IEEE Distinguished Lecturer

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TITLE:	**The Evolution and Revolutions in Disk Drive Recording**
SPEAKER:	***Dr. Michael Mallary***
	Seagate Technology and Magnetics Society Distinguished Lecturer for 2009
DATE:	Thursday, July 23, 2009
TIME:	Reception: 3:30 PM – Presentation: 4:00 PM
PLACE:	Auditorium – Center for Magnetic Recording Research
HOST:	Prof. Paul H. Siegel

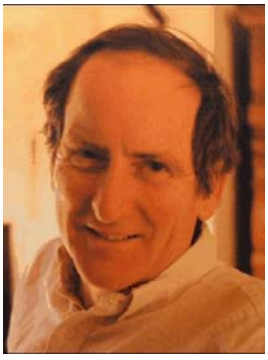
Since 1956 the areal density of hard disk drives, HDDs, has increased by eight orders of magnitude through a process of evolution punctuated by a number of important revolutions. The disk evolved for three decades through many generations of painted gamma ferric oxide particulate media with in plain orientation. During this time areal density was increased from 2 kilo-bits/inch2 (2kbpsi) for IBM's RAMAC to ~20Mbpsi .

The technology has seen a number of revolutions. In the mid 1980s the first (non-magnetic!) revolution was a diamond like carbon over coat for media that is key to its durability. The next revolution was the introduction of read sensors based on Giant Magneto-Resistive films with improved sensitivity. HDD proceeded to evolve up to ~100 Gbpsi on this technology base.

By the mid 1990's Prof. Stanley Charap of Carnegie Mellon University calculated that longitudinal recording would start to experience thermal decay of the data at densities of ~40 Gbpsi. In response to this impeding crisis, the Ultra-High Density Recording project was initiated by Prof. Mark Kryder (CMU) under the National Storage Industry Consortium umbrella. The UHDR team established the reality of the problem and proposed strategies to delay the crisis to ~100 Gbpsi. Key amongst these was to increase tracks per inch faster than bits per inch.

The UHDR theory team also determined that magnetizing the media perpendicular to the disk could extend magnetic recording by almost an order of magnitude beyond the thermal decay limit of longitudinal recording. Perpendicular HDDs are now being shipped at ~300Gbpsi. Key head innovations in achieving this density are the use of the the Shielded Pole writer invented by the author, and the Tunneling Magneto-Resistive reader with an MR effect approaching 100%.

The 30-40% per year growth in areal density will soon drive perpendicular recording to its thermal decay limit near 1 Tbpsi in demonstrations and less in products. Two revolutionary technologies are being developed to deal with this. Heat Assisted Magnetic Recording will allow high anisotropy media to be written at elevated temperatures thus allowing for finer thermally stable grains to be written. Bit Patterned Media will allow the recording of a bit on a single grain as compared to scores of grains with unpatterned media. The promise and problems of these technologies will be discussed in detail.



Michael Mallary is an IEEE Fellow and Distinguished Lecturer for 2009. He received his S.B. degree in physics from the Massachusetts Institute of Technology in 1966, and Ph.D. degree in Experimental High Energy Physic from the California Institute of Technology, in 1972.

He was a post doctoral fellow at the Rutherford Laboratory for from 1972-1974 and an Assistant Professor of physics at Northeastern University from 1974-1978. There he participated in an experiment at Fermi Laboratory that produced early evidence for the fifth quark using a 300 ton solid iron magnet. From 1978 to 1980 he worked at the Magnetic Corporation of America designing large superconducting magnets for MHD, MRI, energy storage and magnetic separation.

In 1980 he joined the Digital Equipment Corporations effort to produce thin film heads for disk drive recording as a head modeler and designer. Here he invented the Shielded Pole perpendicular recording head which has demonstrated superior performance over the conventional monopole head and is now in very disk drive shipped today. He also invented the Diamond inductive head which doubles the effective number of turns. In addition he has contributed to the theory of: flux conduction in thin film heads at high frequency; low bit aspect ratios for high density in the thermal decay limit; and tilted write fields for improved switching. His publications and patents have significantly advanced the field of magnetic recording.

Mike Mallary is presently working on Heat Assisted Magnetic Recording, Shingle Recording and 2 Photon Recording at the Seagate Technology Research Center in Pittsburgh. He has authored and co-authored 67 issued patents and 52 publications including "Our Improbable Universe" (ISBN 1-56858-301-X).

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If you have any questions or want to meet with the speaker before the seminar, contact Betty Manoulian (bmanoulian@ucsd.edu / Phone 858-534-6707).

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