Bill Rivaley

Final Program

&

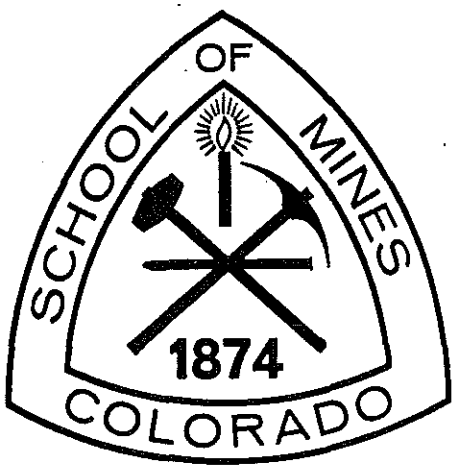
*Book of Abstracts*

Rocky Mountain Sectional MAA Meeting

*Colorado School of Mines*

*Golden, Colorado 80401-1887*

April 2-3, 1993



# Final Program

**Lectures, workshops and panels will be held in**

- The NeXT Laboratory (NL) located in Stratton Hall 104
- Metals Hall (MH) and Petroleum Hall (PH) in the Green Center

**The reception and banquet will be in the lounge in the student center (SC)**

## FRIDAY, APRIL 2

| | | | |
|---|---|---|---|
| Lobby | 12:00-13:00 | Registration | open till 15:20 |
| MH | 13:00-13:15 | Welcome | Dr. F. Schowengerdt, Vice-President CSM |
| MH | 13:15-13:20 | Announcements | A. Boes & W. Hereman, organizers |
| | | **Parallel Session 1** | **Special Session in Honor of J.H. Hodges** |
| MH | 13:20-13:40 | Porter, D. | J.H. Hodges and matrix equations |
| MH | 13:40-14:00 | Hodges, J.H. | Remarks on the matrix equation $X^e = B$ over a finite field |
| MH | 14:00-14:20 | Cisneros, J. | A development of polynomial ADT |
| MH | 14:20-14:40 | Shader, L. | Odd neighbors and odd neighborhoods |
| MH | 14:40-15:00 | Barnett, J. | If "matrix" means "womp", who is the baby? And who is the father? |
| Lobby | 15:00-15:20 | COFFEE BREAK | |
| MH | 15:20-15:40 | Carlson, D. | The good bug problem |
| MH | 15:40-16:00 | Davenport, H. | The differential and matrix groups |
| MH | 16:00-16:20 | De Toustain, N. | The mathematics of optics, as viewed by René Descartes |
| MH | 16:20-16:40 | Olsen, J. | The function minute: an effort to teach basic function concepts more effectively |
| MH | 16:40-17:00 | Kokko, W. | Advanced programming on the HP-48sx |
| | | **Parallel Session 2** | **Math Education** |
| NL | 13:20-14:20 | Emerson, B. | Workshop on interactive Mathematica texts |
| NL | 14:20-15:00 | Hagin, F., Bath, B. | Calculus with Mathematica at the Colorado School of Mines |
| Lobby | 15:00-15:20 | COFFEE BREAK | |
| PH | 15:20-16:20 | Panel (Emerson, Jensen, Newton & Leth) | Use of Technology and Cooperative Projects in the Classroom |
| PH | 16:20-16:40 | Leth, S. | The use of writing in teaching mathematics |
| PH | 16:40-17:00 | Dorn, B., LaVita, J. | A case study course in mathematics for non-science students |
| SC | 17:30-18:30 | RECEPTION | in Honor of J.W. Kenelly and J.H. Hodges |
| SC | 18:30-..... | BANQUET | with J.W. Kenelly, banquet speaker |

## SATURDAY, APRIL 3

| | | | |
|---|---|---|---|
| MH | 8:00-9:00 | MAA | Business Meeting |
| MH | 9:00-10:00 | Kenelly, J. | **Keynote Address:** Technology in mathematics instruction - Changes beyond compare |
| MH | 10:00-10:20 | COFFEE BREAK | |
| | | **Parallel Session 1** | **Scientific Talks** |
| MH | 10:20-10:40 | Elliot, D. | A ring of Lebesque integrable functions |
| MH | 10:40-11:00 | Teets, D. | Chaos for the uninitiated |
| MH | 11:00-11:20 | Bradley, E. | The driven pendulum: theory, practice and implications for control |
| MH | 11:20-11:40 | Pruess, S. | Stable qualitatively correct interpolants for accurate data |
| MH | 11:40-12:00 | Mendez, C.G. | Bachelier's theory of speculation |
| | | **Parallel Session 2** | **Math Education** |
| NL | 10:20-10:40 | Kelley, T. | Some Mathematica mistakes? |
| NL | 10:40-11:00 | Crockett, C. | A comprehensive game plan for calculus reform. Are we close yet? |
| NL | 11:20-11:40 | Starrett, J. | Why is Bach out of tune? |
| NL | 11:40-12:00 | Donovan, G. | Computer simulation - A capstone course for math majors |
| NL | 12:00-12:20 | Ethredge, J., Nammari, A., & Bailey, C. | Mathematica in math courses: Student perspectives |
| NL | 12:20-12:40 | Szczyrba, I. | What should you know about continuum and how to teach about it? |
| NL | 12:40-13:00 | Talman, L. | Computer algebra systems and visualization in mathematics |

# Rocky Mountain Sectional MAA Meeting
## *Colorado School of Mines*
## *Golden, Colorado 80401-1887*
## April 2-3, 1993

# Book of Abstracts

Crista Bailey, Jean Ethredge, and Aref Nammari

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**Mathematica and Math Courses: Student Perspectives**

Metropolitan State College of Denver has been using Mathematica in some of its math courses for almost three years now. Faculty members are still debating if, when and how to use Mathematica in math courses. The question arises: "What do students think?" In an attempt to answer this, three MSCD students will present their experiences with Mathematica.

Crista Bailey has experienced Mathematica in Calculus I, II, and III and is presently a tutor in the MSCD NeXT lab.

Jean Ethredge has used MSCD's Mathematica Modules in Calculus I and II.

Aref Nammari has used Mathematica as part of the Partial Differential Equations course.

Janet H. Barnett

Department of Mathematics, University of Southern Colorado, Pueblo, CO 81001

**If "Matrix" means "Womb", Who is the Baby? And Who is the Father?**

A brief account of the history of matrix theory, with emphasis on those events with pedagogical interest.

Barbara Bath

Department of Mathematical and Computer Sciences, Colorado School of Mines, Golden, CO 80401-1887

**Calculus with Mathematica at Colorado School of Mines**

Abstract: see Frank Hagin.

Elizabeth Bradley

Department of Computer Science, and Department of Electrical and Computer Engineering, University of Colorado, Boulder, CO 80309-0430

**The Driven Pendulum: Theory, Practice and Implications for Control**

Almost all studies of the dynamics of the driven damped pendulum, one of the classic examples in the fields of dynamical systems and nonlinear control, use some minor variation on the equation: $a\ddot{\theta} + b\dot{\theta} + c\sin\theta = k\sin(\alpha t)$.

However, the dynamics of this simple model bear only a very general resemblance to the dynamics of physical pendulums that rotate on ball bearings and are driven by motors. Data from — and demonstrations of — an instrumented driven-vertex pendulum will be used to illustrate these discrepancies and to develop a variety of improvements on the ODE model. Several important implications of these modeling issues (e.g., effects on controllability) will be discussed.

David Carlson

Colorado Department of Agriculture, Lakewood, CO 80125

**The Good Bug Problem**

Jose Cisneros

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**A Development of a Polynomial ADT**

The ring of polynomials having coefficients over a commutative ring with unity and having no zero divisors motivates an abstract data type whose elements are polynomials and whose operations are the usual operations used in arithmetic. This development is instructive to both algebra and computer science students.

Carl Crockett

United States Air Force Academy, DFMS, USAFA, CO 80840

**A Comprehensive Game Plan for Calculus Reform. Are we close yet?**

The phrase Calculus Reform means so many different things to different people that it seems prudent to take pause and evaluate where we each stand. This talk provides issues considered during our "no holds barred" reform efforts at the Unites States Air Force Academy. While we have only two years of experience we believe that the outline of issues

we have developed is a good outline for any reformer to follow. We are confident that different decisions will be made at each school, but the same issues need to be addressed.

One fact that will become clear very quickly is that there is a lot to think about. It is a physical impossibility to address everything at once. Hence each institution focuses on those issues which are most important to them. This is appropriate. However, it is useful to have a context from which work. In our own case we have not yet addressed all of the issues which we list, be we will discuss those which we have addressed.

W. Harold Davenport

Mesa State College, Department of Computer Science - Math - Engineering, Mesa State College, Grand Junction, CO 81502

**The Differential and Matrix Groups**

Some questions on teaching the differential in an undergraduate mathematics program will be considered such as what and how should the differential be taught. A matrix group is a closed subgroup of $GL(n, k)$. How the differential can be used to give information about matrix groups will be delineated. If $T_G$ and $T_H$ are the tangent spaces of the groups $G$ and $H$; $\phi : G \to H$ a smooth group morphism of matrix groups then $d\phi : T_G \to T_H$ is a Lie algebra morphism.

Nicolas De Toustain

Department of Mathematics, University of Colorado, Boulder, C0 80309-0395

**The Mathematics of Optics, as Viewed by René Descartes**

Following a brief history of the life of Descartes (included will be his "discourse on the method for rightly directing one's reason and searching for truth in the sciences") the presentation will begin with a selection of his works dealing with light, refraction, the human eye, the senses in general, the development of the telescope, and other topics relating to optics. Of these, one or two interesting problems will be chosen, and will be discussed in greater depth. If time permits, a problem or two from Descartes' work on meteorology will be presented.

The presentation, due to the historical time frame of Descartes, will not be overly complicated and is intended to be enjoyed by a general audience. Anyone having a seventeenth century or greater knowledge of mathematics will have no trouble following the semi-historical, semi-mathematical presentation.

George S. Donovan

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**Computer Simulation - A Capstone Course for Math Majors**

A discussion of the purpose of the course, its prerequisites, the text, the contents, and the value of such a course for math majors.

William S. Dorn and James A. LaVita

Department of Mathematics and Computer Science, University of Denver, Denver, CO 80208

**A Case Study Course in Mathematics for Non-science Students**

An overview of a FIPSE-supported project on the development of course materials for a first-year mathematical sciences program for non-science students. The material is case study driven in contrast to the conventional topic-driven mathematics course for liberal arts students. The case studies illustrate such mathematical concepts as simplification, abstraction and experimentation. Social and ethical implications of the case studies are an essential part of the materials as are student writing assignments. To illustrate this new approach we will present several specific case studies. The illustrative case studies will include some ethical and social questions and typical writing assignments.

Donald P. Elliot

Department of Mathematical Sciences, University of Northern Colorado, Greeley, CO 80639

**A Ring of Lebesque Integrable Functions**

Students studying the classical $L^p[0,1]$ spaces, for $p > 1$ are aware that they are topological linear spaces with respect to the $L^p$ norm. However, it is easily seen that they are not closed under products and hence none of these classical spaces forms a ring of functions. This presentation explores an interesting Frechet space which is a subset of these $L^p$ spaces and forms a topological ring.

Bill Emerson

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**Workshop on Interactive Mathematica Texts**

This workshop will be an opportunity to examine an interactive computer text written in the form of Mathematica notebooks. The notebooks are files which allow word-processed text to be inserted in the middle of active code. Thus, a notebook is an electronic text in

which all calculations and grapics are alive and may be modified and reexecuted. This text is an example of second generation computer laboratories where technology is integrated directly into the mainstream calculus curriculum. The workshop will include a demonstration of a notebook as well as an opportunity for "hands-on" experience in the NeXT computing laboratory.

Jean Ethredge

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**Mathematica and Math Courses: Student Perspectives**

Abstract: see Crista Bailey.

Frank Hagin and Barbara Bath

Department of Mathematical and Computer Sciences, Colorado School of Mines, Golden, CO 80401-1887

**Calculus with Mathematica at Colorado School of Mines**

We will give an overview of the changes in our calculus curriculum that have occurred during the last two years. The impetus for these changes was our own sense that the course needed to reflect developing technology - and the availability of our new computer classroom/lab.

John H. Hodges

Department of Mathematics, University of Colorado, Boulder, C0 80309-0395

**Remarks on the Matrix Equation $\mathbf{X}^e = \mathbf{B}$ over a Finite Field**

Since 1955 a variety of results have been obtained, some by the speaker, concerning the number of solutions of this equation for certain values of $e$ and/or for $2 \times 2$ matrices $\mathbf{A}$. A summary of these results will be presented.

Thomas Kelley

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**Some Mathematica Mistakes?**

The advice, "Check your result.", is even sounder when a machine is doing the calculations for you. Now that students are using computers and graphics calculators to do mathematics they need to learn how to check and interpret their numerical results and graphs. This talk will look at some examples of numerical results and graphs produced by Mathematica that require an interpretation. These examples are used in MSCD's Mathematica Modules to illustrate mathematical concepts and connections for the students. One of the results is, in fact, a definite integral that was incorrectly evaluated by Mathematica.

John Kenelly

Banquet Address

**New Moves in Assessment and Educational Accountability**

Saturday's talk:

**Technology in Mathematics Instruction – Changes Beyond Compare**

This talk will be on the way that mathematics instruction is changing in the face of overwhelming technology developments.

Warren W. Kokko

Department of Mathematics, Arapahoe Community College, Littleton, CO 80221

**Advanced Programming on the HP-48sx**

The use of the HP-48sx in deriving exact results for a 'Two-Dice Problem' will be presented. The problem can be formulated as follows: Two dices are rolled $N$ times and the numbers are recorded. What should $N$ be so that the probability of getting all the numbers 2 through 12 at least once is closest to 50 % ?

James A. LaVita

Department of Mathematics and Computer Science, University of Denver, Denver, CO 80208

**A Case Study Course in Mathematics for Non-science Students**

Abstract: see Bill Dorn.

Steven Leth

Department of Mathematical Sciences, University of Northern Colorado, Greeley, CO 80639

**The Use of Writing in Teaching Mathematics**

The most successful new element in our Calculus Reform efforts at UNC is the use of Student "Projects" or term papers. Writing projects in our Math for Elementary Teachers classes has also been beneficial. In this talk I will discuss ways to use writing assignments to enhance the level of student involvement in classes at various levels.

C.G. Mendez

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**Bachelier's Theory of Speculation**

A number of funtion approximation and statistical models were developed in the 1950's to value risk management securities. Corresponding research in the 1960's shifted to the study of probabilistic models based on Bachelier's Sorbonne doctoral dissertation. In this talk we review his work and discuss its significance as a problem solving strategy.

Aref Nammari

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**Mathematica and Math Courses: Student Perspectives**

Abstract: see Crista Bailey.

Jim Olsen

Mathematics Department, University of Northern Colorado, Greeley, CO 80639

**The Function Minute: An Effort to Teach Basic Function Concepts More Effectively**

The function concept is unifying and central to the understanding of modern mathematics and mathematical modeling. The function concept is composed of many aspects. This complex concept is further complicated by the many representations a function can have. Basic concepts surrounding the function concept are easily overlooked by students and instructors. One reason being that they are conceptual in nature, and emphasis and attention is placed on procedural skills. Other reasons exist for the difficulty students have with the function concept.

Jim is currently implementing, in his College Algebra course, a program he has developed to teach basic function concepts. The program, called the *Function Minute*, also attempts to show students how functions appear (repeatedly) in the real world, emphasize multiple representations, and make the function concept a central thread of the course.

Jim has taught high school mathematics for ten years. He holds a Masters of Mathematics from C.S.U. and is currently in his second year in the Ph.D. program in Educational Mathematics at U.N.C. His activities both inside and outside the classroom have peaked his interest in the teaching and learning of the function concept.

A. Duane Porter

Department of Mathematics, University of Wyoming, Laramie, WY 82071

**J. H. Hodges and Matrix Equations**

Comments on the career of Prof. Hodges; his effect on teaching, matrix equations and on the speaker.

Steven Pruess

Department of Mathematical and Computer Sciences, Colorado School of Mines, Golden, CO 80401-1887

**Stable Qualitatively Correct Interpolants for Accurate Data**

Several numerical algorithms for estimating the solution of an ordinary differential equation can produce highly accurate approximations at a finite set of points. It is often desirable to produce a closed form approximation based on this data. The obvious piecewise polynomial interpolants frequently do not work, especially for highly nonuniform meshes. A stable alternative is presented.

For Sturm-Liouville eigenfunctions the mathematical theory provides the oscillation properties (number of zeros) of the solution. Can an accurate interpolant be constructed cheaply which has the correct qualitative behavior as well as being accurate?

Leslie E. Shader

Department of Mathematics, University of Wyoming, Laramie, WY 82071

**Odd Neighbors and Odd Neighborhoods**

Let $G$ be a graph (no loops or multiple edges), $v$ a vertex of $G$, the neighborhood determined by $v$, $N_v = \{v\} \cup \{v_i,$ where $vv_i$ is an edge of $G\}$. It is known that the vertices of $G$ can labeled with 0's and 1's so that every neighborhood contains an odd number of odd neighbors, i.e. every neighborhood is odd.

In this talk two theorems are proven:

Theorem I. Every graph $G$ labeled with 0's and 1's can be embedded in a graph $G'$ in which all neighborhoods are odd. In fact, only one additional vertex must be added to $G$.

Theorem II. If $v$ is an 0-1 $n-$tuple then there is a $n \times k$ rectangular grid with $nk$ unit squares, with $v$ labeling the squares on one edge and every neighborhood is odd. The neighborhood of a square $s$ is $N_s = \{s\} \cup \{s_i,$ where sand $s_i$ share an edge$\}$.

John Starrett

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**Why is Bach Out of Tune?**

Pythagoras gave the first mathematical treatment of musical scales and harmonies. He concluded that pitches related by small number ratios are the most harmonious. These results have been borne out by psycho-acoustic experiments, yet, since the success of The Well Tempered Clavier we have been using scales and harmonies that are deliberately out of tune. We explore the reasons for this, and some remedies and alternatives made possible by modern technology.

Igor Szczyrba

Department of Mathematics, University of Northern Colorado, Greeley, CO 80639

**What Should you Know about Continuum and how to Teach about it?**

What intuitions are behind the notion of continuum? Do we really see in three dimensions? How to introduce real numbers in high school without talking about fractions? Those and other questions will be addressed starting from original thoughts of Henri Poincaré and Henri Lebesque.

Louis A. Talman

Department of Mathematical Sciences, Metropolitan State College of Denver, Denver, CO 80217-3362

**Computer Algebra Systems and Visualization in Mathematics**

Mathematica and its siblings make it possible to visualize mathematical objects, techniques, and processes in new ways. In this talk I demonstrate some possibilities at all levels of undergraduate mathematics. Some of these things were not feasible only a few years ago; others simply were not something one was likely to think of doing. Ability to visualize in new ways changes one's approach to many problems. Computer-aided visualization has the potential to do to mathematics what the telescope did to astronomy, what the microscope did to biology; it offers to change the way we perceive mathematical objects, the way we do mathematics, how we teach it, and what we conceive it to be.

Don Teets

Department of Mathematical and Computer Sciences, South Dakota School of Mines and Technology, Rapid City, SD 57701

**Chaos for the Uninitiated**

This talk will introduce the fundamental concepts of chaotic dynamics. It will be presented at a level that assumes no specific knowledge about the subject of chaos; only a modest background in analysis is needed. This talk is derived from a junior-senior level course on chaotic dynamics offered last Fall at The South Dakota School of Mines and Technology.