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CMRR Report

Center for Magnetic Recording Research

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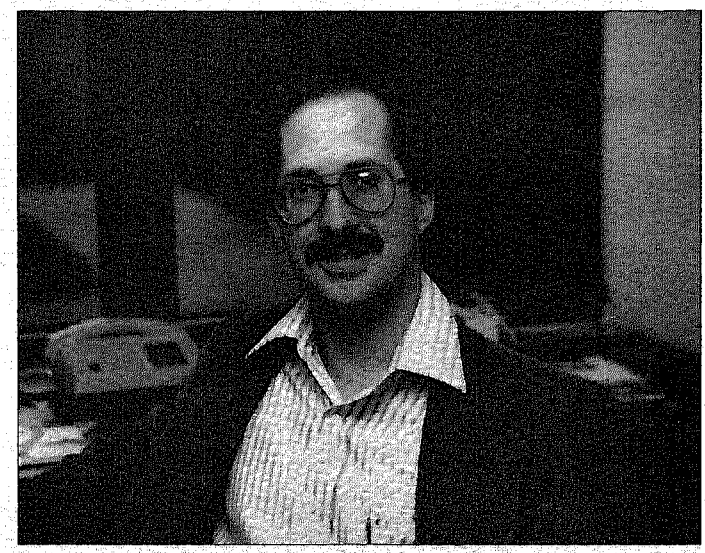
IBM Visitor at CMRR

In November 1987, Stephen Edel, advisory engineer from IBM's General Products Division, San Jose, California, took up residence at CMRR as an industrial visitor. Sponsoring companies of CMRR who contribute at the two highest levels are encouraged to send a visitor to the center to work with the center's faculty. Some pursue research interests while others are appointed as visiting faculty.

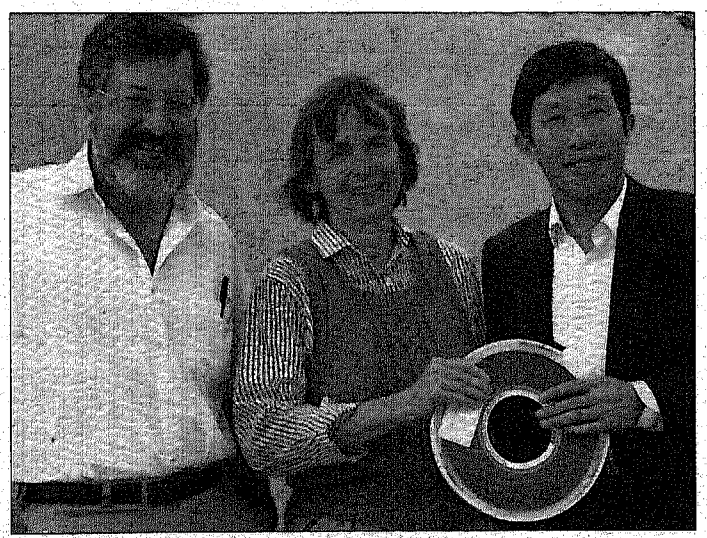
After graduating with a B.S. in electrical engineering from the University of California, Davis in 1977, Edel began working as a manufacturing engineer at IBM, San Jose. He worked on 8" disk drives for IBM while continuing his studies at Stanford University. After an international assignment at IBM's Havant facility in England, Edel was awarded his master's degree in control systems in 1981. He then entered IBM's development laboratory where he had servo design responsibility for IBM's 3380E disk drive. In 1985 Edel became manager for the Servo Integration Department and in 1986 took over management of the advanced Servo Architecture Group which produced the control system for the 3380K disk drive.

While at CMRR, Edel has worked with Professor Jack Wolf and his graduate students in the communications and signal processing laboratory. He has been involved with the design and construction of disk drive spinners and read/write channels. Unique error correction and modulation codes have been recently demonstrated which improve channel capacity and data integrity in disk and tape storage systems.



Stephen Edel

Edel has also spent time working with CMRR's Neal Bertram on analyzing head and media characteristics on the disk spinner, including reproduce head efficiencies and write transition parameters.



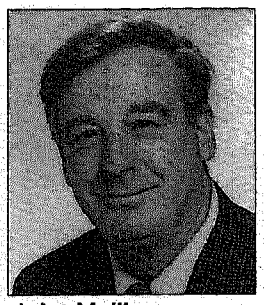
Left to right: H. N. Bertram, Irene Beardsley, Jian-gang Zhu

Computer Code Developed

Jian-gang Zhu, a student in Professor Neal Bertram's group at CMRR has spent the past twelve months working on micromagnetic analysis of thin film media.

He has developed a computer simulation model, which has been utilized to explain successfully the relationship between medium microstructure and the hysteretic and recording properties of films. The program has been used to show that intergranular exchange coupling in these polycrystalline films substantially increases noise.

The program has been given to Irene Beardsley, a member of the research staff at IBM's Almaden Research Center, who has worked closely with Professor Bertram and Zhu over the past two years. The code will be used at IBM to continue studies of magnetic recording in thin films. Beardsley's initial studies will concern side writing in these thin film media. Close collaboration will continue between Beardsley and CMRR.



John Mallinson

FROM THE DIRECTOR

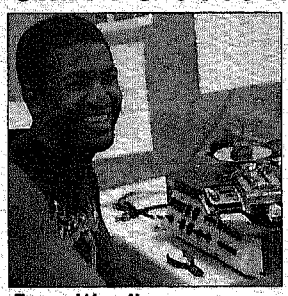
Over the past five years, I have become increasingly concerned that Magnetic Recording, a $30 billion per year business in the U.S. alone, has almost no voice in Washington. Indeed, not only does recording have no "home" in the National Science Foundation but also very few of the Department of Defense laboratories are supportive of the science and technology of magnetic recording.

I am extremely interested, therefore, in two new and recent initiatives. First, that the industry support a "technical lobbyist," Clark Johnson, in Washington and second, the plan being considered at NIST (formerly NBS) to do work on magnetic thin films. I have already written, on several occasions, to CMRR sponsors about these matters but if others need more information, do not hesitate to call me at (619) 534-6210.

Meanwhile, CMRR continues to become an even more impressive national center of magnetic recording research. At the November Advisory Council meeting, no less than thirty-four of our students gave presentations and our efforts were widely praised by our sponsors. If you know of any other company whom you regard as a potential new sponsor, please call me.

John C. Mallinson

Tony Weathers, CMRR Graduate Student



Tony Weathers

Tony Weathers graduated in 1984 with a B.S. in electrical engineering and in 1985 with an M.S. in electrical engineering, both from the Georgia Institute of Technology. His area of specialization was digital signal processing. Presently, he is working on a Ph.D. in electrical engineering at UCSD where he is specializing in communication theory with Professor Jack Wolf as an adviser.

The basic goal of the signal processing group at CMRR is to apply techniques used in communication theory to digital magnetic recording. Weathers is concentrating on developing new write equalization and modulation techniques to reduce the amount of signal processing needed to detect the readback signals reliably. He is also concerned with the development and evaluation of signal detection techniques matched to these write equalization schemes.

In collaboration with Professor Cathy French from the University of Idaho, Tony presented a paper at the Intermag '88 Conference describing the generation and detection of a class of modulation codes which allow the possibility of readback waveforms with pulses which do not have to alternate in polarity. Also in collaboration with Dr. French, Weathers has submitted a paper for presentation at Intermag '89 giving the results of comparisons of standard (d,k) codes with these new "controlled polarity" codes.

IBM Fellowship Awarded

An IBM fellowship has been awarded to CMRR student Jian-gang Zhu. The presentation was made to Zhu in September by Denis Mee, an IBM Fellow who acted as the IBM mentor submitting the nomination for this award. The one-year fellowship will pay for Zhu's salary

Left to right: John Mallinson; Denis Mee, IBM; Jian-gang Zhu; H. Neal Bertram; Tom Arnoldussen, IBM; Louis Nunnelley, IBM.

as a postdoctoral student. Although there is no commitment at the time of the award's being granted to extend the fellowship beyond one year, renewals may be granted after review of the year's progress.

Each year IBM awards some 200 fellowships to both pre- and post-doctoral students. This year IBM's General Products Division, San Jose awarded five fellowships. In addition to the award to Jian-gang Zhu, awards were made to students at the University of California, Berkeley, University of California, Davis, University of Washington and Carnegie Mellon University.

Jian-gang Zhu has been working on theoretical studies of the micromagnetics of magnetic thin films. He will continue this work during the fellowship period, working closely with Tom Arnoldussen at IBM, San Jose and Professor Bertram at CMRR. The fellowship will provide an opportunity for collaboration between IBM's experimentalists and the theoretical studies being pursued at CMRR.

Third Workshop on Applications of Micromagnetics to the Recording Process

The third in an annual series of workshops on applications of micromagnetics to recording materials will be held at the Center for Magnetic Recording Research from February 8 to 10, 1989.

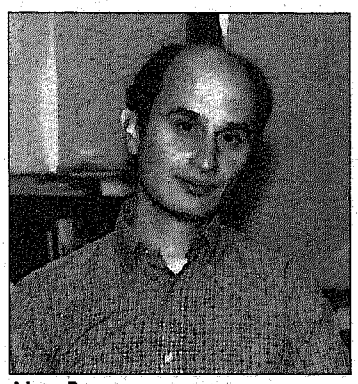
Approximately twenty-five invited specialists from the U.S. and Europe will attend, together with representatives from CMRR's sponsoring companies. The format centers on round-table discussions rather than a lecture format to facilitate the exchange of ideas. Consequently there are no published proceedings. This year, a number of experimentalists have been invited in order to promote a healthy exchange of ideas with the theoreticians.

Topics for discussion have been limited to allow in-depth discussion at each of the half-day sessions. Discussion topics are:

- Micromagnetic studies of single (or multiple) particles
- Micromagnetic studies of thin recording films
- Noise in thin film recording media
- Domain structure and dynamics in MR and thin film heads
- Modeling of thermo magneto optic processes

Alex Barany, In Memoriam

Alex Barany, a graduate student in Professor Bertram's group at CMRR, passed away suddenly on August 18, 1988.



Alex Barany

Alex was a student in the ECE Department, majoring in communications. This, together with his background in physics, suited him to the study of noise in recording media. For the past few years Alex had been working on theoretical studies of noise and non-linear bit shift in thin metallic films. He published two papers on this work in the *IEEE Transactions on Magnetics* and presented a paper at the Tokyo Intermag conference in 1987. His thesis, which was almost complete at the time of his death, will be presented by Professor Bertram to the reviewing committee and the Ph.D. is expected to be conferred posthumously.

Alex had worked for Hughes Network Systems since December, 1981. At the time of his death at age 32, he was one of the youngest senior principal engineers in the company. Alex is remembered as "one of the true bright lights in the engineering organization." Destined for great achievement, Alex won the Hughes Network Systems President's Award in August 1987 for his continual outstanding performance.

In the academic arena, Alex has been described by Professor Bertram as a rare student, perhaps the ideal Ph.D. candidate. Not only was he extraordinarily bright but he showed a great deal of initiative and was a good problem solver. He was a delightful person, warm, with a great sense of humor. We were fortunate indeed to have Alex work with us at CMRR. He will be sadly missed by all his colleagues.

Alex is survived by his wife, Laura, and their two year old son, Aaron.

Theses from CMRR Students

The following list provides names of CMRR-funded students and the titles of their completed theses:

Ph.D. Theses:

Ching-Ray Chang	The Reversal Mechanism of Uniaxial Ferromagnetic Particulate Medium. 1988
Weng-Ruey Chang	Contact, Adhesion and Static Friction of Metallic Rough Surfaces. 1986
Catherine Ann French	Signal Processing for Digital Magnetic Recording Channels. 1987
Patrick Lee	Combined Error-Correcting/ Modulation Recording Codes. 1988
Denny Kwok-Kun Miu	Dynamics of Gas-Lubricated Slider Bearings in Magnetic Recording Disk Files: Theory and Experiment. 1985
Thomas Shield	Multiple Region Contact Solutions for a Flat Indenter on a Layered Elastic Half Space. 1988
Ephraim Zehavi	Coding for Magnetic Recording. 1987
Xin-Yun Zhang	Some Aspects of Non-linear Dynamics in Magnetic Systems. 1987

Masters Theses:

Gilles Bouchard	Experimental Measurement of Scattered Surface Waves Using a Laser Doppler Technique. 1983
Clifton Cooper	Ferrites for Recording Head Applications. 1984
T. T. Dao	Measurement and Characterization of the Surface Roughness of Rigid Disk Substrates Used in Computer Storage. 1985
Glenn S. Dixon	Experimental Studies in Linearity and Write Equalization for Digital Magnetic Recording. 1987
Linda Hsi	Application of Dynamic Measurements to Disk Files. 1985
Catherine Keely	Experimental Wear Studies of Magnetic Media Disks. 1985
Becky May	Wear Protection Properties of Carbon Overcoats on Thin Film Magnetic Media. 1986
Timothy Riener	Dynamics of Magnetic Recording Sliders Using Laser Doppler Interferometry. 1988
Jeffrey Streator	A Preliminary Study of Slider Friction, Take-Off Speed and Slider Impact. 1985
David Towne	Free Vibration Analysis of a Spinning Annular Disk. 1986
Joan Tang Waltman	Software for the Development of Sliding Block Encoders for Modulation Codes. 1987
Kenny Wong	Accelerated Wear of Magnetic Media. 1986
Li-yan Zhui	Spacing Variation in Magnetic Disk Drives. 1986

Workshop on Signal Processing for Recording

Jack Wolf has organized a two and one-half day workshop on signal processing for recording from January 18-20, 1989 at CMRR. Over eighty people from universities, industry and government are expected to attend the workshop. Topics to be covered include: physics of the magnetic recording process, physics of magneto-optic recording, systems implication of the physical phenomena for both magnetic and magneto-optic recording, equalization and detection, modulation codes, error correcting codes, information theoretic models for recording systems and source coding.

CALENDAR

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

February 3-4, 1989 – 23rd SMPTE Television Conference, San Francisco. *For info:* SMPTE, 595 W. Hartsdale Avenue, White Plains, NY 10607

February 28-March 3, 1989 – 2nd International Symposium on Trends and New Applications in Thin Films. *For info:* Prof. Dr. H. Hoffmann, Inst. für Angewandte Physik, Universität Regensburg, 8400 Regensburg, Fed. Rep. Germany

March 14, 1989 – Tape Head Interface Committee (THIC), Annapolis, MD. *For info:* C. D. Wright (201) 234-9484

March 20-22, 1989 – International Symposium on Magneto-elasticity and Electronic Structure of Transition Metals, Alloys and Films, Duisburg, West Germany. *For info:* Dr. M. Acet, Universität Duisburg, Postfach 10 15 03, D-4100 Duisburg 1, W. Germany

March 21-23, 1989 – Optical Storage of Documents and Images, Washington, DC. *For info:* Rothchild Consultants, 256 Laguna Honda Blvd., San Francisco, CA 94116-1496 (415) 681-3700

March 27-31, 1989 – Intermag, Washington, DC. *For info:* Courtesy Associates, 655 15th St., NW, Suite 300, Washington, DC 20005 (202) 639-5088

April 3-7, 1989 – 7th International Seminar on Magnetism, Dresden. *For info:* Prof. Dr. K. Elk, HfV "Friedrich List," PSF 103, DDR-Dresden, 8072, GDR

April 18-20, 1989 – Optical Memory Applications, London. *For info:* Rothchild Consultants, 256 Laguna Honda Blvd., San Francisco, CA 94116-1496 (415) 681-3700

April 24-28, 1989 – Materials Research Society, San Diego, CA. *For info:* Materials Research Society, 9800 McKnight Rd., Suite 327, Pittsburgh, PA 15237 (412) 367-3003

May 17-19, 1989 – 10th International Workshop on Rare-Earth Magnets and Their Applications, Kyoto, Japan. *For info:* Prof. K. J. Strnat, Magnetics Lab, LK- 365, University of Dayton, Dayton, OH 45469 (513) 229-3535

July 25-27, 1989 – Optical Drive and Media Manufacturing, San Francisco. *For info:* Rothchild Consultants, 256 Laguna Honda Blvd., San Francisco, CA 94116-1496 (415) 681-3700

August 29-31, 1989 – Perpendicular Magnetic Recording Conference '89, Tokyo, Japan. *For info:* Prof. Masahiko Naoe, Dept. of Physical Electronics, Tokyo Institute of Technology, 2-12-1 O-okayama, Meguro-ku, Tokyo 15, Japan

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