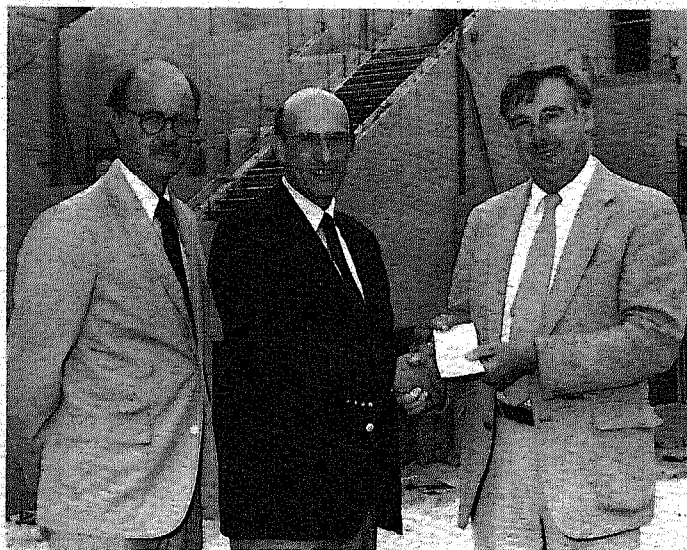


# CMRR Report

Center for Magnetic Recording Research

Vol. 2, No. 3  
Fall 1985

## Honeywell Joins CMRR



*l. to r. Lea Rudee, Ira Langenthal, John Mallinson.*

The Center for Magnetic Recording Research is pleased to announce Honeywell Inc. as the latest corporation to join the growing list of corporate sponsors. Dr. Ira Langenthal, Vice President, Operations, at Honeywell's Test Instruments Division, met with the Center's director John C. Mallinson and UCSD's dean of Engineering, Dr. Lea Rudee, on June 12 to discuss Honeywell's participation in our program. Dr. Langenthal was taken on tour of the new \$5 million facility which will house the Center early in 1986. While at the building site, Dr. Langenthal presented a check from Honeywell Inc. to John Mallinson. Dr. Langenthal will serve on the Center's Advisory Council as the Honeywell representative. Dr. Langenthal, who received his Ph.D. from Yale University, has been an innovator in the use of signal processing techniques for instrumentation. When not pursuing his professional interests, Dr. Langenthal can be found on the ski slopes or the tennis court.

With this agreement, Honeywell will be joining thirteen other corporations in sponsorship of the Center for Magnetic Recording Research. These are:

- Ampex Corporation • Applied Magnetics Corporation
- Control Data Corporation (PCI) • Data Electronics Incorporated • Digital Equipment Corporation • Eastman Kodak • IBM • Memorex • National Micronetics Incorporated
- Pfizer Pigments Incorporated • Seagate Technology • 3M
- Verbatim Corporation

## Equipment Donated

Since its inception almost two years ago, CMRR has attracted a number of generous donations of equipment. Much of the donated equipment will be used in the laboratory coursework conducted by CMRR faculty for students enrolled in magnetic recording electives. This practical perspective will enable students to apply the principles learned in the theoretical sessions.

Equipment donations to the Center include:

- 275 longitudinal hard disks from Applied Information Memories (AIM), Milpitas, CA
- Disk drive, disks, and transversal filter from Lanx Corporation, San Jose, CA
- 24 reel-to-reel 1400 series 3-speed recorders with remote control from Telex Communications, Minneapolis, MN
- Magnetic head components and ring samples from Nortronics Company, Inc., Minneapolis, MN
- Magnetic audio and video heads plus an experimental audio recorder from Ampex Corporation, Redwood City, CA
- Maxtor disk drive from Hewlett Packard Disc Memory Division, Boise, ID
- IBM Personal Computer XT, IBM Corporation, Armonk, NY
- Surplus office furniture from TRW, San Diego, CA

## UCSD/CMRR Courses in Magnetic Recording

A major goal of the Center for Magnetic Recording Research is to train graduate students such that they will be suitably qualified for employment in the industry. Pursuant to that objective a number of new courses will be taught beginning in the fall quarter.

Professor H. Neal Bertram will offer a course within the Department of Electrical Engineering and Computer Sciences. The course is open to first year graduate students and senior undergraduate students. The course outline is as follows:

### 210A. Physics of Magnetic Recording Materials

This course will address basic magnetic phenomena as related to magnetic materials utilized for both recording media and transducers (recording heads). Topics covered include classical fields, atomic magnetism, domains, dynamics, thermal effects, coercivity models, and particle interactions, as well as a characterization of current media and transducers.

### 210B. Analysis of the Recording Process

In this course the recording and reproduction process will be discussed in depth. Fields and Fourier transforms of recording heads will be reviewed, including analytic, conformal transform, and numerical solutions. The linear reproduce process will be analyzed, with particular focus on the utilization of

reciprocity principles. Both temporal and frequency effects will be discussed. The nonlinear record process will be discussed with emphasis on models for both longitudinal and vertical recording. Fundamental medium noise mechanisms will be analyzed and signal to noise ratios derived.

### 210C. Magnetic Recording Laboratory

In this course the principles discussed in the first two quarters will be clarified in practice. It is hoped that the student will gain experience in most of the basic measurements in magnetic recording. Head core permeability and head inductance will be measured and related via equivalent circuit modeling. Both spatial and transform fields of heads will be analyzed by resistance mapping techniques. Media will be characterized by large scale recording measurements. The recording process will be examined by pulse and spectral measurements on recording systems, and noise and interference phenomena will be measured.

Professor Amikam Aharoni will teach a course on the Theory of Magnetic Materials also in the fall quarter. This two unit course is open to senior undergraduate students only. The course outline is as follows:

- Ferromagnetism: basic experimental definitions
- Molecular-field theory of ferromagnets, antiferromagnets and ferrimagnets
- Superparamagnetism
- Magnetostatic self-energy and Neel's explanation of domains
- Exchange and anisotropy energies in a continuous medium: the Landau and Lifshitz wall
- Magnetostatic principles and their applications
- Block and Neel walls
- Brown's equations
- Linearized equations: The nucleation problem
- Outline of the results for finite particles
- The Brown paradox and its resolution
- Numerical methods

Professor D. J. Mapps will direct a Foundation course in Applied Magnetism for Magnetic Recording. This course will be offered in the fall quarter and is designed for (a) students at the undergraduate level wishing to gain fundamental knowledge which underpins future courses in magnetic recording or (b) industrial engineers and scientists who are making the transition from other disciplines into magnetic recording. The course will cover the following areas:

- Basic magnetic fields
- Fundamental definitions
- Ampere's circuital Law
- Biot-Savart Law
- Laws of induction
- Flux and flux density
- Permeability
- Magnetization curve
- Use of Ampere's laws in analyzing magnetic circuits in recording heads
- Field plotting as a means of evaluating fields near air gaps and tapes
- Calculation of magnetic reluctance from two dimensional fields
- The Laplace Equation
- Basis of numerical methods
- Relevant examples using Iteration and Relaxation techniques
- The magnetization curve and Magnetic Domains
- The B-H Loop
- Hysteresis loss
- Skin-effect
- Complex permeability
- Classification of materials for recording
- Inductance and impedance of recording heads

Courses for the winter quarter are well in hand. Descriptions of these will appear in a later report.



## From the Director

Our industrial sponsors will be pleased to learn that the celebrated academic summer slump has not been observed at CMRR. Our temporary quarters are now almost filled with visitors, summer students and staff. There are currently three academic visitors: Dr. Amikam Aharoni, Weizmann Institute, Israel; Dr. Desmond J. Mapps, Plymouth Polytechnic, England; and Dr. Rainer Rueppel, Swiss Federal Institute, Switzerland. During the forthcoming

academic year, the following classes directly related to magnetic recording will be taught: Micromagnetics (Aharoni), Applied Magnetism (Mapps), Physics of Magnetic Recording Materials (Bertram), Analysis of the Recording Process (Bertram), Physics of Magnetic Recording (Mallinson); in addition, a laboratory course will be taught by Neal Bertram. A student who completes all of the above should be, at the very least, a formidable conversationalist! Negotiations are underway to add classes in magneto-optics and, of course, Jack Wolf will continue to offer his "Information Theory and Digital Communication Coding for Error Control."

I am informed that our building will be ready for occupancy on 28 December 1985. I believe that all of us are looking forward greatly to being "on campus." The close physical proximity to the academic departments can only enhance our deepening associations with the faculty. To promote close personal and working relationships, a short retreat, to the U.C. Conference Center at Lake Arrowhead, is planned early in September; all professors and all industrial visitors have been invited.

John C. Mallinson

## Modulation, Coding and Signal Processing Workshop

The Center for Magnetic Recording Research was host to a Workshop on Modulation, Coding and Signal Processing for Magnetic Recording Channels which was held in La Jolla from May 19-22, 1985. The organizer of the workshop was Professor Jack Keil Wolf of CMRR.

Participants included experts in magnetic recording as well as information theory and data transmission. All participation at the workshop was by "invitation only." Sponsors of CMRR were encouraged to suggest names of invitees. Academic participants included Lewis Franks (University of Massachusetts), Robert Gallager (Massachusetts Institute of Technology), Chris Heegard (Cornell University), Robert McEliece (California Institute of Technology), Ned Weldon (University of Hawaii) and a number of faculty and students from the University of California, San Diego.

The format of the workshop included both formal and informal presentations. More than half of the time was set aside for informal discussions.

The primary objectives of the workshop were: 1) to acquaint the communications theorists with the details of magnetic recording so as to introduce them to a challenging new channel to which they could apply their expertise, and 2) to allow the communication theorists the opportunity to acquaint the magnetic recording experts with the techniques that have produced the remarkable increase in both data rate and reliability in data transmission.

Feedback from the participants indicates that an excellent beginning was made in accomplishing these objectives. In particular, several of the academic participants expressed interest in pursuing further work in this area at CMRR.



## Noted Scientist Aharoni at CMRR

Dr. Amikam Aharoni has taken up residence at the Center and will remain here through January 1986. Dr. Aharoni is currently the Richard Kronstein Professor of Theoretical Magnetism at the Department of Electronics, Weizmann Institute, Rehovot, Israel. He gained his undergraduate degree from the Hebrew University, Jerusalem in the Department of Physics and Pure and Applied Mathematics and was awarded his Ph.D. in 1957 for his work on Magneto-Resistive Memory.

Dr. Aharoni first went to the Weizmann Institute in 1953 and has held a number of positions there before being promoted to his present position in 1978. During this time, Dr. Aharoni has been invited to spend extended periods at various institutions in the United States of America, Canada, and England. He spent a year as Research Associate at the University of Illinois, Urbana, was senior Research Physicist for the National Cash Register Company's Physical Research Department and has been visiting professor of Electrical Engineering at Purdue University, Lafayette, Indiana. In 1971, he spent a year as a Senior Research Fellow in the Department of Metallurgy at the University of Oxford and returned there again in 1977 as visiting professor. Less extended periods have recently been spent at Simon-Fraser University, Vancouver, British Columbia, and at the Corporate Research and Development division of the General Electric Company, Schenectady, N.Y. Dr. Aharoni joins the Center after having spent time at Drexel University, Philadelphia and again at Simon-Fraser University. Dr. Aharoni is a member of the Israeli Physical Society, The American Physical Society, and a senior member of the IEEE. He has well over one hundred papers to his credit.

While at the Center, Dr. Aharoni will work closely with the faculty on magnetic recording theory as well as teaching a course on the theory of magnetic materials.

*Amikam Aharoni*



*Desmond Mapps*

## Academic Visitor from U.K.

Dr. Desmond Mapps, reader in Electrical and Electronic Engineering at Plymouth Polytechnic, began a five month stay at CMRR on July 29.

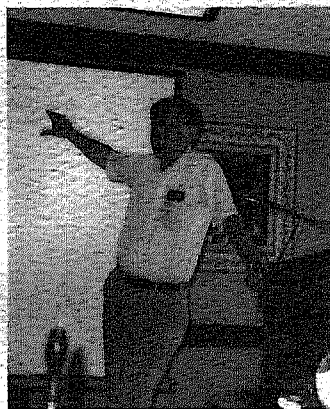
Dr. Mapps graduated in Electrical Engineering from the University of Wales Institute of Science and Technology in 1966. His Ph.D. entitled "Stress, Power Loss and Domain Structure in 3% Grain-oriented Silicon-iron" was granted in 1969 also from the University of Wales.

Dr. Mapps worked in the Advanced Technology Group of the data recording instrument company, Staines, a subsidiary of International Computers Ltd. While there he carried out research on computer memories including magneto-optics and magnetic recording, and supervised projects under the government-funded Advanced Computer Technology Project.

In 1973 Dr. Mapps joined Plymouth Polytechnic as a lecturer, and has since been promoted twice to his current position as reader, held since 1980. He is a past chairman of the faculty of Technology Research Committee, a member of the CNAA Polytechnic Research Degrees Committee, the Polytechnic Research Committee and the Institute of Physics Magnetism Group Committee. Actively involved in seeking grants from funding bodies outside the Polytechnic, he has received in excess of £400,000 to date for his research projects.

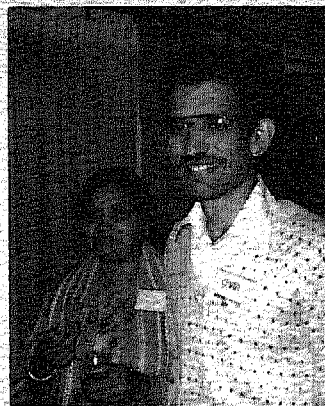
Dr. Mapps has written some thirty-five industry-confidential research reports, holds four patents and has written eighteen journal articles including three in preparation. He has presented papers at a number of international meetings and at present supervises seven Ph.D. candidates. He is a Fellow of the Institute of Physics (UK) and a Fellow of the Institution of Electrical Engineers.

His main interests are in magnetic (principally digital) recording, fundamental electromagnetic processes (micromagnetics) and electric current interruption. While at the Center Dr. Mapps plans to support the ongoing research effort in magnetic recording, give an introductory course on magnetic recording, supervise the design and construction of a magnetic domains television demonstration system and study materials for magneto-optical computer memories.



*Richard Blahut*

## Modulation, Coding and Signal Processing Workshop



*Arvind Patel and Mrs. Patel*



*John Mallinson, Dennis Howe*



*Roy Adler, Ian Blake*



*Roger Wood, Mike Haynes, Chuck Coleman*



*Robert White, Gordon Hughes*

## Employment Opportunities File

At a recent Advisory Council meeting it was decided to establish a file containing information on various types of employment opportunities available through CMRR's sponsoring companies.

The file will be maintained in the Information Center. Such information will be of interest to senior undergraduate and graduate students associated with CMRR.

The following topics will be covered in the file:

- General Information on the Company
- Summer programs
- Internship programs
- Scholarships/Grants available
- Career openings

Any information on employment opportunities within the sponsoring companies can be sent to Kitty Morris, CMRR, S-008, University of California, La Jolla, CA 92093.

## Information Center Contents Page Service

The Information Center has been offering a Contents Page Service to members of the sponsoring companies since May 1985. This monthly compilation of the contents pages of journals of interest to those working in the magnetic recording industry has been very successful.

Recent issues have included titles of papers translated from

CENTER FOR MAGNETIC  
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S-008  
University of California, San Diego  
La Jolla, CA 92093

Director John C. Mallinson  
Editor Dawn E. Talbot  
Editorial Assistant Kitty Morris

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foreign languages, particularly Japanese into English. There is also a listing of current papers on magnetic recording topics published in Japan. The information center can arrange translation of these under its translation program. Further details can be obtained from: Dawn Talbot, Manager (619) 452-6213

## Calendar

This section includes forthcoming conferences, meetings, symposia, special courses, etc. related to magnetic recording.

- |                |  |
|----------------|--|
| September 26   | Magnetics Society, San Diego Chapter meeting, Room 111A, UCSD, 7-9 p.m.<br>Speaker: Dr. Amikam Aharoni   |
| October 14-18  | Short Course on Magnetic Recording Technology, CMU, Pittsburgh, PA   |
| October 24     | Magnetics Society, San Diego Chapter meeting, Room 111A, UCSD, 7-9 p.m.<br>Speaker: Dr. Desmond J. Mapps   |
| Oct. 30-Nov. 4 | 7th IEEE Symposium on Mass Storage Systems, Tucson, AZ   |
| November 26    | Magnetics Society, San Diego Chapter meeting, Room 111A, UCSD, 7-9 p.m.  |
| December 2-3   | Regional Conference on Advanced Topics in Magnetic Recording, CMRR/University Extension. Please note change of date. Further details from Extension (619) 452-6947 |
| December 17    | Magnetics Society, San Diego Chapter meeting, Room 111A, UCSD, 7-9 p.m.  |
| April 1986     | Short Course on Magnetic Recording Technology, CMRR, San Diego, CA   |
| March 17-21    | 6th International Conference on Video, Audio & Data Recording, Sussex, England   |

For further information: (619) 452-6198  
Please send notices of meetings, etc. to the editor

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