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TRIBOLOGY

Tribology Division Newsletter

Andres Soom, Editor *Summer 2001*

Chair's Message

Roger Barnsby

The Tribology Division continues to be an active Division of ASME. Membership is stable, finances are in excellent health and operations and interests are expanding. The goal of the Tribology Division, as stated in our bylaws, is to serve the members and associates of ASME who are interested in the science, technology and applications of tribology, which includes all friction, wear and lubrication phenomena. Tribology encompasses many new fields, such as magnetic storage, predictive maintenance, electrochemical systems, nanotribology and bioengineering as well as the more traditional areas, such as bearings, seals, lubrication, coatings and contact mechanisms.

We have established technical committees in some of these areas as discussed later in the newsletter. Other like-minded groups and societies are also active in these disciplines and there is a major need to consolidate our efforts as much as possible so as to share ideas, interests and developments with the larger community. The Tribology Division is beginning to make significant strides to this end. We have established a liaison position on the Executive Committee to maintain close ties with one of our primary sister organizations, the Society of Tribologists and Lubrication Engineers (STLE). We are fortunate to have *Selda Gunsel*, curently a Director of STLE, serving in this vital role. We have also initiated a core committee whose mission is to improve communication throughout the tribology community. The Division is actively supporting the World Tribology Congresses in 2001 and 2005, respectively, and promoting improved collaboration with other organizations, such as STLE, Wear of Materials (WOM), Society of Automotive Engineers (SAE) and American Society of Testing for Materials (ASTM). *Rick Cowan*, who is currently serving as Technical Expositions Chair and as our web master, is expanding our web site to incorporate up-to-the-minute news and information consistent with the latest ASME initiatives in this area. *Crystal Heshmat*, Membership Development Committee Chair for the Division, is the ASME representative between the Council on Engineering and the Committee on Membership and its Young Engineers Committee. She is active not only in developing Tribology Division membership but also in publicizing the discipline of tribology throughout ASME.

We continue to maintain our established strengths of technical excellence in publications, conferences, education and service to members. We are becoming more involved with new technology and national issues, developing and using electronic media and actively pursuing more members for the overall advancement, development and application of Tribology throughout the world. These are great challenges and we are counting

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International Joint Tribology Conference

Sponsored by STLE and ASME International
October 22-24, 2001
Renaissance Parc 55 Hotel
San Francisco, California

"An international exchange of state-of-the-art knowledge pertaining to engineering practice in research, development, manufacturing, application and teaching of the science and technology of tribology"

Sponsors:
The Society of Tribologists and Lubrication Engineers (STLE) and ASME International, Tribology Division.

Cooperation Societies:
The Japan Society of Mechanical Engineers (JSME), Machine Design and Tribology Division, and the Japanese Society of Tribologists (JAST).

For further information, please visit www.stle.org

Chair's Message

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on everyone on the Executive Committee and throughout the Tribology Division to help us meet them. Our Executive Committee meetings are held at the Joint ASME/STLE Tribology Conference (this year in San Francisco, October 21-24, 2001) and at the STLE Annual Meetings in May of each year. These meetings are open to all interested ASME members. I would like to extend my very best wishes to *Harvey Nixon* in his new role as Executive Committee Chair and to all the members of the new slate for 2001-2002. I encourage all of you who read this newsletter to contact members of the Executive Committee or Chairs of Tribology Division committees for your valued input and participation in our activities.

Thurston Lecture Award to Duncan Dowson

Congratulations to tribologist Professor *Duncan Dowson* who won the prestigious Thurston Lecture Award. This award was elevated to ASME Society level recognition for the first time last year. Professor Dowson presented his lecture on the history and the future of tribology at the IMECE 2000. We are hoping to make his presentation available to Tribology Division members in the near future.

STLE and ASME Join Forces in Bid to Host WTC 2005

The Society of Tribologists and Lubrication Engineers (STLE), along with American Society of Mechnanical Engineers (ASME), is one of the international societies providing assistance to this prestigious meeting. STLE is also furthering its commitment to the WTC by joining with ASME and others to bid on hosting the third WTC in 2005. STLE is holding an option on meeting space at the Washington Hilton and Towers Hotel for September 8-17, 2005. This facility would be an excellent venue for the 2005 World Congress. The joint proposal for 2005 will be presented to the ITC selection committee in Vienna during this year's meeting. As the nation's capital, Washington, DC, would be an appropriate site for a WTC. The prior two Congresses have been held in the capital city of the host country: London(1997), Vienna(2001).

The WTC 2005 planning committee consists of:

Selda Gunsel (Pennzoil-Quaker State Co.) and *Simon Tung* (General Motors), representing STLE.

Rick Cowan (Georgia Tech University) and *Izhak Etsion* (Technion-Israel), representing ASME.

Joe Knight (Duke University) representing the ASME/STLE Joint Conference Committee.

Selda Gunsel
STLE/ASME Liaison

Honors and Awards

Congratulations to the following tribologists, who won awards this year:

Dr. *Bernie Hamrock*, who won the Mayo Hersey Award for his outstanding continued contributions to the advancement of lubrication science and engineering.

Dr. *Steven Schmid*, who won the Burt Newkirk Award for his notable contributions to research and development in the areas of metalworking, emulsion lubrication and tool design.

Dr. *Matthew Szolwinski*, who won the Marshall Peterson Award for his early-career achievements in material tribology, fretting fatigue and orthopaedic implants.

Dr. *Nelson Forster*, who won the Innovative Research Award for his creative work in carbon composite cage design.

Dr. *Lei Shan*, Dr. *Joseph Levert*, *Lorne Meade*, Dr. *John Tichy* and Dr. *Steven Danyluk*, who won the Best Paper Award for their paper "Interfacial fluid mechanics and pressure prediction in chemical mechanical polishing".

Professors *Sture Hogmark* of NORDTRIB and *Joze Vizintin* of SLOTRIB, who won certificates of appreciation for their efforts in advancing tribology at their respective Tribology Conferences in Finland and Slovenia.

Frank Talke, Chair

International Coordination

Professor *Kuniaki Dohda* from Gifu University in Japan fulfilled his tenure as Chairman of the International Coordination Committee (ICC) and has assumed the Past Chairman's consulting role with the committee. The new officers are *David E. Brewe* (Chair), *Bo Jacobson* (Vice Chair), and *Benyebka Bou-Said* (Secretary). Since the implementation of the new officer's, Ben Bou-Said has been actively working with the Tribology Division's Exposition Committee headed by Rick Cowan to gather opinions on whether the joint ASME/STLE conference is meeting the needs of the Division membership. Dr. Bou-Said had solicited more than 360 researchers in the field of tribology and received at last count 106 responses. In another activity with the Division's Exposition Committee, Prof. Bo Jacobson has agreed to serve as the ICC's representative to the Exposition Committee for the purpose of posting any future International Tribology activities and conferences on the division's web page.

The ICC has recently agreed to create sub-committees based upon a modification of Region 13's international sub division. The modification suggested by Prof. Jacobson and accepted by the ICC was to base the sub-division on "near-even membership distribution" among: South America; Asia; Middle East and Africa; Australia and New Zealand

We will be actively pursuing members to head the various sub-committees. We encourage all those interested in this committee to join us at our next business meeting in San Francisco at the joint ASME/STLE Conference.

David Brewe, Chair

Education

The education committee will be contacting academics involved in tribology teaching and research with a questionnaire about curriculum and research in tribology. The results will be compiled and analyzed to determine the current status of tribology activity in the USA. The results will be posted at the ASME Tribology Division web site sometime next fall and, possibly, published in the Journal of Tribology.

Kyriakos Kovmopoulous, Chair

Technical Expositions

The mission of the Technical Expositions Committee is to facilitate the planning and promotion of technical conferences, expositions and other forums of information exchange that are of interest to the ASME Tribology Division. In addition to the Chair, the Com-

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Second World Tribology Congress (WTC) in Vienna, Austria Sept. 3-7, 2001
For detailed information visit the website http://www.wtc2001-vienna.ccc.at/

Technical Expositions

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mittee members for the 2000-2001 term include *Farshid Sadeghi* and *Hugh Spikes*, as former and senior member of the Joint Tribology Conference Planning Committee, *Steven Schmid*, session organizer at the 1998 ASME IMECE, and *Benyebka Bou-Said* and *Nelson Forster*, secretaries of the Division's International Coordination Committee and Research Committee, respectively.

The Committee took an active role in promoting the Division's presence at ASME's International Congress (IMECE) in November 2000. Four sessions, organized by *Harvey Nixon*, were offered with the intent to educate the Conference attendees on the fundamentals and relevance of tribology. A brochure, consistent with the Conference theme *Beyond Traditional Boundaries*, was distributed to the registrants and highlighted how tribology is present at the boundaries of all fields of mechanical engineering. Given the positive comments by those who attended, the Division is planning to be present at the November 2001 IMECE in New York City by organizing two panel sessions concerning innovations in the traditional and emerging technology areas of tribology. Interested participants are invited to contact the Committee Chair, *Richard Cowan*, at rick.cowan@me.gatech.edu.

While taking a proactive stance in looking for new venues to elevate tribology, the Committee recognizes its commitment to promoting the Division's annual premier event: the ASME/STLE International Joint Tribology Conference, October 21-24, 2001 in San Francisco, CA. *ASME Tribology Division members and friends*, the Committee encourages your presence at this conference. We are confident that the organizers are doing their best to assure that there will be an "intellectual return" on your investment to attend. If past experience has you wary of this claim, the Committee wants to hear from you and has established a web-page to gather suggestions, anonymously! Visit the Division's web-site: http://www.asme.org/divisions/tribology for details.

Richard S. Cowan, Chair

International Joint Tribology Conference

October 21-24, 2001, San Francisco, CA

The 2001 STLE/ASME **International Joint Tribology Conference** (see announcement elsewhere) will be held from October 21-24, 2001 at the Renaissance Parc Fifty-Five Hotel in San

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Journal of Tribology Editor

During the past year, the ASME *Journal of Tribology* has maintained its position as one of the world's most respected archival journals in the field of tribology. In fact, if the eagerness of prospective authors is any measure, I would say it is the most desirable publication venue in the tribology world. I wish to extend my appreciation to the authors, Associate Editors, and reviewers who have contributed to the *Journal*'s success.

The Associate Editors, who in turn call on their colleagues as reviewers, do the real work of the *Journal*. I am primarily an administrator who rules over the paper flow. In principle, I make the final decision to accept or reject papers. However, I nearly always accept the recommendation of the Associate Editors, who in turn accept the advice of the reviewers. In some 80 percent of papers submitted, the decision is clear - the opinion of the reviewers is fairly uniform. In the remaining 20 percent, we earn our keep. We must make difficult decisions that make reviewers, or authors, or both, unhappy. And since I mentioned "earn our keep," please keep in mind that this is a voluntary operation in its entirety. Only when an approved manuscript is turned over to ASME Headquarters, does paid professional staff enter the picture.

While I am on the topic of work and service to our community, if you are a prospective author, I believe you have a duty to also review papers. Associate Editors are always scrambling to find competent people willing to do timely and careful reviews. It is not uncommon for an author who submits two papers a year to comment on the burden of performing two reviews per year. To keep the system in balance, an author owes about three reviews for every paper he or she submits.

Since the last Newsletter, we have added the following colleagues to our Editorial Board: *George Adams* of Northeastern University (contact mechanics, magnetic storage), *Michael Dugger* of Sandia National Labs (nanotribology, wear, coatings, materials), *Kees Venner* University of Twente (EHL, hydrodynamics, machine systems), and *Shifeng Wu* of A. W. Chesterton Company (seals, friction, wear). These individuals are already pressed into action and are doing an outstanding job. *David Fleming* of NASA Glenn Research Center and *Tom Farris* of Purdue University have completed their terms after outstanding service. They deserve a hearty thanks from me and the entire community.

During the most recent yearly reporting period to ASME (the October 1999 issue through the July 2000 issue) we published 139 papers and 4 technical briefs, comprising 1016 pages. During this period, 246 papers were submitted (up from 220 in the previous year) for an acceptance rate of about 55 percent. The median time to a decision on publication is about 4.7 months. We are always working to reduce this time, which is too long, but considerably better than most ASME journals. The median time to an "accept" decision is longer because, typically, there is an intermediate step of deliberation with the Associate Editor. The time from approval to publication is determined by the normal page allotment (about 210 pages or 30 papers per issue) and the backlog, which is currently about 50 papers.

The distribution of papers per subject matter in the Journal has varied slightly during the past five years, as follows:

SUBJECT	DISTRIBUTION					
	99-00	98-99	97-98	96-97	95-96	94-95
Friction/wear/contact mechanics	30	26	23	28	29	24
Hydrodynamics (including gas)	28	27	21	26	22	25
EHL/rolling elements	12	12	18	18	18	21
Magnetic storage	20	17	18	14	13	14
Other (including seals, coatings, molecular, manufacturing)	10	18	20	14	18	16

The categories of "magnetic storage" and "other" have been increasing in recent years. This year, there was a sudden downturn in the "other" category, which I cannot account for. A downturn in the number of "EHL/rolling elements" papers has occurred in the last two years. It will remain to be seen if this is a permanent change or an aberration. In many cases, the assignment of a paper to one category or another is fairly arbitrary: a gas bearing paper could be "hydrodynamics" or "magnetic storage," an adhesion paper could be either "contact mechanics" or "other," etc. The range of papers in the "other" category is huge: from our most scientific papers on, say, molecular nanotribology; to the most applied papers on, say, wear in forming processes.

As mentioned in the last Newsletter, I encourage perspective authors to submit Technical Briefs. Typically, they are about half the size of a normal journal article, about 3,500 words. Briefs do not need to exhibit "permanent value," a necessary condition for normal journal papers. I plan to publish them in a more timely fashion, appearing in the *Journal* as soon as they are typeset and proofed.

Again, I am always interested in comments and suggestions and how we can best serve those who are doing, and using, research work in tribology, tichyj@rpi.edu.

John Tichy, Technical Editor

Technical Note

The Quest for Higher Area Density Magnetic Recording

Andreas A. Polycarpou
Department of Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign, IL

Trends in magnetic storage emphasize the need for reduced head/disk spacing, which is coupled directly to the achievement of higher recording densities in hard disk drive (HDD) systems. Fig. 1(a) shows a typical HDD system, and Fig. 1(b) shows a schematic of the head/disk interface. Typical modern HDD operate with a head/disk spacing of about 20 nm, corresponding to an areal density of about 15 Gbit/in^2. This means that 1 in^2 (6.45 cm^2) area on a magnetic disk can store 15 billion bits! No wonder that modern desktop hard disk drives have capacities ranging from 20 Gbytes - 80 Gbytes (1 byte = 8 bits). Moreover, there have been numerous feasibility demonstrations of around 50 Gbit/In^2 areal densities. For magnetic HDD, the compound annual growth rate (CGR) of areal densities has been on the rise since the introduction of the first HDD in 1957. From the early 1970's until 1991 the CGR was 25%, then, increased to 60% from 1991 to 1997, and finally increased to an incredible 100% since 1997, as depicted in Fig. 2. Also, shown in the same figure is the CGR for DRAM that has remained constant at 40%, in accordance to Moore's law. Even though the 100% CGR for magnetic HDD may not be sustainable, a CGR of approximately 80% should lead to 100 Gbit/in^2 hard disk drive on the market sometime in 2004. With optimum material selection for recording media and transducers, reduction of written magnetic bit aspect ratio, and process equipment enhancement to fabricate ultra narrow track width and achieve uniform recording media grain size, it is now accepted that the current longitudinal

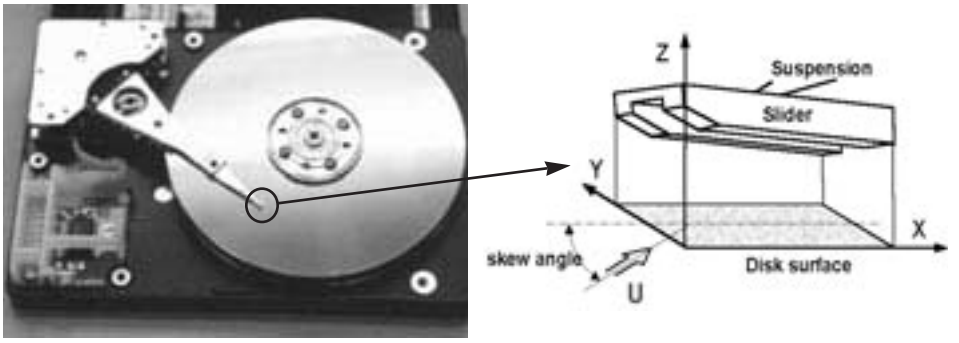

Fig. 1: Typical magnetic hard disk drive; (a) photograph of a hard disk drive, (b) schematic of the head/disk interface.

recording systems can be extended to 100 Gbit/In^2 and higher areal densities.

The reliable implementation of 100 Gbit/in^2 and higher recording systems will depend on the head/disk interface

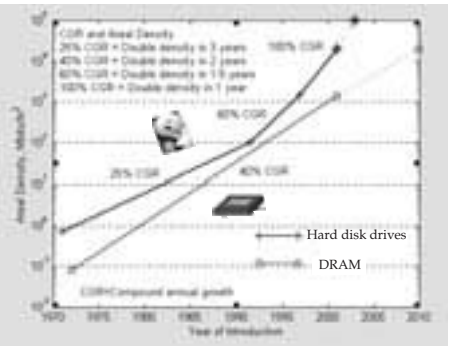

Fig. 2: Areal density trends for magnetic recording hard disk drives (HDD) and DRAM.

design and testing at nanometer scales. Recording performance modeling indicates that 10 nm, and 6.5 nm magnetic spacing is required to achieve 100 Gbit/in^2, and 1 Tbit/in^2 (1 Tbit = 1 trillion bits) areal densities, respectively. Allowing for sufficient wear and corrosion protection overcoats on media and head would permit approximately 6 nm, and 3 nm physical head/disk separation, for 100 Gbit/in^2, and 1 Tbit/in^2 areal densities, respectively. However, the tribological and contact dynamic issues that will be encountered for such interfaces are challenging. In such ultra low flying height regimes, the mechanical integrity of the head/disk interface is a main concern, since, due to manufacturing process induced variabilities, head/disk contact-intermittent or sustained-is virtually unavoidable. Such interfaces are usually known as pseudo-contacting interfaces. Some of the tribology and microtribology research areas that are covered by the head/disk interface are tribomechanics, tribochemistry, tribomaterials, tribotesting, interface dynamics and contact dynamics. These issues are expected to play a critical role for the successful design and implementation of pseudo-contacting head/disk interfaces that are required for 100 Gbit/in^2 and beyond. State of the art research on the tribological and contact dynamics areas, specifically targeted at 100 Gbit/In^2 and higher areal densities will help overcome the difficulties associated with the design of such interfaces, and elucidate on some of the complex challenges involved in this exciting area of microtribology.

International Joint Tribology Conference

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Francisco, California. This year's conference will feature sessions on a wide range of exciting tribology topics including fluid film tribology (EHD, HD and Gas bearings), Magnetic Storage Tribology, Metalworking tribology, Rolling Element Bearings, Tribology Fundamentals, Seals and others. Several panel discussions are planned to highlight current issues and over one-hundred papers are expected to be presented. The **International Joint Tribology Conference** represents one of the few annual events dedicated to the science and application of tribology and is an excellent opportunity to see cutting edge, peer reviewed papers long before they are published in journal form.

In addition, an all-day **Magnetic Media Tribology Symposium** (see announcement elsewhere) will be held on Sunday, October 21 featuring well known experts in the field. Registration for the full conference entitles attendance at the Sunday symposium as well.

A strong technical program coupled with participation by many of the world's foremost tribologists in a great location are sure to make this year's **International Joint Tribology Conference** one of the best ever! See you in San Francisco!

Christopher DellaCorte, Chair

Technical Committee Reports

Research Committee on Tribology

The Research Committee on Tribology met at the ASME/STLE Joint conference, and the STLE conference. Current officers are Chair Professor *Michael D. Bryant* of University of Texas at Austin, Vice-Chair Dr. *Christopher Della-Corte* of NASA Glenn Research Center, and Secretary Dr. *Nelson Foster* of AFRL/PRSL, Untied States Air Force. Current member include Dr. *Ali Erdemir* of Argonne National Laboratories, Professor *Thierry A. Blanchet* of Rensselaer Polytechnic Institute, Professor *Timothy C. Ovaert* of University of Notre Dame, Professor *Farshid Sadeghi* of Purdue University, Professor *Luis San Andres* of Texas A&M University, and Professor *Q. Jane Wang* of Northwestern University.

Current activities of the Research Committee for Tribology include formation of a website, and sponsoring of two workshops.

The Research Committee on Tribology will conduct a Workshop "Tribology Issues in Biology & Medicine", at Argonne National Laboratories, outside of Chicago. The workshop committee includes chair is *M.D. Bryant* of University of Texas at Austin, *T. Blanchet* of Rennselaer Polytechnic Institute, *A. Erdemir* of Argonne, *T. Ovaert* of University of Notre Dame, *J. Wang* of Northwestern University, and *G. Fenske* of Argonne. This workshop will have two principle goals: 1. Overview existing areas of tribology research in biology and medicine, and recommend direction, and 2. Identify NEW areas for research. Existing areas will include joint wear, replacement, and lubrication; dental contact and wear; heart valves and blood pumps; and surgical tools. New areas will seek tribology research issues in anatomy, physiology, medical equipment, and other areas of medicine, especially with respect to degenerative conditions. Such issues could arise in cell structure, organ transplants, artificial organs, eye-ear, nose and throat, cardio-pulmonary, etc.

A second workshop "Virtual Tribology and Design" is in the early planning stages, and is intended for the ASME/ASLE Joint conference of 2002. The chair will be *Nelson Forster*, a civilian employee of the US Air Force. This workshop will examine issues related to modeling to support design of systems that have tribological components. Especially stressed will be computer models, and problems of linking codes together.

Michael D. Bryant, Chair

Life Ratings for Modern Rolling Bearings

The goal of this committee is to publish a Design Guide for bearing life ratings, based on the most recent developments in bearing tribology. The Design Guide establishes a common and consistent life rating approach throughout the bearing industry, supported by a broad range of application data. It offers a standard and staightforward procedure for bearing users which generically extends the ratings in typical manufacturers' catalogs to include the latest bearing technology in a convenient and simplified format. It addresses different bearing types, competing surface and subsurface failure modes, lubrication and contamination effects and material fatigue stress limits.

An initial report on this activity was published by ASME in 98-TRIB-57. Active committee members include *Dwayne Arff, Ted Bailey, Roger Barnsby (Chair), Tedric Harris, Michael Hoeprich, Stathis Ioannides, Bryan Johnson, Thomas Losche, Kikuo Maeda, Les Miller, Yasuo Murakami, Bill Needelman, Harvey Nixon, Alfred Rivinius, Daniel Snyder, Nortake Tsushima* and *Martin Webster.* The procedure will be presented at an American Bearing Manufacturers' Association (ABMA) symposium in October, 2001 and at IMECE in November, 2001. For additional information on these plans, please contact Roger Barnsby at barnsbrm@pweh.com or 860-565-1370.

Roger Barnsby, Chair

Predictive Maintenance Technology

The Technical Committee on Predictive Maintenance Technology (PMT) was organized to facilitate a dramatic reduction in operating and maintenance costs through the application of products and methods that result from ASME-fostered collaboration between predictive maintenance technology developers and end-users. To that end, the Committee organized a blue ribbon panel discussion for the International COMADEM Conference (Machinery Failure Prevention Technology Society) in Houston, TX, December 3-8, 2000 entitled "University-Industrial Collaborative Programs in Condition Monitoring and Predictive Maintenance". The panel was organized by *Bill Marscher* of Mechanical Solutions, Inc. and was chaired by *Rick Cowan,* Director of the Georgia Tech MultiUniversity Center for Integrated Diagnostics. Panel members included *Ed Crowe,* Head of the Penn State ARL Condition-Based Maintenance Group; *Tom Byerly*, Head of the University of Tennessee Center for Machinery Diagnostics; *John MacIntyre* of the University of Sunderland; as well as *Rick Cowan* of Georgia Tech. The session was well attended, and a lively discussion took place.

The committee also represented the ASME Tribology Division at the STLE-organized Condition Monitoring 2001 Conference in San Antonio, TX, February 26-28, 2001, where the ASME PMT committee offered a one-day short course on technology updates aimed at heavy machinery end users. *Carl Byington* of the Penn State ARL CBM Group presented a lecture on advanced diagnostic methods. The Georgia Tech MultiUniversity Center for Diagnostics provided a set of speakers focusing on bearing and seal diagnostics, including presentations by *Ward Winer, Richard Salant, Steve Danyluk* and *Tom Kurfess*. *Bill Marscher* of Mechanical Solutions, Inc. presented modern vibration monitoring and evaluation procedures, as well as the principles of electric current spectrum analysis. *Warren Garber* of the Infraspection Institute presented an excellent overview of where and how to perform infrared thermography, with a number of useful case histories. The course had 35 attendees, and is likely to be given again at next year's conference, "Condition Monitoring 2002", in San Antonio TX. Call *Bob Gresham* of STLE (847-825-5536) for information or to offer papers or presentations.

The PMT committee plans to participate as a co-organizer in the "Improving Machinery Reliability" Panel Discussion at the May 2001 STLE Annual Meeting, in cooperation with the STLE Seals Technical Committee and Steel Council. Plans are also underway for a newsletter and for a committee membership drive.

If you'd like more information concerning the PMT Committee, or would like to be involved in its activities, please contact committee chair, *Bill Marscher* of Mechanical Solutions, Inc., at bill.marscher@mechsol.com.

Richard S. Cowan, PMT Secretary

Magnetic Storage

The Magnetic Storage Technical Committee of the Tribology Division has been very active since its establishment two and half years ago. The main activities were the organization of two symposia, during the annual ASME/STLE tribology conferences in 1999, and 2000. The theme for both symposia was tribological issues for higher areal density magnetic storage. Specifi-

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Magnetic Storage

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cally, the theme for the 1999 symposium was "Interface Tribology Towards 100 Gbit/in^2," and for the 2000 Symposium "Interface Tribology Towards 100 Gbit/in^2 and Beyond." Both Symposia were very successful with approximately 60 and 100 participants, respectively. Following the successes of the last two symposia, we are organizing a third symposium this year during the 2001 STLE/ASME international joint tribology conference. The symposium is sponsored by the Tribology Division of ASME. The announcement and details are shown below.

For more Magnetic Storage Committee information please contact the symposium organizers:

Andreas A. Polycarpou [polycarp@uiuc.edu]

C. Singh Bhatia [bhatias@us.ibm.com]

Kyriakos Komvopoulos [kyriakos@newton.berkeley.edu]

ANNOUNCEMENT AND INVITATION

Symposium on Nanotribology and Nanoengineering for 1 Tbit/In^2

San Francisco, CA, USA, October 21, 2001

Organized by the Magnetic Storage Committee of the Tribology Division of ASME

The technical areas of interest are Tribological and micro, nanoengineering issues for 1 Tbit/In2 interfaces. Some subjects that will be covered at the symposium are:

- Tribology, microtribology, and nanotribology of the head/disk interface
- Contact-flyability issues at ultra low flyheights
- High tracks per inch: Servo-mechanical design, micro-actuation
- Tribomaterials (self assembled monolayers, carbon)
- Thermal asperities
- High RPM challenges
- Perpendicular recording
- Patterned media
- Spindle and motor design/fluid bearings

Symposium organizers:

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