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CMRR Report

Center for Magnetic Recording Research

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Fredrickson Receives Doctorate

Joining the growing number of doctoral students to graduate from CMRR is Lyle Fredrickson who was awarded his Ph.D. in electrical engineering in June.

Fredrickson received his A.B. in mathematics from the University of California, Berkeley in 1980. After working as an engineer for several years, he returned to the University of California, this time to the San Diego campus. He pursued his studies in electrical engineering, specifically in communication theory and systems. While studying for his doctorate Fredrickson also worked as an engineer at Qualcomm, Inc., a local San Diego company.

Lyle Fredrickson

During his time at CMRR, Lyle presented two papers at national meetings — "Error Detecting Multiple Block (d,k) Codes" at the 1989 Intermag in Washington, DC and "Coding Using Multiple Block (d,k) Codes" at the International Conference on Communications in Boston, MA.

Fredrickson's thesis "Coding for Magnetic Channels" gratefully acknowledges support he received from IBM Corporation, Control Data Corporation, The National Science Foundation and the Center for Magnetic Recording Research.

Fredrickson has accepted a position with IBM Corporation in their General Products Division in San Jose and will be working with Dr. Roger Wood.

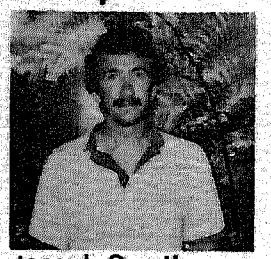
New CMRR Sponsors

Iomega Corporation, with home offices in Roy, Utah, recently joined the growing list of CMRR sponsors. Iomega is a leading supplier of high performance removable mass storage products for desk-top computers. Iomega-patented Bernoulli technology provides unlimited data storage capability by combining the removability of floppy drives with the high capacity and performance of rigid drives.

Cipher Data Products, a local San Diego company, has become the newest sponsor of the Center. Cipher manufactures a number of removable storage media products including 1/2" reel-to-reel, 1/4" cartridge, 1/2" cartridge and optical disk drives.

Smyth Receives IBM Fellowship

Joseph Smyth, a doctoral candidate at UCSD, is a recipient of a 1988/89 IBM Fellowship. Smyth received his B.A. in physics from UCSD in 1983 and his M.S. in physics a year later. He is currently working towards his Ph.D. with Professor Sheldon Schultz of the Department of Physics as his adviser.



Joseph Smyth

Smyth's current area of research involves the hysteretic interaction of small magnetic particles as a function of size and spacing. In order to achieve this, state of the art electron beam lithography is being utilized to fabricate arrays of magnetic particles. Collaborating in this project is Dr. David Kern of IBM's T. J. Watson Research Center. In order to measure the hysteresis loops of the magnetic particle arrays, a sensitive

Continued on page 3

Sreen Raghavan Awarded Student Research Position at IBM

Sreen Raghavan, a graduate student at CMRR, is spending the summer at the IBM Almaden Research Center in San Jose as a student researcher in the signal processing group. Sreen was chosen as the successful student for this position from a large pool of candidates nominated by several schools. He will be working with Drs. Paul Siegel and Hemant Thapar. While there, he will be studying the performance of trellis codes on the magnetic recording channel using computer simulation.

Raghavan graduated in 1987 with a B.S. in electrical engineering from the Indian Institute of Technology, Madras, India. He received his M.S. in electrical engineering from the University of California, San Diego this year. His area of specialization is digital communications and information theory with CMRR's Professor Jack Wolf as his adviser.

Sreen Raghavan

In December 1989, Raghavan will return to CMRR to complete his doctoral work. His research at CMRR involves application of information theory to the magnetic recording channel. In particular he is studying optimal soft decision schemes for channels corrupted by both intersymbol interference and additive white Gaussian noise. He is also looking at the computation of the cut-off rate of a discrete memoryless channel whose inputs are from a specific (d,k) encoder.

John Malinson

FROM THE DIRECTOR

It is my pleasure to announce that CMRR has two new sponsors: Iomega and Cipher Data. Iomega is the manufacturer of the well-known "Bernoulli Box" and is based in Roy, Utah. Cipher Data, a San Diego company, makes 1/4" data cassette and 1/2" data cartridge drives. In addition to their magnetic recording activities, these companies have subsidiaries, Bernoulli Optical Storage Company (BOSCO) and Optimem respectively, which are pursuing optical recording technologies.

It is, on the other hand, with sadness that I have to report that one of CMRR's founding sponsors, Minnesota Mining and Manufacturing (3M) has opted to relinquish its sponsorship. 3M's early support of CMRR was invaluable and I live with the hope that 3M will, one day, be persuaded to rejoin and enjoy the fruits of their early investment.

All interested in magnetic recording technology should take note that in April, 1989, two technological firsts were announced in Japan. First, the Hi-8mm VCR becomes the first production recorder ever to surpass a linear density of 100,000 flux reversals per inch. Second, metal-evaporated (ME) tape cassettes were first offered for sale with the Hi-8mm VCR. It is not difficult to predict that, if these developments prove viable, a quantum-like leap in the performance of all types of tape recorders is about to occur.

Already the total data capacity of magnetic recorders using metal particle (MP) tape has already far exceeded those of single optical discs in both small (R-DAT 1.3 Gigabytes; 8mm 2.3 Gigabytes) size and large (D-2L 0.25 Terrabytes) size cassettes. With the arrival of ME tape, the future for magnetic recording has, in the director's opinion, never looked rosier!

John C. Mallinson

CMRR Graduate Accepts Position at Western Digital

Patrick Lee, a former CMRR doctoral student, accepted a position earlier this year with Western Digital, a CMRR-sponsoring company. Lee started his college education as an anthropology major at the University of California, Los Angeles, "by default, since I didn't know what I wanted to do." After graduating in 1973 with a B.A. (in anthropology), he then changed direction and enrolled as an undergraduate in electrical engineering at UCSD. He completed his second bachelor's degree and then an M.S. in information and computer science in 1978.

Lee began his engineering career working for Linkabit, later M/A-COM Government Systems, initially as a software engineer and later as a communication systems engineer. Soon after CMRR was established, Lee decided to return to school full time. He worked with Professor Jack Wolf as his supervisor until "Jack finally got rid of me" when he graduated with a Ph.D. in information and computer science in 1988. On completing his Ph.D., Patrick returned to M/A-COM until March 1989 when he took up a new position with Western Digital at their drives facility in San Jose, CA. Utilizing earlier training as a communications engineer, he is now involved in disk drive research for Western Digital where he is investigating ways of increasing disk storage capacity through the application of communication/information theory to magnetic recording. His primary focus is investigating run length limited (RLL) coding for a buried servo channel, although other research areas include data compaction techniques, AC bias recording and combined ECC/RLL coding. Some other CMRR students who have accepted positions with CMRR's sponsoring companies are:

Eric Hung	Ampex
Douglas Trauner	Ampex
Kuo-nan Yang	Ampex
Craig Cocchi	Archive
Tim Riener	Domain Technology
Glenn Dixon	IBM
Lyle Fredrickson	IBM
Bucknell Webb	IBM

Industrial Visitor Programs

CMRR has recently expanded its policy on industrial visitors. Now, all Level II sponsors are encouraged to send one visitor for periods of up to six months. As before, Level III sponsors may, of course, send any number of visitors for unlimited periods.

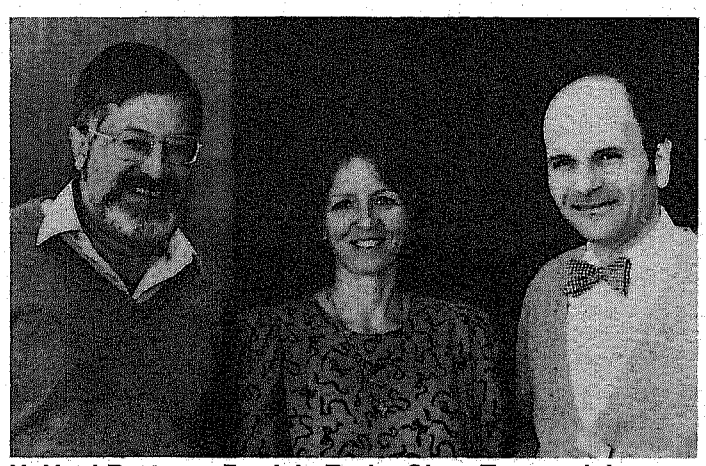
A recent visitor for almost fifteen months from IBM has this to say about the value of being an industrial visitor:

BEYOND THE QUARTERLY EARNINGS
Stephen Edel
IBM General Products Division
San Jose, California

The magnetic storage industry has seen tremendous growth in the 1980s, and with it a sharp increase in competition among hundreds of companies. Corporations continue to seek an edge over other competitors through innovations by their scientists and engineers. However, reduced product cycle times often leave little time for professionals to remain "current" in their field, or to obtain new skills required for next generation products.

Educational institutions such as CMRR can help to fill this need. Upon arrival at the Center, individuals from sponsoring companies will find many avenues open to enhance their growth. These include: (1) easy access to chaired professors, (2) undergraduate and graduate courses in magnetic recording, materials science, physics, and communication theory, (3) weekly CMRR seminars, and (4) regular, individual group discussion among students and professors. A multitude of theoretical and experimental opportunities are open for the visitor to explore from materials, heads, and disks, to tribology and read/write channels. In addition, a deep satisfaction is achieved in working with motivated people at CMRR to further advance the field of magnetic recording.

In short, top level management which is truly committed to staying competitive in the 1990s should take another look at how they are keeping their engineers and scientists technically updated, and what CMRR can offer them.



H. Neal Bertram, Daniele Rode, Giora Tarnopolsky

CMRR Transfers Computer Code to Hewlett Packard Labs

The magnetic recording physics research group of Professor Neal Bertram has been working closely over the past year with Dr. Giora Tarnopolsky of HP Research Laboratories. The focus of research has been noise in metallic thin films and its utilization in head and medium calibration. Dr. Tarnopolsky has performed the experiments while the theoretical work was done by Dr. Alex Barany (deceased). This joint work resulted in a recent paper entitled "DC Modulation Noise and Demagnetizing Fields in Thin Metallic Films" published in IEEE Transactions on Magnetics. Before his death, Dr. Barany had written a one dimensional iterative numerical simulation for magnetic recording signal processes in thin films. This program has been given to Dr. Tarnopolsky to aid in the continuation of his research in this area. Dr. Daniele Rode of CMRR assisted in retrieving the code and certifying its reliability.

Summer Positions for CMRR Students

Two of CMRR's students are spending the summer working for companies which support the Center. They are Joshua Harrison, who completed his M.S. in June and will begin work on his Ph.D. in September. He is at IBM's General Products Division, San Jose, where he is working with Jim Burry and Reinhard Wolter. At CMRR, Harrison's supervisor is Professor Frank Talke.

Another of Professor Talke's students, Ray Karam, is also spending the summer working for a CMRR-sponsoring company — Hewlett Packard. Karam, a master's student at CMRR, is working with Richard Elders while at HP.

Visiting Scholar Acknowledges CMRR

While a doctoral candidate in the Department of Informatics at the University of Bergen, Norway, Oyvind Ytrehus spent a year at CMRR. His stay was financed by the Royal Norwegian Council for Scientific and Industrial Research (NTNF).

In the acknowledgements section of his thesis, Ytrehus recognized "Professor Jack K. Wolf and his CODES-R-US group for the very inspiring working environment they provided." He was recently awarded his doctorate from the University of Bergen for the thesis entitled "Codes for Error Control."

Smyth, continued

alternating gradient magnetometer has been constructed.

Along with Dr. Ian McFadyen of IBM's Almaden Research Center, the magnetization patterns of these particles has been imaged by using differential phase contrast microscopy.

The experimental results obtained from Smyth's work will be compared with the theoretical predictions of Dr. Donald F. Fredkin, Dept. of Physics, UCSD, and Dr. T. R. Koehler, IBM Almaden Research Center which involve extensive numerical simulations. The preliminary results of this work were presented at the 1987 3M Meeting in Chicago, IL.

Third Workshop on Applications of Micromagnetics to Magnetic Recording Materials

The third workshop on "Applications of Micromagnetics to Magnetic Recording Materials" was held at CMRR from February 8 to February 10, 1989. The goal of this conference was to provide an interactive forum for experimentalists as well as theoreticians. The thirty-two attendees comprised specialists in the field as well as representatives from CMRR's sponsoring companies. Foreign attendees were Dr. J. Chapman of the University of Glasgow and Professor Alex Hubert from the University of Erlangen-Nurnberg.

The topics discussed covered both recording media and heads and included: single domain particles, longitudinal thin films, perpendicular films, soft films, very high frequency effects in heads, and magnetization time decay. An example of focusing both on theory as well as experimental aspects of a topic was the session on magnetic thin recording films. Dr. McFadyen of IBM showed Lorentz microscopy pictures of reversal magnetization patterns while Dr. Zhu of CMRR showed results of theoretical simulations which corresponded closely to the experimental observations. In addition, Dr. Heiman from Seagate, Dr. Yogi from IBM, and Dr. Tarnopolsky of HP discussed results of film underlayer thickness and film composition on hysteresis loops and recording noise. The system results appeared to confirm the theory that low noise films consist of a well-defined grain structure with no intergranular exchange coupling.

Participants at Workshop

Tribology Class at CMRR

A week-long class on "Tribology and its Applications to Magnetic Recording" was held at CMRR beginning July 31, 1989. This is the second time the class has been offered and it attracted twenty-seven attendees. The class was taught jointly by Professors D. Bogy, E. Rabinowicz and F. Talke.

The class began with an introduction to tribology presented by Professor Talke, CMRR, followed by a session on surface characterization. The afternoon session on the theory of friction and principles of wear was given by Professor Ernest Rabinowicz, MIT.

The second day was opened by Professor Talke discussing boundary lubrication and synthetic lubricants, followed by Professor Rabinowicz's presentation on frictional polymers. An evening session was held which began with a discussion of hydrodynamic lubrication by Professor F. Talke, followed by Professor Bogy's presentation of work in the area of the head/disk and head/tape interface. Wednesday started with a session on the transition from flying to sliding given by Professor Talke, followed by Professor Bogy's lecture on carbon overcoats, failure prediction and drag tests. The session was concluded by Professor Rabinowicz with a discussion of stiction. The afternoon continued with size effects in tribology and a tour of CMRR's tribology laboratories.

Flexible media tribology was covered in the morning session on Thursday with the afternoon devoted to the instrumentation of magnetic recording tribology. The week finished up with a session on advanced topics in friction, wear and lubrication.

A repetition of the course is planned for the week of July 30 – August 3, 1990 at CMMR. Information concerning registration and other course details can be obtained by calling Ms. Pam Perry, (619) 534-3796 or Professor F. Talke at (619) 534-3646.

Workshop Notebooks Available

Copies of the notebook distributed at the Workshop on Signal Processing for Recording, held at CMRR, January 18-20, 1989 are available from:

Jan Neumann
Information Center
CMRR, R-001
UCSD La Jolla, CA 92093
(619) 534-6199

The loose leaf collection of the visuals presented at the workshop are available in a 3-ring binder at a cost of $50.

Calendar

This section includes forthcoming conferences, meetings, symposia, special courses, etc. related to magnetic recording. Please send notices of meetings, etc. to the editor.

October 3-4, 1989 – THIC Meeting, Tervose, PA For info: Gary Feurer (215) 441-2898

October 16-19, 1989 – STLE/ASME Tribology Conference, Fort Lauderdale, FL

October 17-19, 1989 – Optical Storage for Large Systems, New York City. For info: Rothchild Consultants, 256 Laguna Honda Blvd., San Francisco, CA 94116-1496 (415) 681-3700

November 28-December 1, 1989 – 34th Conference on Magnetism and Magnetic Materials, Boston, MA. For info: Courtesy Associates, 655 15th St., NW, Suite 300, Washington, DC 20005 (202) 639-5088

February 11-16, 1990 – Image Storage and Retrieval Technologies, Santa Clara, CA. For info: H-P David Shieh, IBM T. J. Watson Research Center, P.O. Box 218, Yorktown Heights, NY 10598.

April 16-20, 1990 – Intermag, Brighton, England. For info: Davina Houseago, Intermag '90, c/o ITEL, Brighton Polytechnic, Brighton BN2 4GJ, England 44-273-670400

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