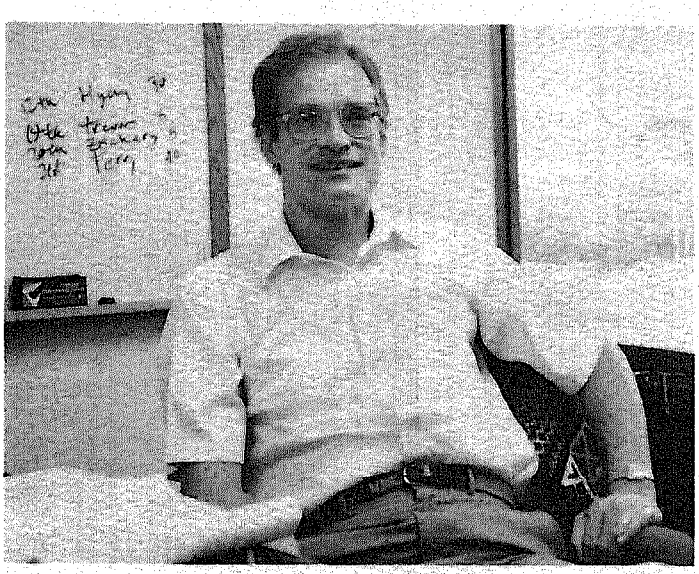
ISSN: 0888-7381

CMRR Report

Center for Magnetic Recording Research

VOL 4, NUMBER 1 SUMMER 1987



John Bortins

Industrial Visitor from CDC

In September 1986 Mr. John Bortins began a sabbatical leave at CMRR. At Control Data Corporation, Minnesota, John is in his thirteenth year and is presently a principal scientist at the Magnetic Peripherals Incorporated subsidiary. His responsibilities include the design and development of thin film heads for MPI's customers. Prior to joining MPI, John was a staff member of CDC's Central Research Laboratory where he worked on magnetic plated wire memory element manufacturing, magnetic bubble memory development, and optical modulation for computer circuitry.

At MPI John has worked on a variety of design and development topics. His experience includes work on a dynamic iterative model of the recording medium. He has contributed to the testing of thin film heads by establishing inductance measurement and improving testing efficiency. He created an algorithm for establishing the throat height of a thin film head and wrote new software for the head lapping machines. Prior to his sabbatical, John laid out a new thin film head design for a disk drive product family that featured computer-generated design elements to "let the computers do the boring jobs."

At CMRR John is working on a pet project, the digital acquisition of readback signal, a technique he wants to exploit upon his return to MPI. He is also taking the three-quarter graduate sequence in magnetic recording given by CMRR's Professor H. Neal Bertram. John hopes to gain a unified view of magnetic recording and to develop some facility with its theoretical foundations. While here John also has attended many of CMRR's seminars and talks in an attempt to absorb all that CMRR has to offer.

John's personal interests include mathematics and physical fitness. In order to pursue these interests, he is taking the three-quarter graduate sequence in complex analysis offered at UCSD and leads a 6 a.m. general fitness class at the North Coast YMCA.

NSF Presidential Young Investigator Award

Dr. D. K. Miu, a former student of Professor David Bogy, University of California, Berkeley has won a Presidential Young Investigator Award from the National Science Foundation. From the 1,122 applications received nationally, 200 grants were awarded.

Each winner receives a $25,000 annual research grant for up to five years and as much as $37,500 in additional yearly federal support if it can be matched by contributions from industry. The NSF-sponsored program is aimed at supporting the nation's most promising young scientists and engineers working in academia.

Denny Miu was one of Professor Bogy's first Ph.D. students to receive his degree while doing research on a CMRR-funded project. On completion of his doctorate, Miu worked for Kodak Research Laboratories, San Diego for eighteen months. He is now an assistant professor in the Mechanical, Aerospace and Nuclear Engineering Department at University of California, Los Angeles.

CMRR Adds New Sponsors

In January 1987 Hewlett-Packard became a corporate sponsor of the Center for Magnetic Recording Research. Dr. Jim Opfer has been named as H-P's representative to the Advisory Council.

In order to attract members from the many smaller companies involved in the magnetic recording industry, CMRR recently introduced a third level of sponsorship. While companies contributing at this level do not have membership on the Advisory Council, there are nevertheless a number of tangible benefits to be gained. We are pleased to announce our first level III sponsor in Sunward Technologies, a San Diego based company specializing in disc file heads. The Center looks forward to association with many more such sponsors. Interested companies can obtain further details from Phebe Cohen, Assistant to the Director, at (619) 534-6563. An informative packet will be sent to you on request.

The current list of CMRR sponsors follows:

CMRR Sponsors

Ampex Corporation
Applied Magnetics Corporation
Control Data/Unisys
Data Electronics, Inc.
Digital Equipment Corporation
Eastman Kodak
Hewlett-Packard
Honeywell Corporation
IBM
National Micronetics, Inc.
National Security Agency
Pfizer, Inc.
Seagate Technology
Sunward Technologies
3M
Verbatim Corporation

From the Director

As CMRR enters the fourth year of its operations, it is satisfying to report that we are now fully up to the planned operational level. Our endowed professors have each established effective research groups: Jack Wolf, Neal Bertram, Frank Talke and Ami Berkowitz have six, four, three, and three graduate students respectively. The outfitting of the second floor laboratories is in its final stages and it is planned that Professors Fredkin, Schultz, Middleman and Oesterreicher will occupy them soon.

Our continuing efforts to receive more industrial sponsors have borne fruit: Hewlett-Packard and Sunward Technologies have recently joined us. We now have fifteen industrial companies and one government agency as CMRR sponsors.

Despite a vigorous program to convince other federal agencies of the value of supporting research in storage technology, CMRR still lacks substantial federal funding. Currently, we have four proposals pending at the National Science Foundation, one group proposal and three individual proposals from professors. As always, CMRR urges you to lobby on its behalf with any contacts you may have in the various government agencies.

A significant measure of the growing stature of CMRR may be inferred from the fact that we had no fewer than fourteen papers at the 1987 Intermag Conference which was held in Tokyo in April. CMRR is indebted to the IEEE Magnetics Society for no fewer than six student travel grants. These generous grants enabled our students to enjoy a learning experience which I am sure they will remember for many years.

—John C. Mallinson

Magnetic Recording Process Workshop

A three-day workshop on "Modeling the Magnetic Recording Process" was held at the Center for Magnetic Recording Research earlier this year from February 8-10. A total of twenty-four participants attended the workshop, three having travelled from Europe to participate. CMRR's Professor H. Neal Bertram chaired the meeting.

On the first day the results of two types of recording simulations were presented. These included continuum modeling as well as models which explicitly modeled the medium as an array of interacting grains with a definite geometry. Of particular interest were the discussions of granular modeling of Barium Ferrite media and of metallic thin films.

During the second day the program dealt with hysteresis models. Numerical simulations of reversal in single particles were discussed. Included were exact calculations utilizing both integral equation and finite element techniques together with simplified approximate solutions. General micromagnetic methods and vector Preisach modeling were also reviewed.

The concluding session was devoted to a discussion of modeling magnetization time decay phenomena. Simulated annealing techniques as well as explicit solutions for interacting particles were reviewed.

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CMRR Report is published quarterly.

Tribology Workshop

The third annual workshop on "Tribology of the Head/Medium Interface" was held at CMRR from March 15-18, 1987. The topics included instrumentation and boundary lubrication of the head/medium interface, rarefaction effects and flying at ultra-low spacings, and tribology of the head/tape interface.

In the first session on March 16, Professor Talke reviewed physical aspects of the head/medium interface. Thereafter, Dr. Hoo from IBM discussed electrical effects at the head/medium interface, Professor Lauer surveyed optical and analytical methods of tribology, and Dr. Timsit talked about interaction of lubricants with solid surfaces.

After a lab tour of the tribology laboratories in Professor Talke's area, boundary lubrication of disks and microhardness measurements of carbon films were discussed by Professor Bogy and Dr. Ananth, Unisys. Recent modeling work by Benson and Talke on the transition from sliding to flying was presented by Dr. Benson from the University of Rochester, and the day ended with a summary of tribological studies of thin metal disks by Mr. Doan of Cyberdisk.

On March 17 the meeting started with a presentation by Professor White on the theory of low flying sliders, followed by a discussion of the role of the Boltzmann equation in lubrication theory by Professor Ganz of the University of Rochester and a summary of experimental results of low flying heads by Dr. Mo of Censtor Technology. Flexible media abrasivity was discussed by Professor Rabinowicz, followed by flexible media surface roughness measurement (C. Lacey, Kodak). Thereafter, the role of friction in tapes was discussed by Dr. Smith of 3M, and microdisk media mechanical requirements were presented by L. Tao of Verbatim.

The last day of the meeting featured a discussion of particles (Gustard, Pfizer) and image processing applied to rigid disk media (Jones, IBM). An open forum summarized the results and findings of the 2-day seminar, and directions for future research were discussed.

The meeting was well attended and has become an important forum for the interchange of ideas and research results in the field of tribology of magnetic recording devices.

If you require any further information about the meeting, please contact Professor Frank Talke, chair of the workshop.

Wolf Speaks at Breakfast Meeting

CONNECT, a UCSD Extension program in technology and entrepreneurship conducts a breakfast series called "Meet The Researcher." This is aimed at acquainting UCSD's surrounding high-tech community with some of the research currently being done at UCSD. The talks are presented such that they are of interest to managers and others without a technical background as well as to scientists and engineers.

In January, 1987, Dr. Jack K. Wolf, one of CMRR's four endowed professors, presented a talk on the work being done at the Center. He discussed the importance of the magnetic recording industry to the United States, compared the areal and volume density of magnetic recording to optical and optically assisted magnetic recording, and discussed the future of magnetic recording in light of these two other technologies.

The talk was attended by approximately seventy-five persons.

CMRR Well Represented at Intermag

The recent International Conference on Magnetics, held April 14-17, in Tokyo, Japan, provided a forum for many of the research projects currently underway at CMRR. Titles of papers resulting from CMRR research follow:

Barany, A.; Bertram, N.;
"Transition Position and Amplitude Fluctuation Noise Model for Longitudinal Thin Film Media"

Benson, R.; Talke, F.;
"The Transition Between Sliding and Flying of a Magnetic Recording Slider"

Berkowitz, A.E.; Hall, E.L.;
"Microstructural Defects and Morphological Irregularities in Gamma Fe_2O_3 Particles"

Bouchard, G.; Lau, L.; Talke, F.;
"An Investigation of Non-Repeatable Spindle Run-Out"

Chang, C.; Zhang, X.;
"The Dispersion Patterns of Acicular Particles in Viscous Medium"

Chang, C.; Fredkin, D.;
"The Shearing of Perpendicular Loop with Columnar Structure"

Dixon, G.; French, C.; Wolf, J.;
"Results Involving (d,k) Constrained M-ary Codes"

Fredkin, D.; Koehler, T.;
"Numerical Micromagnetics by the Finite Element Method"

Mallinson, J.;
"Magnetic and Optical Rigid Disc Recording: A Comparison of Design Philosophies"

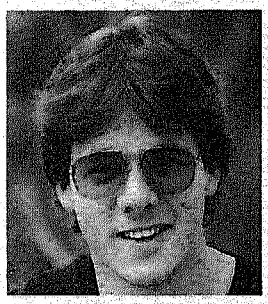
Oseroff, S.; Franks, D.; Tobin, V.; Schultz, S.;
"Magnetization Time Decay in Particulate Media"

Perlov, C.; Bertram, N.;
"An Improved Model for Perpendicular Recording"

Rode, D.; Bertram, N.; Fredkin, D.;
"Effective Volume of Interacting Particles"

Wolf, J.; Lee, P.;
"Combined Error Correction/Modulation Codes"

Zhu, J.; Bertram, N.;
"Computer Simulation of Nonlinear Bit Shift in Perpendicular Recording"



Winfried Richter

German Student Studies with Talke

Winfried Richter arrived at CMRR on May 4 to study with Professor Frank Talke. In Germany, Winfried is completing his diploma in Mechanical Engineering from the Institut fuer Maschinenelemente und Gestaltungslehre, University of Stuttgart. The project he will work on here at the Center will count towards his diploma.

While at the Center, Richter and another student, Douglas Trauner, will work on the non-repeatable runout of hard disk spindles. In this project they will be studying the effect of design parameters on the degree of non-repeatable runout, both radial and axial. Statistical methods will be used to study the cross correlation of radial and axial non-repeatable runout.

Capacitive probe techniques will be used to achieve simultaneous measurement of radial and axial runout. Laser Doppler vibrometry will also be used to investigate non-repeatable runout.

This visit was arranged by Professor Talke and Dr. Karl Heinz Hirschmann from the University of Stuttgart. Talke and Hirschmann studied together in Stuttgart and Dr. Hirschmann spent one year as a colleague of Professor Talke's at IBM.

Jian-gang Zhu

Spotlight on Graduate Student Projects

In this ongoing series, we will focus attention on the graduate projects underway at CMRR. This issue will look at the work of Jian-gang (Jimmy) Zhu, a graduate student at CMRR since May 1985 under the supervision of Professor H. Neal Bertram.

Jimmy graduated in 1982 from the Department of Physics at Huazhong University of Science and Technology, Wuhan, China with a B.S. in physics. In September of that year he was admitted to UCSD's Department of Physics as a graduate student. In October the following year he was awarded his M.S. in physics.

At the recent Intermag meeting in Tokyo, Jimmy presented a paper co-authored with Neal Bertram on "Computer simulation of nonlinear bit shift in perpendicular recording." Initially, after his arrival at the center, Jimmy worked on modeling perpendicular recording with Professor Bertram, and has three published papers to his credit in this area.

The project Jimmy is currently working on for his Ph.D. thesis concerns Micromagnetic Studies of Thin Metallic Films. He is studying the magnetic phenomena of thin metallic films using UCSD's Cray supercomputer to conduct computer simulation studies. The study focuses on dynamic, collective magnetization reversals, transition structures, intertransition interactions and noise phenomena. The overall objective is to investigate the influence of micro characteristics of these films to magnetic recording performance.

Workshop on Modulation and Coding for Digital Recording Channels

On January 8-10, 1987, a workshop was hosted by CMRR concerned with modulation and coding for digital recording channels. This was the second workshop on this topic hosted by CMRR, the first having been held in May 1985.

This workshop gathered experts in recording technology and communication theory to address problems common to both fields. While the first workshop was aimed at acquainting the communication theorists with the details of the magnetic recording channel, this workshop attempted a more balanced approach. Specifically, the goal was to identify specific approaches from communication theory to improve the efficiency and reliability of signaling schemes for magnetic recording.

The first morning included three presentations on characterizing the magnetic recording channel. John Mallinson reviewed information on the channel itself, Neal Bertram did the same for noise models and Tom Howell reviewed peak detection techniques. The afternoon of the first day addressed three aspects of equalization. Lin Barbosa reviewed equalization approaches to magnetic recording and John Proakis did the same for communications channels. Paul Newby and Dave Forney discussed equalizing to a partial response channel.

The discussions of the second day covered modulation and coding schemes. In the morning Paul Siegel reviewed modulation codes, Richard Schneider discussed write equalization and Lew Franks surveyed schemes for timing recovery and synchronization. In the afternoon Elwyn Berlekamp and Andy Viterbis surveyed block and convolutional coding respectively, and Aaron Wyner discussed the channel capacity of an additive white Gaussian channel with a peak power constraint on the input signal. The final day was reserved for informal presentations and discussions.

The meeting was attended by approximately sixty persons from both academia and industry.

Calendar

August 3-7, 1987	Rapidly Quenched Metals 6th Annual Conference, Montreal, Quebec
August 17-21, 1987	ICAME87—International Conference on the Applications of the Mossbauer Effect, Melbourne, Australia
August 25-28, 1987	Conference on Computation of Electro-Magnetic Fields, Graz, Austria For further info: COMPUMAG-Secretariat, INTERCONVENTION, P.O. Box 80, A-1107 Vienna, Austria
August 31-September 3, 1987	Ninth International Workshop on Rare-Earth Magnetics and Their Applications and Fifth International Symposium on Magnetic Anisotropy and Coercivity in Rare Earth-Transition Metal Alloys, Frankfurt, Germany For further info: Rainer Poerschke, Deutsche Physikalische Gesellschaft, AG Magnetismus der Deutschen Physikalischen Gesellschaft EV, Hauptstrasse 5, D-5340 Bad Honnef 1, West Germany
September 3, 1987	5th International Symposium on Magnetic Anisotropy and Coercivity in Rare Earth-Transition Metal Alloys, Frankfurt, West Germany For further info: same as above
September 1-4, 1987	Soft Magnetic Materials 8 (SMM8), Congress Centre Badgastein, Salzburg, Austria For further info: H. Pfutzner, Bioelectricity & Magnetism Division, University of Technology, Gusshausstrasse 27, A-1040 Wien, Austria
September 14-16, 1987	European Magnetic Materials for Applications (EMMA'87), Salford, United Kingdom For further info: Dr. P.J. Grundy, Dept. of Pure and Applied Physics, University of Salford, Salford, M5 4WT, UK
September 16-18, 1987	International Symposium & Exhibition on Optical Memory, Tokyo, Japan For further info: ISOM '87 Secretariat, OITDA, 20th Mori Bldg., 7-4, Nishi-Shinbashi 2-chome, Minato-ku, Tokyo, 105 Japan (03) 508-2091, FAX (03) 591-3610
October, 1987	International TOC Conference on Optical Memory Technology, Tokyo, Japan For further info: Rothchild Consultants, P.O. Box 14817, San Francisco, CA (415) 681-3700
October 5-8, 1987	4th Symposium on Tribology and Mechanics of Magnetic & Optical Storage Systems, San Antonio, TX
November 9-11, 1987	Third Annual Conference on Optical Storage for Small Systems, Los Angeles, CA For further info: Rothchild Consultants, P.O. Box 14817, San Francisco, CA (415) 681-3700
November 9-12, 1987	32nd Conference on Magnetism and Magnetic Materials, Chicago, IL For further info: R.M. Josephs, Naval Air Devel. Ctr., Code 5023, Warminster, PA 18974

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No public funds were used in the production of the CMRR Report.

8687-487