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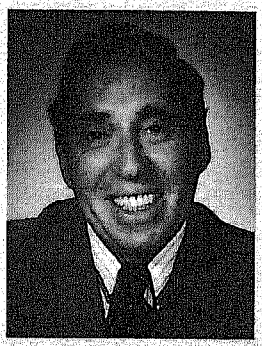
CMRR Report

Center for Magnetic Recording Research

Number 17

Spring 1993

Jack Keil Wolf Named to the National Academy of Engineering



JACK KEIL WOLF

On February 12, Robert M. White, president of the National Academy of Engineering, announced the names of those newly elected to membership in the Academy. Among those honored was Jack Wolf, professor of electrical engineering at UCSD, who holds one of CMRR's four endowed chairs. The citation for professor Wolf's award reads for contribution to information theory, communication theory, magnetic recording, and engineering education. Membership in the Academy is awarded to those who have made "important contributions to engineering theory and practice including significant contributions to the literature of engineering theory and practice," and to those who have demonstrated "unusual accomplishments in new and developing fields of technology." Members are elected by their peers and are drawn from all engineering disciplines and include engineers from industry, academia, and government. Founded in 1964, the National Academy of Engineering conducts its activities jointly with the National Academy of Sciences. It is a private, independent nonprofit institution that acts as adviser to the federal government, and provides a channel for the advancement of engineering and technology.

3M Rejoins the Center

ROBERT J. YOUNGQUIST

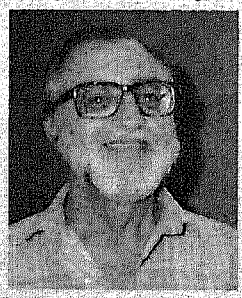
If you look at the list of companies on the plaque in the lobby of the CMRR building honoring the founding industrial sponsors of the center, you will recognize the 3M Company. Thus, we are particularly pleased to announce that 3M rejoined the center on January 1. 3M has a special place in the U.S. magnetic storage industry as a major supplier of tape cartridges, and as an innovator in developing new recording systems for license. Dr. Robert J. Youngquist will be representing 3M on the CMRR Advisory Council, and we are delighted to welcome back an "ex-graduate" of the center. Well, ex-graduate may be a bit misleading, but Bob was one of the early Industrial Visitors-in-Residence. We look forward to his wise council and the benefits of his many years of experience in the magnetic storage industry.

CMRR's list of current industrial sponsors include:

Applied Magnetics Corporation
Conner Peripherals
Digital Equipment Corporation
Eastman Kodak Company
Hewlett-Packard
IBM Corporation
Iomega Corporation
Maxtor Corporation
Metrum Information Storage
3M Company
Quantum Corporation
Seagate Technology
Storage Technology Corporation

Barbosa at CMRR

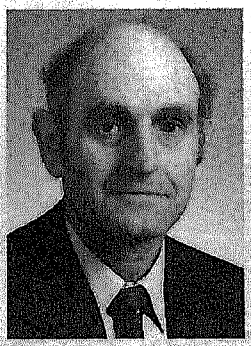
Lineu Barbosa joined the center in August 1991 as a visiting research engineer after retiring from IBM Almaden Research Laboratory in April. No stranger to CMRR, Lineu spent a year's sabbatical here from April 1986. At that time, Lineu worked with professors Jack Wolf and Neal Bertram and he is continuing that collaboration in his current position.



LINEU BARBOSA

Dr. Barbosa's approach to magnetic recording as well as to communications problems is as a form of inversion of operators. His primary interest is in understanding the mechanism of errors in the detection of digital recording. He is in the process of evaluating a number of potential detection and coding schemes.

Working with CMRR students Jim Fitzpatrick and Eric MacDonald from the Wolf group, and Herbert Lin of the Bertram group, and Carl Che, formerly at CMRR but now with Quantum Corporation, Lineu is building a more realistic noise model which also takes into account mismatches between the real system and the detector. He is also developing with Davis Ly of ECE, a software model to explore track density as well as linear density. A keen saxophone player, Lineu has re-enrolled in the Jazz Improvisation class in the UCSD Department of Music.



SHELLY SCHULTZ

From the Director

As reported in a separate article, the 3M Corporation has become a sponsoring member of CMRR, and Dr. Robert J. Youngquist has been appointed as their representative to the CMRR Advisory Council. It is a particular pleasure to welcome back both 3M and Bob, because 3M was one of the original founding members of the center in 1983, and Bob was a resident Industrial Visitor at the center during the 1985-86 academic year. In the relatively few months since 3M has renewed their membership in the center, several technical teams from 3M have already visited, and new sponsored projects are under way. We are gratified that our technical capabilities in several areas have once again been recognized as being supportive to cutting-edge technology within the storage industry.

Speaking of Bob having been an Industrial Visitor, I should mention that Roy Gustafson from DEC is currently in residence at CMRR with the signal/channels group. Many readers may not be aware of the opportunities to participate in the center's program as an Industrial Visitor, so please do get in touch with me if you need more information. I have personally spoken with many of the past visitors, and they have been unanimously enthusiastic about both their own professional growth and the benefits gained by their company as a consequence of their residence. Perhaps you should look into the possibility!

Having mentioned that 3M was a founding member in 1983 is an illustration of the major theme that I wanted to bring to the reader's attention. This year, 1993, is the Tenth Anniversary of CMRR, and we are having a special symposium and reception (and more!) in celebration on May 4. If you haven't received an invitation, along with the notice of the regular Research Review on May 5 and 6, and you would like to attend, please call the center ASAP.

The symposium on May 4 is not just a celebration. Rather, it is an opportunity for us to nucleate an exciting new project, titled MSM-2000. In the last *CMRR Report* I reported the good news that we were major participants in both the ATP and DARPA projects recently awarded to NSIC. Recall that the goals are to develop disk densities at 10Gbit/in2, and tape storage at 1 Terrabyte/in3. MSM-2000 stands for Magnetic Storage Manufacturing by the year 2000, and at the symposium we will be addressing the initiation of a new industry-university-federal joint program. This program is charged with ensuring that the U.S. magnetic storage industry has the techniques, personnel, and opportunity to retain its commanding position in manufacturing at those densities, well into the next century. I can assure you that we will have an outstanding representation from the Magnetic Storage Industry speaking and participating at the symposium. By the time you are reading this article we will be sending out the specific program, so again, please call me if you did not receive the first announcement.

Finally, let me bring to your attention that Ms. Jean Wilbern has joined the center as assistant to the director. Jean had been my secretary in the physics department for more years that we both care to admit, and amongst many other skills, is an expert at knowing where I am and getting messages to me. She can be reached at 619-534-6563.

I hope to see you at the May 4 symposium.

Shelly Schultz

Bertram Contributor to Solid State Physics Series

The latest volume in the *Solid State Physics* series, published by Academic Press, contains three lengthy articles, each addressing the underlying physics of a different area of science and technology. CMRR professor H. Neal Bertram and former CMRR graduate student Jian-Gang Zhu co-authored the extensive section, "Fundamental Magnetization Processes in Thin-Film Recording Media."

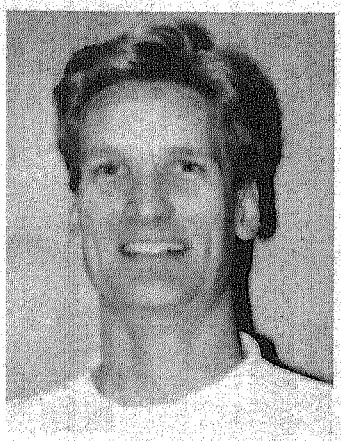
While this series, *Solid State Physics,* aims to cover scientific advances in a comprehensive manner, surveys on magnetism have not appeared since the 1960s. This review by Bertram and Zhu is therefore particularly noteworthy. Areas discussed include magnetic hysteresis, reversal processes, and domain patterns in hard magnetic materials consisting of closely packed thin-film crystallites utilized as magnetic recording media. The basic physics problems of understanding the effects of long-range magnetostatic and short-range exchange fields on assemblies of anisotropic grains are discussed in detail. The recent increases in recording densities have come about in large part as a result of the development of necessary thin-film technology and the understanding of the underlying physics.

Editors Henry Ehrenreich and David Turnbull describe this section as a concise overview of the magnetic write and read process, and the basic magnetism underlying it. The microstructures and magnetic properties of both longitudinal and transverse thin-film materials are discussed in detail, as are the single and multiple particle reversal mechanisms and domain structures.

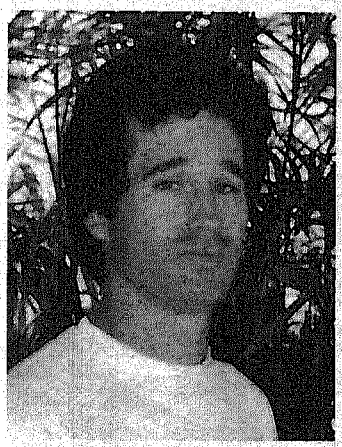
Because of the publication of this review in a physics text, many engineers in the recording industry may miss this important work. The book is now available from Academic Press (1-800-321-5068) at a cost of $79. For ordering purposes, use the unique ISBN number, 0-12-607746-0.

The table of contents for the section "Fundamental Magnetization Processes in Thin-Film Recording Media" is reproduced below.

Postdoctoral Research Fellows Join Berkowitz



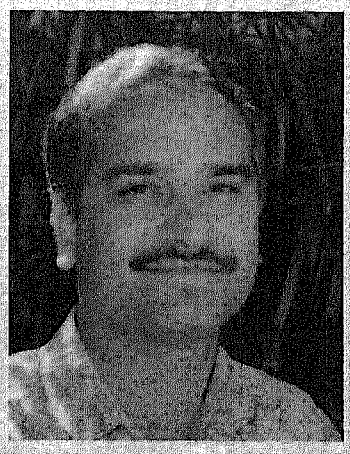
Alfred Nash joined the Berkowitz group here at CMRR last October as a postdoctoral research fellow. He is working on spark erosion in the formation of permanent magnetic materials. Al received his B.S. in physics from Stanford and then proceeded to UC Santa Barbara to complete his graduate studies with Professor Vince Jaccarino. After obtaining his Ph.D. in 1991, Al spent some time teaching upper- and lower-division physics at UCSB before coming down to UCSD as a postdoctoral fellow at CMRR.



A second postdoctoral fellow, **Robert Beach,** joined the Berkowitz group in December 1992. Bob has just received his Ph.D. from the University of Illinois at Urbana-Champaign where he worked on rare earth multilayers. His thesis title is "Magnetic and Magnetoelastic Phenomena in Dy/Lu Superlattices" and his supervisor was Professor Myron Salamon of the Department of Physics. Bob completed his undergraduate studies at Wesleyan University, Middletown, CT in 1985. Currently he is working with Professor Berkowitz on giant magnetoresistance in granular films.

Talke Lab Welcomes Postdoc Fellow

In November of last year, **Chandrasekhar Nadimpalli** joined Professor Frank Talke's group to begin work on a postdoctoral appointment. Currently he is studying pole tip recession and also plans to work on the tribology of contact recording. Sekhar received his bachelor of technology degree (B.Tech.) in metallurgical engineering from the Indian Institute of Technology, Bombay, in May 1985. From there he enrolled as a graduate student in September 1985 at Ohio State University, Columbus, Ohio, in the Department of Materials Science and Engineering. Working with Professor David Rigney, he completed a non-thesis M.S. project looking at the wear of brass coated steel wires, which was sponsored by the Goodyear Tire & Rubber Company of Akron, Ohio. He then went on to complete his Ph.D. in September 1992, again with Professor Rigney as his adviser. His thesis topic was "Friction and Wear Behavior of Silicon under Conditions of Sliding." Having an interest in the storage industry, Sekhar applied to join Professor Talke's group here at CMRR.

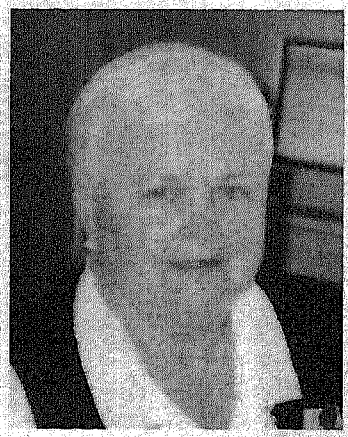


Ninth Tribology Workshop

On March 8 and 9 the Ninth Annual Tribology Workshop with emphasis on contact recording, was held at CMRR, under the chairmanship of Professor Frank Talke. Over twenty representatives from various companies involved in magnetic recording were in attendance. During the two days, twenty-five papers were presented in the areas of contact recording, instrumentation of the head/tape interface, tribology and mechanical studies of the head/tape interface, as well as friction and wear of carbon-coated disks.

The next tribology workshop, the tenth in the series, is scheduled for March 1994. A firm date and the major focus of the meeting will be announced closer to that time.

Assistant to the Director Appointed



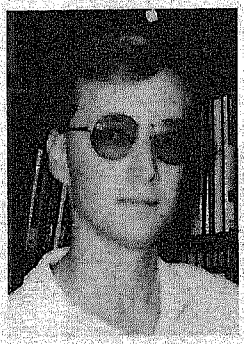
We are pleased to announce that **Ms. Jean Wilbern** has recently joined the center as assistant to the director. Jean is already quite familiar with many aspects of CMRR, because she has been Shelly Schultz's secretary in the Department of Physics for over twenty-three years. Since the Center started ten years ago, she has followed Shelly's increasing involvement from the original CMRR Building Committee through the NSF Materials Research Group proposals (ask to see the very first magnum opus Jean put together!), to his becoming director. Right now Jean is focusing on the upcoming Tenth Anniversary Symposium and celebration. Please call her at 619-534-6563 if you need more help in that regard, or about administrative matters in general. Please stop in and say hello when you next visit the center.

Students Graduating from CMRR

On these pages short descriptions are given of the recent graduates from CMRR. In all cases, copies of their papers and theses—whether master's or doctoral—are available to members of the center's sponsoring companies. Please contact:

Jan Neumann Phone: (619) 534-6199 Fax: (619) 534-2720 Email: jneumann@ucsd.edu

Pablo Ziperovich



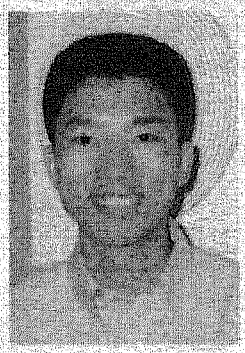
Pablo Ziperovich, who has been working with professor Jack Keil Wolf since September 1991, was awarded his M.S. in electrical engineering-communication theory and systems in September 1992.

Pablo received his B.S. in electrical engineering in 1983 from Texas A&M University. From 1983 to 1989 he worked for IBM, Rochester, on the implementation of advanced channels for disk drives. In 1989, Pablo transferred to IBM, San Jose, working under Roger Wood at the then General Products Division.

While at the center, Ziperovich built a high-speed Viterbi detector for hard disk drives as his master's project. His master's thesis, entitled "VLSI Implementation of Viterbi Detector for Hard Disk Drives," is available to members of CMRR's sponsoring companies.

Pablo Ziperovich has accepted a position with Quantum Corporation, Milpitas, CA, where he will work on advanced channels under the direction of Bill Abbott.

Samuel Yuan



Samuel Yuan successfully presented his Ph.D. defense this past August and has been working as a post-doctoral student for Professor H. Neal Bertram since then. Samuel came to UCSD in 1987 after having completed his B.S. in Physics from the University of Science and Technology of China. After obtaining an M.S. in physics in 1989, Samuel joined CMRR under the direction of Professor Bertram.

While at the center, Yuan worked on the micromagnetics of domains and domain walls in ferromagnetic soft thin films, with applications focusing on inductive and magnetoresistive recording heads. His thesis is entitled "Micromagnetics of Domains and Walls in Soft Ferromagnetic Materials." He also visited a number of the center's sponsoring companies to give presentations on his research.

Papers published during this time include:

S.W. Yuan and H. Neal Bertram, "Domain Wall Dynamic Instability", *Jnl. Applied Phys.*, Vol.69, No.8, pp.5874-5876, April 1991.

S.W. Yuan and H. Neal Bertram, "Domain Wall Structure and Dynamics in Thin Film", *IEEE Trans. Magn.*, Vol.27, No.6, pp.5511-5513, November 1991.

S.W. Yuan and H. Neal Bertram, "Domain Wall Dynamic Transitions in Thin Films", *Phys. Rev. B*, Vol.44, No.22, pp.12395-12405, December 1991.

S.W. Yuan and H. Neal Bertram, "Statistical Data Analysis of Magnetic Recording Noise Mechanisms", *IEEE Trans. Magn.*, Vol.28, No.1, pp.84-92, January 1992.

S.W. Yuan and H. Neal Bertram, "Magnetic Thin Film Domain Wall Motion under Dynamic Fields", *Jnl. Applied Phys.*, Vol.72, No.3, pp.1033-1038, August 1992.

S.W. Yuan and H. Neal Bertram, "Fast Adaptive Algorithms for Micromagnetics", *IEEE Trans. Magn.*, Vol.28, No.5, pp.2031-2036 September 1992.

S.W. Yuan, H.N. Bertram, J.F. Smyth, and S. Schultz, "Size Effects of Switching Fields of Thin Permalloy Particles", *IEEE Trans. Magn.*, Vol.28, No.5, pp.3171-3173 September 1992.

S.W. Yuan and H. Neal Bertram, "Inhomogeneities and Coercivity of Soft Permalloy Thin Films", *IEEE Trans. Magn.*, Vol.28, No.5, pp.2916-2918 September 1992.

S.W. Yuan and H. Neal Bertram, "Domain Wall Dynamics in Thick Permalloy Films", presented at MMM'92, Houston, to appear in *Jnl. Applied Phys.*, April 1993.

S.W. Yuan and H. Neal Bertram, "Micromagnetic Response of Small Unshielded MR Element", presented at MMM'92, Houston, to appear in *Jnl. Applied Phys.*, April 1993.

S.W. Yuan and H. Neal Bertram, "Eddy Current Damping of Thin Film Domain Walls", to be presented at Intermag '93, Stockholm.

S.W. Yuan and H. Neal Bertram, "Ultra High Density Recording for Magnetoresistive Heads" (invited), to be presented at Intermag '93, Stockholm.

S.H. Liao, S.W. Yuan and H.N. Bertram, "Biasing Characteristics of Exchange-tabbed MR-SAL Heads", to be presented at Intermag '93, Stockholm.

S.W. Yuan and H. Neal Bertram, "Spatial Resolution of Shielded MR Heads", submitted to *IEEE Trans. Magn.*.

S.W. Yuan and H. Neal Bertram, "Off-Track Spacing Loss of Shielded MR Heads," submitted to *IEEE Trans. Magn.*

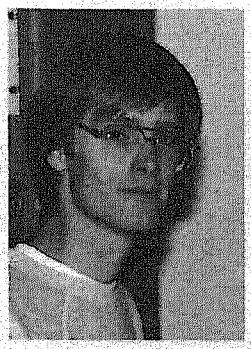
S.W. Yuan, N. Smith, and H. Neal Bertram, "Modeling of Narrow-Trackwidth Dual MR Heads for Ultra High Density Recording" (invited), to be presented at TMRC'93, Minneapolis.

S.W. Yuan, H. Neal Bertram, and M.K. Bhattacharyya, "Cross-Track Characteristics of Shielded MR Heads" (invited), to be presented at TMRC'93, Minneapolis.

Most recently, Samuel has been working on a joint research project with Applied Magnetics Corporation, Goleta, in which he developed the code to perform theoretical modeling of AMC heads. A similar project with Eastman Kodak involved modeling of dual magnetoresistive heads for design optimization. Since August 1992, he has been involved with design projects for ultra-high density MR heads as part of NSIC/ATP's charter.

Starting in May 1992, he will be working as a senior technical staff member in the MR head engineering group at Applied Magnetics Corporation, reporting to Simon H. Liao.

Matthew Carey



On March 29, **Matthew Carey** successfully defended his Ph.D. thesis. A California native, Matt received his B.S. with honors (in physics) from Harvey Mudd College, Claremont. He then spent the next year at the University of Illinois at Urbana-Champaign and was awarded an M.S. in 1986. He came to UCSD shortly after to commence his graduate studies with professor Ami Berkowitz as his supervisor at CMRR. Matt received a second master's degree in physics, this time from UCSD in 1988, and then his Ph.D. degree in 1993.

While at the center, Matt has been working on preparation and characterization of magnetic thin films. He was the first student in the Berkowitz lab to work on thin films, which has become a major focus of this group over the years. Matt spent most of 1988 at the University of California, Berkeley at the Department of Materials Science studying under Professor Garth Thomas. While there he studied electron microscopy which, on his return to UCSD, was deployed in the structural characterization of materials.

Matt also spent extended periods of time during 1992 at the National Institute of Standards and Testing (NIST) studying the ordering behavior of CoO/NiO superlattices with neutron diffraction.

Matt's research provides an outstanding example of work that is of the highest calibre in both science and technology. His work on magnetic ordering in antiferromagnetic NiO-CoO superlattices was just recently reported in a *Physical Review Letter*. Less than a year prior to that paper, he was a principal author on another *Physical Review Letter* announcing the discovery of giant magnetoresistance in heterogeneous alloy films. He was an invited speaker at the Conference on Magnetism and Magnetic Materials, Houston, and has had a number of other significant publications. A list is included. However, he has also developed Nio-CoO alloy films that are equivalent to FeMn for magnetoresistive (MR) head biasing/pinning applications, but are much more robust. Thus he represents the very best combination of scientific and technological expertise.

Following is the extensive list of publications which resulted from Carey's studies at CMRR:

"CoO-NiO Superlattices: Interlayer Interactions and Exchange Anisotropy with $Ni_{81}Fe_{19}$;" M.J. Carey, A.E. Berkowitz. To be published in *Journal of Applied Physics.*

"Propagation of Antiferromagnetic Order in CoO/NiO Superlattices;" J.A. Borchers, M.J. Carey, R.W. Erwin, A.E. Berkowitz, C.F. Majkrzak. To be published in *Journal of Applied Physics.*

"Giant Magnetoresistance in Heterogeneous Cu-Co and Ag-Co Alloy Films;" A.E. Berkowitz, J.R. Mitchell, M.J. Carey, A.P. Young, D. Rao, A. Starr, S. Zhang, F.E. Spada, F.T. Parker, A. Hutten, G. Thomas. To be published in *Journal of Applied Physics.*

"Quantitative Characterization of Epitaxial Superlattices by X-Ray Diffraction and High Resolution Electron Microscopy;" E.E. Fullerton, W. Cao, M.J. Carey, I.K. Schuller, G. Thomas, A.E. Berkowitz. To be published in *Applied Physics Letters.*

"Polarized Neutron Reflection Study of the Unidirectional Magnetic Anisotropy of Permalloy on $Ni_{0.5}Co_{0.5}O$;" G.P. Felcher, Y.Y Huang, M.J. Carey, A.E. Berkowitz. To be published in *Journal of Magnetism and Magnetic Materials.*

"Strong Interlayer Coupling in CoO-NiO Superlattices;" M.J. Carey, A.E. Berkowitz, J.A. Borchers, R.W. Erwin. To be published in *Physical Review B,* (April 15, 1993).

"Long Range Antiferromagnetic Order in CoO/NiO Superlattices;" J.A. Borchers, M.J. Carey, R.W. Erwin, C.F. Majkrzak, A.E. Berkowitz. *Physical Review Letters,* Vol. 70, pp.1878-1881 (1993).

"Giant Magnetoresistance in Heterogenous AgCo Alloy Films;" M.J. Carey, A.P. Young, A. Starr, D. Rao, A.E. Berkowitz. *Applied Physics Letters,* Vol. 61, pp.2935-2937 (1992).

"Giant Magnetoresistance in Heterogenous CuCo Alloy Films;" A.E. Berkowitz, J.R. Mitchell, M.J. Carey, A.P. Young, S. Zhang, F.E. Spada, F.T. Parker, A. Hutten, G. Thomas. *Physical Review Letters,* Vol. 68, pp.3745-3748 (1992).

"Exchange Anisotropy in Coupled Film of $Ni_{81}Fe_{19}$ with NiO and $Co_xNi_{1-x}O$;" M.J. Carey, A.E. Berkowitz. *Applied Physics Letters,* Vol. 60, pp.3060-3062 (1992).

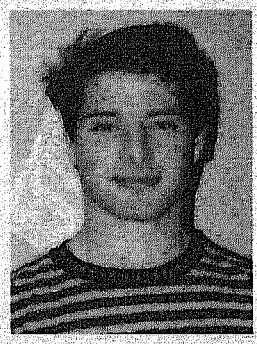
"Preparation and Structural Characterization of Sputtered CoO, NiO and $Co_{0.5}Ni_{0.5}O$ Epitaxial Thin Films;" M.J. Carey, F.E. Spada, A.E. Berkowitz, W. Cao, G. Thomas. *Journal of Materials Research,* Vol. 6, pp. 2680-2687 (1991).

"Characterization of Epitaxial Sputtered $Ni_xCo_{1-x}O$ Thin Films on alpha-Al_2O_3 using Transmission Electron Microscopy;" W. Cao, G. Thomas, M.J. Carey, A.E. Berkowitz. *Scripta Metalurgica et Meteriala,* Vol. 25, pp. 2633-2638 (1991).

"Magnetic and Structural Properties of Granular Fe-SiO2 Thin Films;" M.J. Carey, F.T. Parker, A.E. Berkowitz. *Materials Research Society Proceedings,* Vol. 195, pp. 445-449 (1990).

For two months following the completion of his graduate studies Carey will be travelling outside of the country. On his return to the U.S. he will take up a position in industry.

Pablo Levi



After receiving a B.S. in bioengineering from UCSD, **Pablo Levi** joined Frank Talke's tribology group in 1990 to begin work for a master's degree. His research area included the load/unload mechanism and 50 percent sliders. With load/unload, the slider, instead of being in contact with the disk prior to startup, is loaded onto the disk once the disk has reached its maximum RPM. Likewise the slider is taken off the disk—unloaded, should the drive be turned off or power lost to the drive. The main benefit of the load/unload mechanism is that stiction - static frictional forces that occur when the slider is in contact with the disk are avoided.

Pablo was awarded his M.S. from the Department of Applied Mechanics and Engineering Sciences in October 1992 for his thesis entitled "An Investigation of Rayleigh Step Sliders and a Rotary Load/Unload Mechanism." Presently he is working for Applied Magnetics Corporation, Goleta, CA, as a design engineer. Pablo feels his experience at CMRR has prepared him well for the challenges presented by his current position.

Joshua Harrison

Joshua Harrison completed his Ph.D. in mechanical engineering this past December. He joined Professor Frank Talke's group in 1987 after having received his B.S. in mechanical engineering *cum laude* from the University of Southern California. He received his M.S. in 1989 from UCSD with Professor Talke as his research adviser for his thesis, "Non-Repeatable Runout of Cantilever and Doubly Supported 5 1/4 inch Disk Drive Spindles."

Continuing with Professor Talke as his Ph.D. adviser, Josh's thesis topic was "Constrained Layer Damping of Head and Lens Suspension Modes Excited by Disk Vibration and Air Flow in DASD." Constrained layer damping is used in both optical and magnetic drives, and Josh was able to demonstrate that a constrained tuned damper can be designed to act as a damper for bending mode vibrations, and as a tuned damper for in-plane mode vibrations.

During the summers while a graduate student at CMRR, Josh worked for IBM, first as a development engineer at GPD San Jose, and in the last two summers as a research engineer at IBM's Almaden Research Center. As part of his work at IBM he co-authored an IBM Technical Disclosure on "Capacitive RPE Transducer for Galvo Mirrors" in September 1991.

Harrison's list of publications follows:

J.C. Harrison and W. Imaino. "Numerical Studies of Damped Suspension for an Optical Focusing Actuator." *Adv. Info. Storage Syst.*, Vol.1, pp.405-418, 1991.

W. Imaino and J.C. Harrison. "A Comment on Constrained Layer Damping Structures with Low Viscoelastic Modulus." *Journal of Sound and Vibration*, Vol.149, No.2, pp.354-359, 1991.

J.C. Harrison, C.W. Miller and F.E. Talke. "Disk Surface Acceleration Effects Due to Air Flow Induced by Rotation." *Adv. Info. Storage Syst.*, Vol.1, pp.155-169, 1991.

J.C. Harrison and F.E. Talke."Non-Repeatable Runout of Cantilever and Doubly Supported 5 1/4 Inch Disk Drive Spindles." *Precision Engineering*, Vol.13, No.1, pp.33-40, 1991.

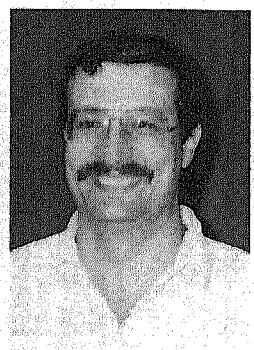
J.C. Harrison, W. Imaino and F.E. Talke. "Tuned Constrained Damping of a Cantilevered Plate." to appear in the *Journal of Sound and Vibration.*

J.C. Harrison, D.H. Lou and F.E. Talke."Air Flow Around the Tip of an Obstruction between Corotating Disks." to appear in *Adv. Info. Storage Syst.*, Vol.5.

J.C. Harrison and F.E. Talke. "Tuned and Constrained Layer Damping of a Type 13 Magnetic Recording Head Suspension." submitted to *IEEE Trans. on Magnetics*, presented at Intermag, 1993.

In January, Josh took up a position at Applied Magnetics Corporation, Goleta as a senior member of the technical staff working in the MR Products Group for Paul Smith.

Constant Baggen



Constant Baggen, or Stan as he is known at CMRR, successfully defended his thesis on January 25. Stan has been studying with Professor Jack Wolf, with full support from his employers at Philips, Eindhoven.

Stan completed an ER degree from the Technical University, Eindhoven, The Netherlands in 1979. This is a five-year program similar to a master's degree from an American university. Intending to go into the biomedical engineering field, Stan's course work focused on control systems theory, although his thesis work was in cognitive science. His thesis topic, "Recognition Models for Alpha Numeric Characters," was done at the Institute of Perception Research—a consortium of the Technical University and Philips.

On completing his university degree in 1979, Stan went to work for Philips Research Labs in Eindhoven. As a senior scientist, he worked in the area of error correcting codes for optical storage media. While algebraic coding and its application was Stan's area of expertise since coming to CMRR, he has broadened his area to communication and information theory in general.

Beginning with the 1989-90 academic year, Stan enrolled in a doctoral program in the ECE department at UCSD, studying with CMRR professor Jack Wolf. His thesis title is "An Information Theoretic Approach to Timing Jitter." The significance of this research is that previously timing uncertainties have not been considered as a major limiting factor in the achievable densities of information storage.

The thesis is arranged into two major sections. The first, "The Impact of Timing Jitter on the Capacity of Hard Limiting Channels," has been presented at a number of international meetings as described below:

C.P.M.J. Baggen and J.K. Wolf. "An information theoretic approach to timing jitter." October 1990. Presented at the Eleventh Symposium on Information Theory in the Benelux, Noordwijkerhout, The Netherlands.

C.P.M.J. Baggen. "Optical storage: New opportunities in recording channel technology." 1990. Presented at GLOBECOM'90 Workshop #3: The Next Generation of Digital Recording Systems, organized by Prof. Jack Wolf, San Diego.

C.P.M.J. Baggen and J.K. Wolf. "On timing jitter and channel capacity of hard-limiting channels." *Proceedings of the IEEE International Symposium on Information Theory*, p.308, 1991. Budapest, Hungary, June 24-28.

C.P.M.J. Baggen and J.K. Wolf. "Timing jitter: Coding theorems and spectral properties." *Proceedings of the Twelfth Symposium on Information Theory in Benelux*, p.108, 1991. Veldhoven, The Netherlands, May 23-24.

C.P.M.J. Baggen and J.K. Wolf. "On the influence of timing jitter on the capacity of hard-limiting channels." *Proceedings 1992 URSI International Symposium on Signals, Systems and Electronic ISSSE '92*, p.799-804, 1992. Paris, France, Sept. 1-4.

The second section, "Band-Limited Additive Gaussian Noise Channels in the Presence of Sampling Jitter," has yet to be presented outside the thesis. The first presentation of this section of his research will be at the Thirteenth Symposium on Information Theory in the Benelux, May 1993.

Stan is returning to Philips Research Labs, Eindhoven, and will continue to work in communication and information theory in algebraic coding. His primary focus on his return will be digital broadcasting. This is the digital replacement of current analog FM and NTSC systems which will result in much higher quality audio and video reception.

Chris Lacey

Having graduated from Worcester Polytechnic Institute, Massachusetts in 1985 with a B.S. in mechanical engineering—design, **Chris Lacey** went to work for Kodak Research Labs in San Diego, CA. During his three-year stay at Kodak, Chris worked in the Head/Tape Interface Research Group under the direction of Dick McClure.

In 1987, Lacey left Kodak in order to pursue further study at the University of Virginia, Charlottesville, earning an M.S. in mechanical engineering in 1989. His adviser there was Paul Allair, and his master's thesis topic was "Surface Roughness Effects in Thin Film Gas Lubrication."

In May 1987, Chris returned to San Diego, this time to UCSD to begin his doctoral studies with professor Talke at CMRR. His thesis topic is entitled "The Head/Tape Interface."

Papers resulting from Lacey's research are listed below:

C.A. Lacey and F.E. Talke. "A Tightly Coupled Numerical Foil Bearing Solution." *IEEE Trans. Magn.*, MAG-26, No.6, pp.3039-3043, 1990.

C.A. Lacey and F.E. Talke, "Interferometric Measurement of Head/Tape Spacing in a High-Speed R-DAT Helical Recorder." *IEEE Trans. Magn.*, MAG-27, No.6, pp.5091-5093, 1991.

C.A. Lacey and F.E. Talke, "Measurement and Simulation of Partial Contact at the Head/Tape Interface." Transactions of the ASME, *Journal of Tribology* No.114, pp.646-652, 1992.

C.A. Lacey and F.E. Talke, "Simulation of Wear of Tape Head Contours." *IEEE Trans. Magn.*, MAG-28, No.5, pp.2554-2556, 1992.

C.A. Lacey and F.E. Talke, "The Effect of Head Wear and Tape Shear on the Head/Tape Interface." *Tribology and Mechanics of Magnetic Storage Syst ems* (STLE-35) v.8 pp.29-34, 1992.

During his graduate studies, Chris received an IBM predoctoral fellowship for 1990-91 and 1991-92, which paid his tuition fees together with a stipend. During the summer of 1991 and 1992, Chris worked for Phase Metrics developing a dynamic flying height tester which is now in production.

Chris has started his own company, Micro Physics, in San Diego which provides custom instrumentation and software for the magnetic recording industry.

CALENDAR

This section includes forthcoming conferences, meetings, symposia, special courses, etc., of interest to the recording industry. If you would like to list a future meeting, please send details to the editor.

1993

May 4	CMRR 10th Anniversary Symposium For info: Jean Wilbern, CMRR (619) 534-6563 Fax (619) 534-2720
May 5-6	CMRR Technical Review and Advisory Council Meeting, La Jolla, CA For info: Jean Wilbern, CMRR (619) 534-6563 (619) 534-2720 Fax
May 12	PRML/Sub 2-microinch Fly Height Workshop, San Jose, CA For info: IDEMA (408) 720-9352, Fax (408) 720-9380
May 13	IDEMA dinner meeting, San Jose, CA "Advancing Video Communications and Computing", Curtis Crawford, vice-president, Microelectronics, AT&T For info: IDEMA (408) 720-9352, Fax (408) 720-9380
May 18	IEEE Santa Clara Chapter meeting, H-P Auditorium, Santa Clara, CA "Intermag Review" Dave Thompson, IBM For info: Joan Pinder (408) 354-5875
May 24-27	COMDEX, Atlanta, GA For info: The Interface Group, Needham MA (617) 449-6600
June 2-5	NSIC Annual Meeting, Monterey, CA For info: (619) 621-2550; Fax (619) 621-2551
June 15-16	THIC meeting, San Francisco, CA For info: Tom Waschura, (415) 364-1853
July 15	IDEMA dinner meeting, San Jose, CA For info: IDEMA, (408) 720-9352, Fax (408) 720-9380
August 24-27	European Magnetic Materials and Applications Conference EMMA '93, Kosice, Czech and Slovak Federal Republic For info: Dr P Sovak, Dept. of Experimental Physics, P.J. Safarik University Nam. Febr. vitazstva 9, 041 54 Kosice, CSFR 42-95-211 Fax 42-95-221
Sept. 13-15	The Magnetic Recording Conference (TMRC '93), Heads, Minneapolis MN For info: Marti Geredes, IIST, (408) 554-6853

CALENDAR, continued

Sept. 29-30 DISKCON '93 San Jose Convention Center, San Jose, CA
For info: IDEMA (408) 720-9352, Fax (408) 720-9380

October 5-6 THIC meeting, Annapolis, MD
For info: Jim Keeler, (410) 923-0343 or Pat Porto, (410) 544-3244

October 17-21 TMS Fall Meeting, Pittsburgh, PA

October 19-21 NASA Goddard Space Flight Center, Conference on Mass Storage Systems and Technologies, College Park, MD
For info: Bob Kobler, Code 902.1, Goddard Space Flight Center, Greenbelt, Maryland, 20771
(301) 286-3553, Fax (301) 286-3221
bkobler@gsfcmail.nasa.gov

October 24-27 STLE/ASME Tribology Conference '93, New Orleans, LA
For info: ASME Dept TR192A, 22 Law Drive, Fairfield, NJ 07007-2900
(800) 843-2763 ext 930 (201) 882-1717 Fax

Nov. 4 IDEMA dinner meeting, San Jose, CA
For info: (408) 720-9352, Fax (408) 720-9380

Nov. 15-18 38th Conference on Magnetism and Magnetic Materials (MMM), Minneapolis, MN
For info: Courtesy Associates, 655 15th St., NW Suite 300, Washington, DC 20005 (202) 639-5088

1994

January 11-12 THIC meeting, Del Mar, CA
For info: Keith Burnett (619) 278-4900

Feb 27-Mar 3 TMS Annual Meeting, San Francisco, CA

June 20-23 6th Joint MMM-Intermag Conference, Albuquerque, NM
For info: Courtesy Associates, 655 15th St., NW Suite 300, Washington, DC 20005
(202) 639-5088

October 16-19 ASME/STLE Tribology Conference '94, Maui, HI
For info: ASME Dept TR192A, 22 Law Dr, Fairfield, NJ, 07007-2900 (800) 843-2763, ext 930
(201) 882-1717 Fax

1995

April 18-21 Intermag '95, San Antonio, TX

November 6-9 40th Conference on Magnetism and Magnetic Materials, Philadelphia, PA

1996

April 21-25 Intermag '96, Budapest, Hungary

November 12-15 41st Conference on Magnetism and Magnetic Materials, Atlanta, GA

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