harrison White, University of Arizona — (not yet received)

Thursday, January 21

The morning lectures will be in Mayo Memorial Auditorium

Two talks on: **Learning and Conceptualization**

9:30 am — Jean-Claude Falmagne, New York University — KNOWLEDGE SPACES - A STOCHASTIC LEARNING THEORY

Abstract: To capture the cognitive organization of a set of questions or problems pertaining to a body of information, Doignon and Falmagne have proposed, and analyzed in a number of papers, the concept of a *knowledge space*, that is, a distinguished collection of subsets of questions, representing the possible *knowledge states* of individuals in a given population. This collection of sets is assumed to satisfy a number of conditions. Since this concept is a deterministic one, the problem of empirical testing arises. A stochastic version of a

knowledge space is developed, in which the knowledge states are considered as possible epochs in a subject's learning history. The knowledge space is decomposed as a union of a number of possible learning paths, which are maximal chains of states, called *gradations*. The model specifies how a subject is channelled through and progresses along a gradation. A probabilistic axiom relates the knowledge states to the observable responses. The predictions of this model are worked out in details in the case of parametric assumptions involving gamma distributions. Applications of the model to artificial and real data are described, based on maximum likelihood methods. In the case of artificial data, the statistical analysis is shown to be capable of revealing the combinatoric core of the model. The fit to real data is acceptable.

10:30 am **Coffee Break**

11:00 am **Rudolf Wille** CONCEPTUAL SCALING
Technische Hochschule Darmstadt

Abstract: Scaling of empirical data uses formal patterns to lead to a better understanding of realities. In formal concept analysis scaling uses conceptual patterns for this aim. Such conceptual scaling yields hierarchies of concepts which commonly gives a detailed insight into the analysed data contexts. Conceptual scaling is also basic for a general understanding of dependencies between (many-valued) attributes. The notions of data contexts, concepts, conceptual hierarchies, scaling and dependencies of attributes are formalized in a set-theoretical model which allows to apply ideas and results of the theory of ordered sets and lattices. A wide range of examples and applications can be shown.

References:

R. Wille: Restructuring lattice theory: an approcah based on hierarchies of concepts. In I. Rival (ed.): Ordered sets. Reidel, Dordrecht-Boston 1982, 445-470.

R. Wille: Bedeutungen von Begriffsverbanden. In: B. Ganter, R. Wille, K.E. Wolff (Hrsg.): Beitrage zur Begriffsanalyse. B.I.-Wissenschaftsverlag, Mannheim/Wien/Zurich 1987, 161-211.

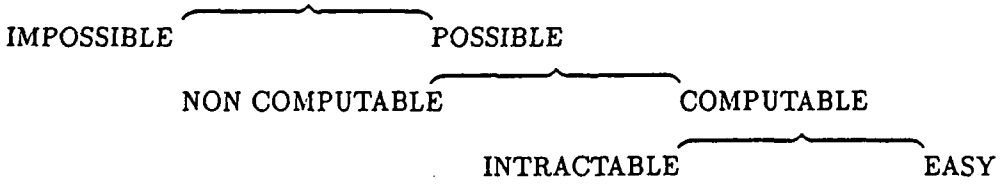
R. Wille: Dependencies of many-valued attributes. In: H.H. Bock (ed.): Classification and related methods of data analysis. North-Holland, Amsterdam (to appear).

The afternoon lectures will be in Vincent Hall 16

Two talks on: **Social Choice and Voting**

2:15 pm **J.P. Barthelemy** SOCIAL CHOICE: COMBINATORIAL AND
Ecole Nat. Sup. Telecommun. ALGORITHMIC ASPECTS

Abstract: An aggregation procedure assigns to each profile of individual preferences on a set X of alternatives one or several social preferences (these social preferences can be of various kinds: subsets of X, preference orderings on $X, \ldots$). The aim of this talk is to illustrate a hierarchy of problems involved in the obtention of aggregation procedures:



This hierarchy of problems will be illustrated by the following examples:

The classical Arrow's theorem and related results illustrate the dichotomy: possibility theorems / impossibility theorems.

The Young & Levenglick characterization of median procedure for linear orders (the Kemeny procedure) is a good example of a possibility theorem.

In the framework of a computational model for both preferences and aggregation functions, a straightforward diagonal argument leads to the "construction" of a non computable aggregation procedure for computable preferences.

Examples of NP-hard aggregation procedures are involved in the median procedure and the Young & Levenglick characterization mentioned above becomes a possibility and intractability theorem.

The abstract framework of median semilattices leads to easy cases for the abstract median procedure. Applied to sets of preferences it allows to obtain new possibility and easiness theorems.

3:45 pm **Philip D. Straffin**
Beloit College

SPATIAL MODELS OF POWER AND VOTING OUTCOMES

Abstract: Voting outcomes are affected by the relative power of the voters, ideological differences among voters, and the structure of the voting process. Measures of voting power have traditionally been combinatorial, counting the number of ways individual voters could change a voting outcome. Ideological models have traditionally been geometric, positioning voters and voting alternatives in an ideological space. In the 1970's game theorists proposed adapting voting power measures to this spatial context, and political scientists investigated the effect of the voting process on voting outcomes in spatial models. Recently, Owen and Shapley have found a beautiful connection between spatial models of voting power and likely voting outcomes. I will survey these developments.

Friday, January 22

The morning lectures will be in Mayo Memorial Auditorium

Four talks on: **Clustering, Ordering and Measurement**

8:30 am **Fred Roberts**
Rutgers University

MEANINGLESS STATEMENTS, MATCHING EXPERIMENTS, AND COLORED DIGRAPHS (APPLICATIONS OF GRAPHS AND COMBINATORICS TO THE THEORY OF MEASUREMENT)

Abstract: The theory of measurement is an interdisciplinary subject developed by mathematicians, psychologists, economists, physicists, and philosophers of science with the goal of putting the process of measurement on a firm mathematical foundation. Many of the mathematical problems arising from measurement theory are interesting problems in graph theory and combinatorics, and we present a variety of such problems in this talk. We shall outline the basic representation and uniqueness problems of measurement theory, discuss the theory of meaningful statements, present several specific measurement questions, and discuss resulting mathematical problems which deal with classifying automorphisms of colored digraphs, specifying certain invariant semiorders and indifference graphs, and identifying certain homogeneous order relations.

9:30 am **Coffee Break**

9:45 am **Peter C. Fishburn**
AT&T Bell Laboratories

UNIQUENESS IN FINITE MEASUREMENT

Abstract: Recent investigations on unique solutions for finite-element structures in measurement theory, conducted by Fred Roberts, Andrew Odlyzko, Helen Marcus-Roberts and Peter Fishburn, have uncovered a variety of interesting combinatorial and number-theoretic problems. Results and open problems are described for finite measurement involving difference comparisons, subjective probability, and additive conjoint measurement.

11:00 am **Margaret B. Cozzens**
Northeastern University

CONSECUTIVE ONE'S PROPERTY AND MATRICES WITH DIAGONAL ENTRIES THAT CAN BE SPECIFIED AS EITHER ONE OR ZERO

Abstract: The general consecutive one's property is applied to matrices with prescribed rows corresponding to sets of elements from a specified set. In applications, the rows and the columns often correspond to vertices of a graph and the entries are determined by the existence of an edge (1) between two vertices or nonexistence of the edge (0) between the two vertices. A 1 on the diagonal implies a loop at the vertex. Similarly, if the matrix represents a relation on a set, all 1's on the diagonal corresponds to a reflexive relation and all 0's on the diagonal corresponds to an irreflexive relation. Often in applications we don't

know if the relation is reflexive or irreflexive, nor do we care. We don't care if an element is related to itself or not. What we are interested in is a linear ordering of the vertices (elements) such that the neighbors of an element appear consecutively in the ordering with or without the vertex itself. We provide an algorithm to determine in linear time if such an ordering is possible. This algorithm determines when a diagonal element must be 0 and when it must be 1, and if an ordering is possible produces the ordering. Roberts showed in 1969 that if all of the diagonal entries are 1 then the corresponding graph (with loops assumed at each vertex) is an indifference graph. This work applies in the social sciences where relationships are it to a particular individual, country, product, etc.. For example, we might want a linear ordering of countries such that all those countries that are allies of the US appear together in the order, all those allies of Russia appear together in the order, etc., and we don't care if in the list of allies of the US the US appears or not.

1:30 pm **Pierre Hansen**
Rutgers University

EXACT CLUSTERING ALGORITHMS FOR CRITERIA BASED ON SPLIT AND DIAMETER

Abstract: To be announced.

SEMINAR IN { Mathematics of Computer Graphics
Vincent Hall 570

4:45 pm **Toby Orloff**
University of Minnesota

Solid modeling and semi-algebraic sets. II

Abstract: This second lecture will develop the theory of semi-algebraic sets defined by linear conditions (i.e. polyhedral solid modeling). We will review some elements of linear programming that we need.

CURRENT IMA PARTICIPANTS

POSTDOCTORAL MEMBERS FOR 1987-88 YEAR

Lynne Butler	Princeton University
Laura Chihara	St. Olaf College
Francis G. Garvan	University of Wisconsin, Madison
Laurent Habsieger	Université Louis-Pasteur
Esther Lamken	Georgia Institute of Technology
Tomasz Luczak	Adam Mickiewicz University, Poland
David Magagnosc	Dartmouth College
John Stembridge	University of California, Los Angeles
Bernd Sturmfels	University of Washington
Sheila Sundaram	University of Michigan
Michael Trick	Georgia Institute of Technology
Michael Werman	Brown University

LONG-TERM VISITORS IN RESIDENCE
One Month or More

Edelman, Paul	University of Minnesota	
Friedman, Avner	IMA	
Fristedt, Bert	University of Minnesota	
Füredi, Zoltan	MIT	Jan 1 - Mar 31
Griggs, Jerrold	University of South Carolina	Jan 1 - May 15
Joichi, James	University of Minnesota	
Johnson, Charles R.	College of William and Mary	Oct 8 - 19, Jan 17 - Feb 4
Kadell, Kevin W.J.	Arizona State University	Sept 14 - Jun 25
Kleitman, Daniel	MIT	Dec 14 - Feb 26
Lemke, Paul	Rensselaer Polytechnic Institute	Sep 14 - Apr 4
Miller, Willard	IMA	
O'Hara, Kathy	University of Iowa	Jan 1 - Jun 15
Sell, George	University of Minnesota	
Sengupta, Sailes	South Dakota Sch. Mines & Tech.	Aug 15 - May 31
Simion, Rodica	George Washington University	Jan 13 - Jun 9
Smith, Jonathan D.H.	Iowa State University	Jan 18 - Jun 25
Stanton, Dennis	University of Minnesota	
Vohra, Rakesh	Ohio State University	Dec 4 - Jan 23
White, Dennis	University of Minnesota	
White, Neil	University of Florida	Aug 3 - Apr 30
Wierman, John	Johns Hopkins University	Sep 1 - Jun 30

SHORT TERM AND WORKSHOP VISITORS IN RESIDENCE

Abello, James	UC, Santa Barbara	Jan 14 - 23
Altschul, Stephan	National Institutes of Health	Jan 17 - 22
Barthélemy, J. P.	Ecole Nat. Sup. des Telecommun.	Jan 18 - 22
Bergstrand, Deborah J.	Williams College	Jan 18 - 22
Cohen, Joel	Rockefeller University	Jan 17 - 22

Cozzens, Margaret	Northeastern University	Jan 17 - 22
Davison, Dan	Los Alamos National Lab.	Jan 18 - 22
Falmagne, Jean-Claude	New York University	Jan 18 - 22
Fishburn, Peter	AT&T Bell Labs	Jan 17 - 23
Ghanta, S.	University of Minnesota	Jan 18 - 22
Halsey, Mark D.	Worcester Polytechnic Institute	Jan 17 - 23
Hansen, Pierre	Rutgers University	Jan 18 - 22
Isaak, Garth	Rutgers University	Jan 18 - 23
Johnsen, Eugene	Univ. of Calif., Santa Barbara	Jan 18 - 22
Kim, Suh	Rutgers University	Jan 18 - 23
Klee, Victor	University of Washington	Jan 18 - 22
Lander, Eric S.	Whitehead Inst. for Biomed. Res.	Jan 18 - 19
Lundgren, J. Richard	University of Colorado at Denver	Jan 16 - 22
Matula, David	Southern Methodist University	Jan 19 - 24
Maybee, John S.	University of Colorado	Jan 17 - 24
Newman, Charles	University of Arizona	Jan 18 - 22
Norman, Robert	Darmouth College	Jan 20 - 22
Percus, Jerome	Courant Institute	Jan 17 - 22
Poling, Craig	Honeywell	Jan 28 - 29
Reid, K. Brooks	Louisiana State University	Jan 16 - 23
Roberts, F.	Rutgers University	Jan 18 - 22
Sellers, Peter H.	The Rockefeller University	Jan 18 - 22
Shahrokhi, Farhad	New Mexico Inst. of Tech.	Jan 14 - 24
Straffin, Philip	Beloit College	Jan 18 - 22
Tesman, Barry	Rutgers University	Jan 18 - 23
Trotter, W. T.	Arizona State University	Jan 16 - 22
Waterman, Michael	University of Southern Calif.	Jan 17 - 19
White, Harrison	University of Arizona	Jan 18 - 22
Wille, Rudolf	Technische Hochschule Darmstadt	Jan 17 - 23

APPLICATIONS OF COMBINATORICS AND GRAPH THEORY TO THE BIOLOGICAL AND SOCIAL SCIENCES
IMA Volumes in Mathematics and its Applications

VOLUME 17, 1989 (EDITOR FRED S. ROBERTS)

CONTENTS

Workshop on

CONSTITUTIVE EQUATIONS AND MODELING OF
DISTRIBUTED CRACKING, STRAIN SOFTENING, AND LOCALIZATION

February 16-18, 1987

Feb 16 Z.P. Bazant Northwestern Univ.

Problems and Recent Advances in Continuum Modelling of Softening Damage"

Feb 16 I. Vardoulakis Univ. of Minnesota

"Experimental Observations with Respect to Strain-Softening and Localization in Granular Media"

Feb 16 J.D. Dougill Imperial College

"A Distributed Damage Model and Some Possible Extensions"

Feb 16 K. William Univ. of Colorado

"Stabilization and Control of Associated and Non-Associated Strain-Softening Computations"

Feb 17 A. Needleman Brown Univ.

"Finite Element Analysis of Failure Modes in Ductile Solids"

Feb 17 M.A. Crisfield Transport & Road Research Lab

"Some Experiences with Finite Element Analyses of Softening Materials"

Feb 17 R. de Borst Univ. of New Mexico

"Computational Issues Regarding the Solution of Boundary Value Problems with an Indefinite Stiffness Matrix"

Feb 17 M. Ortiz Brown Univ.

"Finite Element Analysis of Localized Failure"

Feb 18 H.L. Schreyer Univ. of New Mexico

"Mathematical Formulation and Problems Associated with Strain- Softening and Localization Based on Nonlocal Plasticity"

Feb 18 R.D. James Univ. of Minnesota

"Prediction of the Microstructures of Solids which Arise from a Phase Transformation"

Feb 18 M. Shearer North Carolina State University

"Conservation Laws of Mixed Type Arising in Elasticity and Porous Media Flow"

Feb 18 E. Aifantis Mich. Tech. Univ.

"Plastic Heterogeneity: Instabilities, Dislocations, and Deformation Bands"

Workshop on Stochastic Differential
Systems with Applications in
Electrical/Computer Engineering,
Control Theory and Operations Research

June 9-19, 1986

The Workshop will emphasize topics in the following four areas.

1. Mathematical theory of stochastic differential systems, stochastic control and nonlinear filtering for Markov diffusion processes. Connections with partial differential equations.

2. Applications of stochastic differential system theory, in engineering and management science. Stochastic control models in such areas as production and inventory control, resource consumption-renewal, investment. Adaptive control of Markov processes, stochastic approximation. Techniques for problems with multiple scales (for example homogenization). Advanced computational methods in stochastic control.

3. Stochastic scheduling, queueing networks, and related topics. Flow control, multiarm bandit problems, applications to problems of computer networks and scheduling of complex manufacturing operations.

4. Simulated annealing and related stochastic gradient algorithms. Annealing algorithms for discrete state and Langevin equation models. Connections with statistical mechanics. Effects of multiple scales and problem size. Applications to such topics as VLSI design and computerized image reconstruction.

The Workshop Program Committee consists of W.H. Fleming, P-L Lions (cochairmen), J. Baras, B. Hajek, J.M. Harrison and H. Sussmann. The following is a partial list of invited speakers and participants in addition to the Program Committee. From preliminary responses we expect most of them to come. A. Bensoussan, V. Benes, G. Blankenship, E. Cinlar, M. Davis, L.C. Evans, A. Friedman, B. Gidas, D.S. Johnson, G. Kallianpur, I. Karatzas, F. Kelley, P. Kumar, H. Kushner, J. Lehoczky, A. Mandelbaum, S. Mitter, D. Mitra, E. Pardoux, S. Pliska, J.P. Quadrat, M. Robin, S. Shreve, H.M. Soner, G. Stein, S. Stidham, J. Tsitsklis, P. Varaiya, J. Wahlrand, R. Weber.

STOCHASTIC DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS

Workshop on STOCHASTIC DIFFERENTIAL SYSTEMS, STOCHASTIC CONTROL THEORY, AND APPLICATIONS
June 9-20, 1986

All lectures in Vincent Hall 16 except 8:15 p.m. June 12

MONDAY, JUNE 9		
9:00 am		Welcome
9:15 am	J.M. Harrison	"Brownian networks as approximate models of multiclass networks of queues"
	Coffee Break	
10:45 am	P. Varaiya	"Recent results on multi-armed bandit problems"
2:15 pm	S. Shreve	"An introduction to singular stochastic control"
3:15 pm	A. Makowski	"Implementation issues for Markov decision processes"
TUESDAY, JUNE 10		
9:15 am	J. Tsitsiklis	"Markov chains with rare transitions and simulated annealing"
	Coffee Break	
10:45 am	B. Hajek	"On the complexity of optimization by simulated annealing"
2:15 pm	S. Stidham	"Scheduling, routing and flow control in stochastic networks"
3:15 pm	T-L Lai	"Dynamic allocation and stochastic control of queueing networks"
4:45 pm	R. Elliott	"An approximate minimum principle for partially observed Markov chains"
WEDNESDAY, JUNE 11		
9:15 am	A. Bensoussan	"On some singular perturbation problems arising in nonlinear filtering"
	Coffee Break	
10:45 am	M. Robin	"Some singular perturbation problems in optimal stopping and impulse control"
2:15 pm	B. Gidas	"Parameter estimation for Markov random fields"
3:15 pm		Discussion Session
THURSDAY, JUNE 12		
9:15 am	R. Weber	"Stochastic scheduling on parallel processors and minimization of concave functions of completion times"
	Coffee Break	
10:45 am	J. Baras	"Architectures for real-time sequential detection and nonlinear filtering"
2:15 pm	G. Stein	To be announced
3:15 pm	E. Pardoux	"Piecewise linear filtering"
8:15 pm		Discussion Session (in Physics 133)
FRIDAY, JUNE 13		
9:15 am	M. Reiman	"The heavy traffic diffusion limit for single bottleneck queueing networks"
	Coffee Break	
10:45 am	J. Walrand	"Another look at insensitivity"
2:15 pm	I. Karatzas	"Stochastic control under finite-fuel constraints"
3:15 pm	A. Mandelbaum	To be announced

MONDAY, JUNE 16		
9:15 am	G. Kallianpur	"Some infinite dimensional problems in nonlinear filtering"
	Coffee Break	
10:45 am	H. Kushner	"Control and filtering for systems with wideband driving functions and observations"
2:15 pm	P-L. Lions	"Optimal stochastic control with state constraints"
3:15 pm	M. Davis	"Optimal capacity expansion: an optimal control problem in piecewise deterministic processes"
TUESDAY, JUNE 17		
9:15 am	J-P. Quadrat	"Towards an expert system in stochastic control and identification of stochastic processes. The state of the system and new directions of development"
	Coffee Break	
10:45 am	G. Blankenship	"Homogenization of lattice structures"
2:15 pm	P. Souganidis	"Asymptotic series and the method of viscosity solutions"
3:15 pm		Discussion Session
WEDNESDAY, JUNE 18		
9:15 am	H. Sussmann	"Product expansion of exponential Lie series and the discretization of stochastic differential equations"
	Coffee Break	
10:45 am	P.R. Kumar	"Recent advances in the theory of stochastic adaptive control"
2:15 pm	J. Gartner	To be announced
3:15 pm	H.M. Soner	"Optimal control of jump processes and viscosity solutions"
THURSDAY, JUNE 19		
9:15 am	V. Benes	"Examples of stochastic control with incomplete information"
	Coffee Break	
10:45 am	D. Ocone	"Malliavan calculus applied to stochastic partial differential equations"
2:15 pm	W. Fleming	"Generalized solutions in optimal control of diffusions"
3:15 pm		Blackboard or Discussion Session
FRIDAY, JUNE 20		
		To be announced

STOCHASTIC DIFFERENTIAL SYSTEMS, STOCHASTIC CONTROL THEORY AND APPLICATIONS

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VOLUME 10, 1988

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Brownian models of queueing networks with heterogeneous customer populations

J. Michael Harrison

Non-linear filtering - the degenerate case

U.G. Haussmann

The asymptotic behaviour of the maximum likelihood estimates for a class of diffusion processes

Kurt Helmes

The filtering problem for infinite dimensional stochastic processes

G. Kallianpur and R.L. Karandikar

Stochastic control under finite-fuel constraints

Ioannis Karatzas

Recent advances in the theory of stochastic adaptive control

P.R. Kumar

Almost optimal controls for wideband noise driven systems

Harold J. Kushner

Asymptotic solutions of bandit problems

T.L. Lai

Viscosity solutions of second-order equations, stochastic control and stochastic differential games

P.-L. Lions and P.E. Souganidis

On the memory length of the optimal nonlinear filter

E. Mayer-Wolf, M. Zakai and O. Zeitouni

Implementation issues for Markov decision processes

Armand M. Makowski and Adam Shwartz

Navigating and stopping multi-parameter bandit processes

Avi Mandelbaum

Bounded variation control of a damped linear oscillator under random disturbances

Jose-Luis Menaldi

The support of the law of a filter in C^∞ topology

D. Michel and M. Chaleyot-Maurel

Existence of densities for statistics in the cubic sensor problem

Daniel Ocone

Piecewise linear filtering

E. Pardoux and C. Savona

Quick simulation of excessive backlogs in networks of queues

Shyam Parekh and Jean Walrand

On some perturbation problems in optimal stopping and impulse control

Maurice Robin

Optimal control of jump-markov processes and viscosity solutions

Halil Mete Soner

An introduction to singular stochastic control

Steven E. Shreve

Scheduling, routing, and flow control in stochastic networks

Shaler Stidham, Jr.

Product expansions of exponential Lie Series and the discretization of stochastic differential equations

H.J. Sussmann

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John N. Tsitsiklis

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Richard R. Weber

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