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CMRR REPORT

Center for Magnetic Recording Research

Professor Eric Fullerton receives Honorary Doctorate Degree from Henri Poincaré University

Eric Fullerton received a doctorate honoris causa from the Henri Poincaré University in a ceremony on Oct. 3 in Nancy, France. The award was in recognition of the close relationships with the university, especially with the magnetism team from the Institute Jean Lamour. This close collaboration resulted in 25 publications as well as growing number of exchanges of researchers and PhD students. These activities are supported by a research project "Friends", which is co-financed by the Agence Nationale Dela Recherohe (ANR) and the National Science Foundation (NSF) as a part of the program created by the Materials World Network (MWN) and Partner University Fund (PUF) award. Their collaborations provide opportunities for researchers and students to travel between San Diego and Nancy for research as well as to develop specific courses in common. This description was excerpted from an article in French on the Nancy University website. Read it in full at: http://www.uhp-nancy.fr/universite/actualites/eric_e_fullerton_professeur_a_universite_de_californie_san_diego_docteur_honoris_causa_de_l_uhp

2011 Marconi Symposium: "How Will the Internet Survive?"

The University of California, San Diego hosted the 2011 Marconi Society Symposium on September 8, 2011. The event honored two former UC San Diego Jacobs School of Engineering professors of electrical and computer engineering (ECE). Irwin Mark Jacobs and Jack Keil Wolf were awarded the prestigious 2011 Marconi Society Fellowship and Prize. The late UCSD ECE Professor Jack Keil Wolf, who sadly died just after his selection for the Marconi Prize; his grandson, David Hallac accepted the award on his behalf.

Read the press release of the award at http://www.jacobsschool.ucsd.edu/news/news_releases/release.sfe?id=1110

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From the Director

I am writing to you for the first time as Director of CMRR as my term started on July 1st of this year. I would like to start off by thanking Paul H. Siegel for his 11 years of service as CMRR Director and his continued support during this time of transition. He led CMRR through times of considerable change in the storage industries and has put into place new initiatives for growth and diversification of the CMRR efforts to revitalize the Center's technical mission. Key among them is the growth into solid state storage devices and systems and launching the widely successful Non-Volatile Memories Workshop. I would also like to thank the CMRR sponsors, faculty, staff, students and post docs for their support and encouragement during this transition. It is an exciting time for CMRR and I will need everyone's support.

As CMRR moves forward, it is clear that information storage technologies will remain at the core of research. However, in order to grow, we will have to explore new scientific initiatives that will build on our core strengths. I welcome comments and suggestions as we move forward. As part of this growth, we welcome three new affiliated faculty members into CMRR: Max Di Ventra, Oleg Shpyrko and Shirley Meng (see page 12). Max Di Ventra is a Professor in the Physics department whose research is in the theory of electronic and transport properties of nanoscale systems and will be presenting a special session talk on Memory Effects in Nanoscale Systems: Fundamentals and Applications. Oleg Shpyrko is an Assistant Professor in the Physics department and uses x-ray techniques to probe structure and dynamics in electronic and magnetic systems. Please see the research highlight on Pages 6-8 highlighting Prof. Shpyrko's research on using x-rays a novel magnetic nanoprobe. Shirley Meng is an Assistant Professor in the NanoEngineering department and works with magnetic and battery materials. We look forward to their participation in the coming years.

A key component to growing CMRR will be to broaden the funding base. This has been a priority over the last few years and has been yielding considerable fruit. CMRR has recently received funding from the Advanced Storage Technology Consortium, Information Storage Industry Consortium, multiple grants from the National Science Foundation, UC Discovery grants, Space Micro, Partnership University Funds, Department of Defense, and the Department of Energy. This new funding will supplement sponsorship funding, allow the number of CMRR students and post-docs to grow and keep CMRR at the forefront of research in information storage and nanotechnologies.

I have to close on a sad note both for me and the CMRR community. Professor Jack Keil Wolf, the first holder of a CMRR Endowed Chair, passed away this May at the age of 76 following a battle with cancer. CMRR would not be the institution it is today without his leadership, creativity and support over the last 27 years. His contributions to CMRR will forever be remembered.

Eric E. Fullerton

Professor Jack Keil Wolf in Memoriam

On May 12, the CMRR Family lost a beloved colleague, gifted teacher, and dedicated mentor. As the first CMRR Professor, and throughout his distinguished career at UCSD, Jack set the tone for the Center. He nurtured a culture of collegiality, taught his students the joy of collaborative research, and delighted everyone with his playful sense of humor. We will all sorely miss his friendly presence and his wise counsel.

A memorial service celebrating Jack's life was held at CMRR on June 30. On September 19, in conjunction with the Shannon Memorial Lecture and the awarding of the Shannon Graduate Fellowship – two CMRR traditions established by Jack – the success of a fund-raising campaign to endow the Jack Keil Wolf Chair in Electrical Engineering within the Jacobs School of Engineering was announced in a ceremony attended by his colleagues, students, friends, and family.

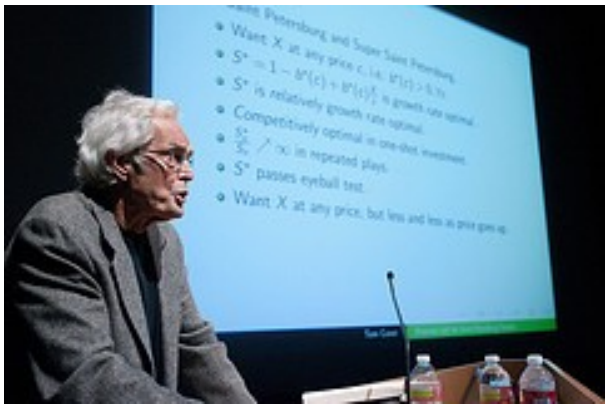
A full article about Prof. Wolf can be found on the Jacob's School of Engineering website

http://www.jacobsschool.ucsd.edu/news/news_releases/release.sfe?id=1068

The official New York Times Obituary can be read at

http://www.jacobsschool.ucsd.edu/news/news_releases/release.sfe?id=1068

9th Annual Shannon Memorial Lecture and Graduate Fellowship



Professor Thomas M. Cover, Kwoh-Ting Li Professor of Engineering and Professor of Electrical Engineering and Statistics at Stanford University presented the 9th Annual Shannon Memorial Lecture to a capacity-approaching audience in the Atkinson Hall Auditorium on September 19, 2011. His lecture was entitled "Shannon and the St. Petersburg Paradox."

Prof. Cover is known for his work in information theory, portfolio theory, pattern recognition and learning. His 1972 paper on broadcast channels was one of the first papers in modern network information theory. He co-authored a textbook in information theory in 1991 and received the 1990 Claude E. Shannon Award in information theory. He received the IEEE Neural Networks Pioneer Award in 1993 for his work on the capacity of neural nets. He received his Bachelor of Science degree in Physics from MIT and his M.S. and Ph.D. degrees in Electrical Engineering from Stanford University in 1964. He became an Assistant Professor in the Department of Electrical Engineering in 1965 and received a joint appointment in Electrical Engineering and Statistics in 1972. He was Lab Director of the Information Systems Laboratory in EE from 1989 to 1996. He is a Fellow of the Institute of Electrical and Electronic Engineers of the American Academy of the Arts and Sciences and of the Institute of Mathematical Statistics and was President of the IEEE Information Theory Society. He has served as an associate editor for numerous journals. He has also been the contract statistician for the California State Lottery and a consultant to AT&T Bell Labs and IBM. He is a member of the National Academy of Engineering and is the recipient of the 1997 IEEE Richard W. Hamming Medal.

Hessam Mahdavifar, a Ph.D. student in the Electrical and Computer Engineering (ECE) Department at UCSD is the 2011-2012 recipient of the Shannon Graduate Fellowship. This endowed fellowship was created to honor an outstanding graduate student at UCSD whose research is in the field of information theory.

Mr. Mahdavifar received his B.Sc.EE in 2008 from Sharif University of Technology in Iran. As a high-school student, he took part in an International Mathematics Olympiad for two years in a row (IMO'2002 in Glasgow and IMO'2003 in Tokyo), earning a Silver Medal in both years. Currently, he is working towards his doctoral degree under the supervision of Professor Alexander Vardy.

The focus of Hessam's research is coding theory and its applications. He has made a number of important and highly original contributions, including: optimal interleaving algorithms for burst-error correcting codes, secure coding schemes for wiretap channels, list-decoding techniques for errors-and-erasures correction in networks, rewriting codes for flash memories, and tag singulation codes for RFID devices. Congratulations, Hessam!

3rd Annual Non-Volatile Memories Workshop

La Jolla, CA

UCSD
The University of California at San Diego

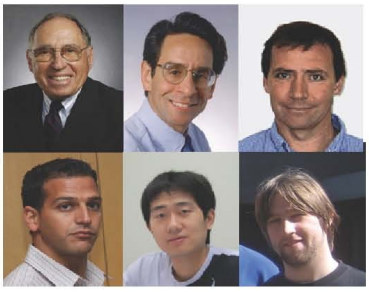
The UCSD Non-Volatile Memories Workshop is a unique showcase for outstanding work related to solid state, non-volatile memories. NVMW brings together researchers and engineers from disciplines ranging across memory devices, data encoding, systems architecture, applications, and more. NVMW 2011 attracted more than 230 academic and industrial researchers from universities, national labs and companies. Please join us for NVMW 2012!

PROGRAM INCLUDES:
Circuits and non-volatile memory devices • Systems architecture
Solid state storage systems • ECC and coding for flash memories
Other non-volatile memories • Tutorials and panel discussions

Learn more at cmrr.ucsd.edu and nvmw.ucsd.edu

Hosted by:

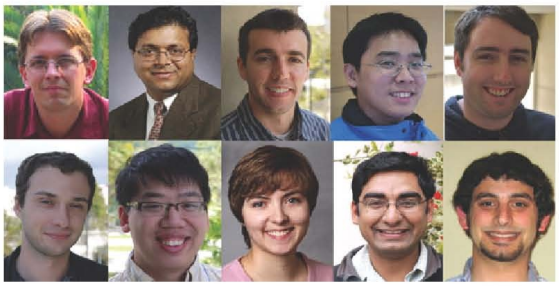
CMRR-SSD
Solid State Drive Program at the
Center for Magnetic Recording Research



Led by Prof. Paul Siegel

The Center for Magnetic Recording Research (CMRR) is an interdisciplinary research organization at the University of California, San Diego. For more than two decades, CMRR has been a leader in fundamental and applied research in support of the advancement of magnetic data storage technology, a cornerstone of the modern information age. In cooperation with industry and government partners, the Center pursues a diverse program of forward-thinking research while producing highly trained graduate students and postdoctoral professionals. CMRR-SSD is a major new research initiative at UCSD, focusing on issues of reliability, security, data integrity, and system applications of solid-state, non-volatile storage.

Non-Volatile Systems Laboratory
Department of Computer Science and Engineering



Led by Prof. Steve Swanson and Prof. Rajesh Gupta

The Non-Volatile Systems Laboratory (NVSL) at UCSD was founded in 2008 and focuses on developing hardware and software prototypes to understand the hardware, software, security, and reliability implications of non-volatile, solid-state memories. Our approach is to build hardware and software systems ranging from embedded storage arrays to flash-enabled high-performance clusters that allow us to characterize the challenges and test solutions on "real world" systems. We work with researchers at the Center for Magnetic Recording Research, the San Diego Super Computing Center, and within the Computer Science and Engineering Department to bring a wide range of expertise to bear on each of these issues.

CMRR Director:
Eric E. Fullerton

Newsletter Editor:
Lauren Coleman

Photography:
Lauren Coleman
Iris Villanueva
Alex Matthews

Contributors:
Eric Fullerton
Iris Villanueva
Paul H. Siegel
Iris Villanueva

http://cmrr.ucsd.edu

Research Highlight

X-ray's as a Magnetic Nano-Probe

Ash Tripathi, Jyoti Mohanty, Sebastian Dietze, Sang-Soo Kim, Ian McNulty,
Erik Shipton, Eric Fullerton and Oleg Shpyrko
University of California, San Diego

X-ray scattering is, in many ways, an ideal probe of magnetic nanomaterials since it allows in-situ, non-invasive investigation of both structural and dynamical properties of materials with nanoscale or even atomic resolution. Deeply penetrating ability of x rays make it a useful probe of truly bulk properties of materials, an advantage over electron scattering and microscopy, or scanning tunneling techniques. The ability to "see" deep inside non-transparent samples and to couple to "invisible" order parameters makes it possible to study samples that cannot be investigated with visible or infrared spectroscopy techniques. And unlike visible light microscopy which has practical resolution limit ≈200 nm due to Rayleigh criterion, the fundamental diffraction-limited resolution of x-ray scattering based techniques is well below 1 Ångström.

High degree of x-ray energy tunability at synchrotron facilities further makes it possible to perform measurements that are element-specific to specific chemical constituents, or use core-level sensitivity at the resonant edges to study magnetism with resonant magnetic scattering. We have recently demonstrated the high degree of spatial coherence available at high-brilliance synchrotron facilities enables a novel approaches to image nanoscale magnetic structure.

Coherent X-ray Diffractive Imaging.

Phase-retrieval lens-less imaging. While the temporal evolution of the x-ray speckle pattern can provide valuable information about fluctuation of the specific order parameter (orbital, charge or spin ordering), reconstruction of reciprocal space speckle "snapshot" pattern back into real space image based on phase-retrieval algorithms, known as Lensless X-ray Imaging, can provide detailed real-space information of both real and imaginary parts of the domain complex order parameters.

Imaging Extended Objects with Ptychography Approach. A novel approach to iterative phase retrieval called the Ptychographic Iterative Engine (PIE) [1-10] PIE is based on the idea of collecting coherent diffraction patterns from overlapping regions on the sample and using this information for unambiguous and fast phase retrieval, and imaging of extended objects on lengthscales greater than the size of the illuminated beam (see **Figure 2**) This approach can also be applied to extended objects of, in principle, unlimited size.

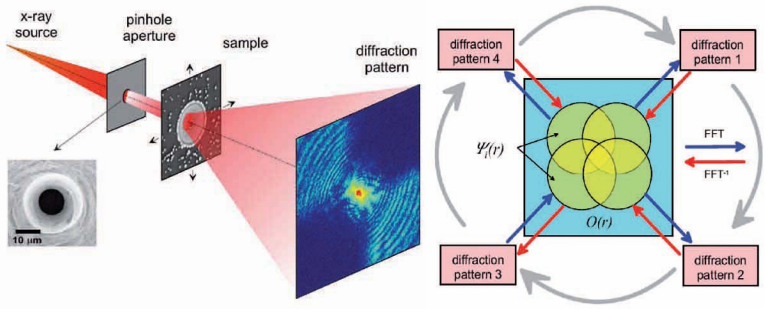


Figure 1: *Schematic of the experimental setup for lens-less ptychographical imaging (left) and the cyclic iterative algorithm of phase recovery. Adapted from Refs. [2,4]*

Research Highlight (cont'd)

We have performed PIE reconstructions of simulated data and so far the outcomes are quite favorable. There are several advantages to using the coherent diffractive imaging techniques, such as ptychography, over other imaging approaches, such as, for example, scanning X -ray Nanodiffraction:

1) The spatial resolution can exceed the dimensions of the x-ray beamspot.

2) The resolution is not limited by the quality of the focusing optics, but only by the coherent x-ray flux

3) Both phase and amplitude of the appropriate order parameter is retrieved, making the CXDI highly sensitive to "phase defects", such as phase strain, compression, dilatation or shear, presence of edge dislocations, as well as more complex topological phase defects, such as anti-phase domains, phase slips, screw dislocations etc.

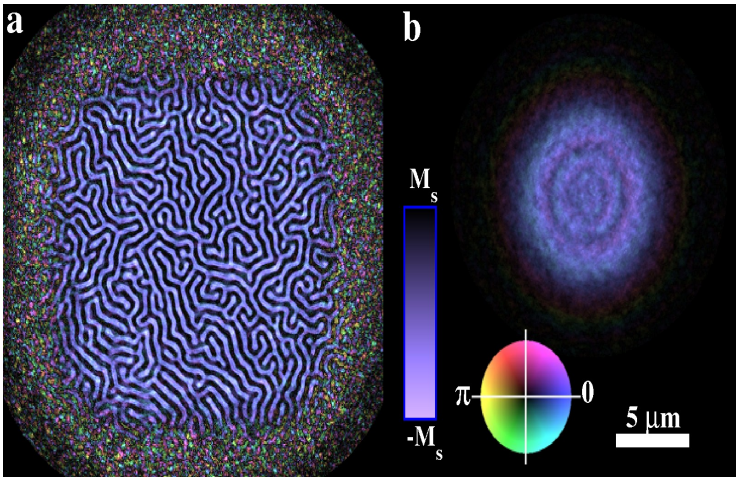


Figure 2: (a) Example of reconstructed magnetic domain structure obtained by 4x4 scanning of overlapping exposures. The extreme dark and light colors represent two anti-parallel fully saturated magnetization values (M_s) normal to the plane of the magnetic film **(b)** Reconstructed complex illumination function (amplitude shown as brightness and phase as hue) of the incident x-ray beam. From Tripathi et al, [11]

Coherent X-ray Diffractive Imaging of Extended Magnetic Nanostructures.

We have successfully performed to our knowledge first ever Coherent X-ray Diffractive Imaging (CDI) of magnetic nanostructures. The approach of CDI is a lens -less alternative to lens-based techniques, such as magnetic microscopy – whereby the diffraction pattern formed by scattering a coherent x-ray beam from a sample is inverted numerically to form an image of the object. By removing the need for optics, the spatial resolution achievable is no longer limited by the quality of the optical elements, but by the highest spatial frequencies measured in the x-ray diffraction pattern.

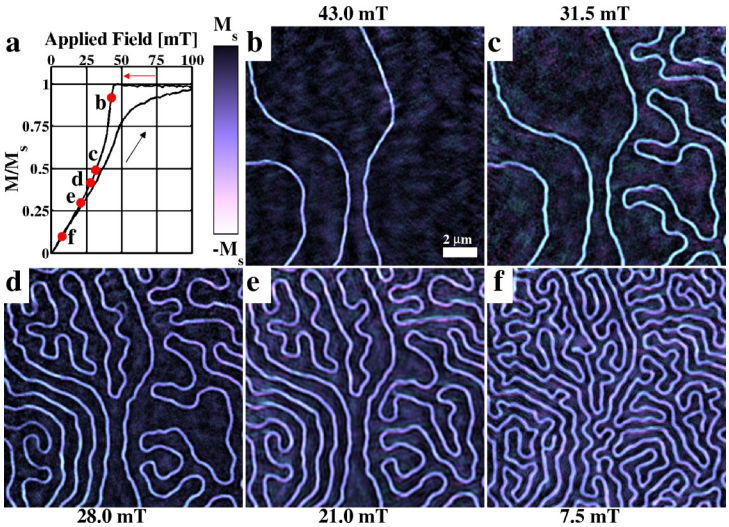


Figure 3: (a) domain evolution as the magnetic field is decreased from saturation towards zero magnetic field. (a) Hysteresis loop of sample magnetization as a function of applied magnetic field; (b-f) magnetic domain reconstructions from series of diffraction patterns taken at various points of magnetic hysteresis curve shown in (a). From Tripathi et al, [11]

Research Highlight (cont'd)

We demonstrated the basic principle of magnetic CDI where by subtracting coherent diffraction patterns collected on- and off- magnetic resonance (in this case at M_5 Gd adsorption edge) one can couple directly to magnetic structure induced by Gd – therefore achieving elemental sensitivity to magnetic moment and eliminating charge scattering contribution.

We have performed the CDI measurements on labyrinthine stripe domains in magnetic multilayers of GdFe, and have successfully demonstrated that both the real-space magnetic structure of the sample and the complex illumination function of the x-ray beam incident on the sample can be recovered in ptychographical approach (see Fig. 3).

The project demonstrates our ability not only to develop in-house algorithms that work on simulated or man-made objects, but can also be transferred to real-life systems. The measurements were performed at sector 2 of Advanced Photon Source at Argonne in collaboration with Ian McNulty of APS and Eric Fullerton and his group at UCSD.

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Associate Professor Raymond A. de Callafon

Boettcher, U. and Lacey, C.A. and Li, H. and Amemiya, K. and de **Callafon, R.A.** and **Talke, F.E.,** Servo Signal Processing for Flying Height Control in Hard Disk Drives, Microsystem Technologies, Vol. 17, pp. 937-944, (2011).

Boettcher, U. and Lacey, C.A. and Li, H. and Amemiya, K. and de **Callafon, R.A.** and **Talke, F.E.**, Analytical Read Back Signal Modeling in Magnetic Recording, Microsystem Technologies, Vol. 17, pp. 997-1002, (2011).

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A complete listing of CMRR papers & talks can be found at: http://cmrr.ucsd.edu

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Visiting Scientist Gordon Hughes

"SSD Trim Commands Considerably Improve Overprovisioning" Tasha Frankie, **Gordon Hughes**, Ken Kreutz-Delgado Flash Memory Summit, Santa Clara, CA, Forum F2C: Solid State Drive Technology August 9th, 2011.

Professor Paul H. Siegel

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A.R. Iyengar, **P.H. Siegel**, R.L. Urbanke, and **J.K. Wolf**, "Windowed Decoding of Spatially Coupled Codes," in Proceedings of 2011 IEEE International Symposium on Information Theory, St. Petersburg, Russia, July 31 - August 5, 2011, pp. 2558-2562.

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B. Butler and **P.H. Siegel**, "Error Floor Prediction for LDPC Codes in the AWGN Channel," in Proceedings of Forty-Ninth Annual Allerton Conference on Communication, Control and Computing, Monticello, IL, September 28 - 30, 2011, Talk WeB1.2.

"Write-Channel Model for Bit-Patterned Media Recording," Department of Electrical and Computer Engineering, Texas A&M University, College Station, Texas, April 6, 2011.

"Write-Channel Model for Bit-Patterned Media Recording," Computer Science Colloquium, Technion - Israel Institute of Technology, June 21, 2011.

"Windowed Decoding : A window of opportunity?" Combinatorial, Algorithmic and Algebraic Aspects of CodingTheory, Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland, July 28, 2011.

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M. Qin, E. Yaakobi, **P.H. Siegel**, "Time-Space Constrained Codes for Phase-Change Memories," Flash Memory Summit, Santa Clara, August 9-11, 2011.

Associate Professor Steven Swanson

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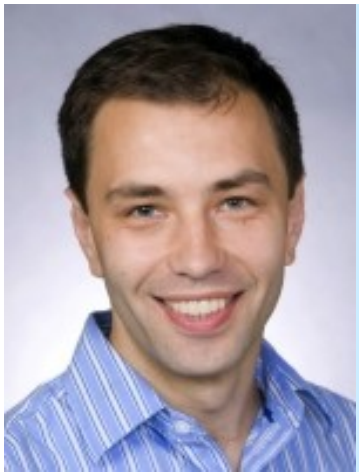
New Affiliated Faculty



Assistant Professor Oleg Shpyrko received his Ph.D in Physics from Harvard University in 2004. He has since served as postdoctoral fellow at Harvard University and as a CNM postdoctoral fellow at the Argonne National Laboratory Center for Nanoscale Materials. Now an Assistant Professor in the Physics Department at the University of California, San Diego. His research interests include experimental condensed matter. In 2010, he received the NSF CAREER (Faculty Early Career Development) Award. He is also the principle investigator for the Shpryko Group which studies nanoscale dynamics and structure of materials - splitting its interest between "soft matter" and electronic/magnetic materials.

For more information visit his website at http://oleg.ucsd.edu/

Assistant Professor Shirley Meng received her B.S. Materials Science and Engineering from Nanyang Technological University of Singapore and her Ph.D in Advanced Materials for Micro- & Nano- Systems from Singapore-MIT Alliance (National University of Singapore) . She also conducted postdoctoral research at MIT in Materials Science and Engineering. Her research interests include the field of energy storage and conversion materials: nano structured electrodes for advanced rechargeable batteries, dye-sensitized solar cells and thermoelectric conversion; charge ordering, structure stability, processing – structure – property - performance relation in functional ceramics and combining first principles computation with high-skilled experiments for rational materials design and optimization for energy applications.

For more information visit her website at
http://nanoengineering.ucsd.edu/faculty/smeng.html

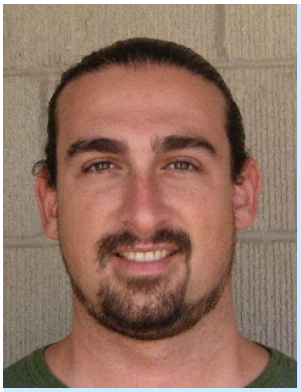
Professor Massimiliano (Max) Di Ventra graduated in Physics from the Ecole Polytechnique Federale de Lausanne in 1997. He is now a Professor at the Physics Department at the University of California, San Diego. His main interest is in the theory of electronic and transport properties of nanoscale systems, and has delivered more than 140 invited talks worldwide on these topics. He serves on the editorial board of several scientific journals and has won numerous awards and honors, including the NSF Early CAREER Award, the Ralph E. Powe Junior Faculty Enhancement Award, and fellowship in the Institute of Physics. He has co-edited the textbook *Introduction to Nanoscale Science and Technology* (Springer, 2004) for undergraduate students, and he is single author of the graduate -level textbook *Electrical Transport in Nanoscale Systems* (Cambridge University Press, 2008).

For more information, visit his website at http://physics.ucsd.edu/~diventra/

Visiting Scholar

Prof. Le Gu is a visiting scholar in Prof. Frank E. Talke's group from Harbin Institute of Technology, China. He received his Ph.D. degree in Mechanical Engineering from Harbin Institute of Technology in 2003. His research interests are in the areas of design and analysis of tribological surface and interface, ceramic ball bearings and sealing technologies. He has been the principal investigator of over 10 funded research projects, including the projects from National Natural Science Foundation of China (NSFC), Grant Basic Research Plan (973 Program), and HRB bearing group company. He was the co-recipient of National Technology Invent Award of China and the co-author of over 50 publications. He has been the vice-president of the Society of Young Tribologists of China since 2006.

CMRR Alumni



Erik Shipton, a grad student of Professor Eric Fullerton's group received his Ph.D. in June 2011. His dissertation was titled "High Anisotropy Materials for Magnetic Nanotechnologies".

Erik is currently a staff scientist at General Atomics here in San Diego where he is doing research on magnetic materials.

Uwe Boettcher a CMRR Ph.D. student advised by Professor Frank E. Talke and co-advised by Professor Raymond A. de Callafon, defended his dissertation successfully in April 2011. His dissertation was entitled "Nano-scale Positioning, Control and Motion Planning in Hard Disk." Uwe also worked as a Postdoctoral Scholar in Professor Talke's group working on active vibration damping in hard drives. He now works for Daimler AG, Mercedes-Benz Cars in Sindelfingen, Germany.

Eitan Yaakobi, received his Ph.D. degree under the supervision of Prof. Paul H. Siegel, Prof. Alexander Vardy and Prof. Jack Wolf in June 2011. He is currently a postdoctoral researcher at the Center for Magnetic Recording Research and works with Prof. Paul H. Siegel. His research interests include algebraic error-correction coding, coding theory, and their applications for digital data storage, and in particular for flash memories.

Visiting Students

Romain Lebrun received his B.S. in Engineering with two majors in Physics and Management from "Ecole des Mines", Nancy in 2010. As an undergraduate student, he worked on fabrication of superconductors wires of MgB2 through physical vapor deposition and held an internship at Pardubice, Qualcomm. Romain joined Fullerton Lab in July 2011 where he works on the study of CoPd/IrMn multilayer film. He is also currently pursuing a Master's Degree in Nanosciences at the University of Paris Sud, and in Engineering at "l'Ecole des Mines de Nancy".

Deng Pan is a graduate student at the Harbin Institute of Technology in China, majoring in Mechanical Design. In the fall of 2010 she joined the research group of Hongyuan Jiang in Harbin. Currently , she is a visitor in the Talke Lab. She is working on the optimization and control of thermal flying height control sliders.

Zhengqiang Tang is currently a graduate student at South China University of Technology in China, majoring in Mechanical Manufacturing & Automation. In the fall of 2010, he joined the laboratory of Advanced Metallic Materials Processing in Guangzhou. Now he is a Visiting Graduate advised by Professor Frank E. Talke. His research will focus on improving the wear properties of materials in fretting wear situations in structured thin films on top of a base material.

New Graduate Students

Chin-Hung (Isaac) Liu is a first-year graduate student in the Materials Science and Engineering PhD program at UCSD. Received his Master degree in MSE at National Tsing Hua University (NTHU) at Taiwan, R.O.C., Isaac joined Prof. Sungho Jin's group on 2011. Isaac's research interest is to incorporate graphene into semiconductor industries. Isaac is also familiar with nanofabrication processes and applications of nanomaterials for solar cells and light-emitting-diodes.

Liane Matthes is a first year graduate student in Mechanical and Aerospace Engineering in Prof. Talke's group. In Sept 2010, she received her B.Sc. degree in Electrical Engineering and Business Administration from TU Dresden, Germany. After that she joined Prof. Talke's group as a visiting graduate student. Liane was working with Uwe Boettcher on experimental investigations of head-disk contact of thermal flying height control (TFC) sliders and suppression of slider off-track vibrations and is now continuing as a PhD candidate at UCSD.

New Staff Members

Kevin Wong is the new fund manager at the Center for Magnetic Recording Research. He received his Bachelor's degree at the University of California, San Diego in 2011. He majored in International Studies: Economics and minored in Accounting. During his undergraduate years, he worked at the Business and Financial Services-General Accounting Office and the School of Medicine Controller's Office. In addition to his past academic studies and experiences, he is currently working toward his Certified Public Accountant license.

Lauren Coleman serves as an administrative assistant to Iris Villanueva. Originally from Sacramento, CA, she is currently a fourth year Psychology student and hopes to attend law school in Fall 2012. In addition to her B.A. in Psychology, she is also pursuing a double-minor in Law and Society and Japanese Studies. After graduation, she hopes to attend law school and pursue a career in international policy.

Internships

Aravind Iyengar	LSI Corporation	Explore new coding and signal processing methods for read channel applications.
Wenping Song	Western Digital	Simulation investigation and experimental study on contact between thermal asperity and disk.

Graduate Student Near Completion

Student	Level	Advisor(s)	Dept.	Area of Research	Completion
Hao Zheng	PhD	Professor Frank E. Talke	MAE	Mechanical design (investigation of the head/disk interface for bit patterned media, the design of thermal flying height control sliders, and the implementation of heat assisted magnetic recording)	October 2011

Celebrations at CMRR

Retirement Party

On June 2, 2011, CMRR celebrated the retirement of Jan Neumann James and Betty Manoulian.

Betty Manoulian had 25 years at UCSD. She joined UCSD in March 1985 in the Drama Department (now the Department of Theater & Dance). In April 1986 she joined CMRR

Jan Neumann James began her career at UCSD in the Biomedical Library in the School of Medicine. She came to CMRR in June 1986. She had 35 **years** at UCSD.

Directors Celebration

On September 2, 2011, we held a bbq to celebrate the transition of director of CMRR. We thanked Prof. Paul H. Siegel for his 11 years of service as CMRR director and ushered in Prof. Eric Fullerton as the new director. It was a day of relaxation and merriment as CMRR faculty, staff, and students mingled, ate delicious food and played ping pong on the new table named after Prof. Paul H. Siegel. Prof. Siegel was also presented with a plaque as a token of gratitude for his service.