

# **2010 Asia-Pacific Magnetic Recording Conference**

**(APMRC 2010)**

**Singapore  
10 – 12 November 2010**



**IEEE Catalog Number: CFP10791-PRT**  
**ISBN: 978-1-4244-8103-3**

# Conference Program

## Day 1

Wednesday, 10 November 2010

Waterfront Ballroom

Morning Refreshment	: 10:00
Lunch	: 12:00 – 13:30
Afternoon Refreshment	: 15:00
IDEMA Night	: 18:00 – 21:00

### Registration

09:00 – 09:20

Welcome speech

**Tow Chong CHONG**

*Singapore University of Technology and Design, Singapore*

### Session AA

#### Head-Disk Interface and Tribology (I)

Session Chair: David Bogy, *University of California, Berkeley, USA*

10:40 – 11:05

AA-1 **Effect of Slider Surface Energy on Head Disk Interface Performance**

J. XU, Y. Shimizu, H. Matsumoto, and K. Matsuda

*Hitachi Ltd, Japan*

1

11:05 – 11:30  
AA-2 **Dynamic Modeling of the Resistance Heater Element in Thermal Flying Height Control Sliders** 3  
U. Boettcher<sup>1</sup>, C. A. Lacey<sup>2</sup>, H. Li<sup>3</sup>, K. Amemiya<sup>3</sup>, R. A. de Callafon<sup>1</sup>, and F. E. Talke<sup>1</sup>  
<sup>1</sup>*University of California, USA*  
<sup>2</sup>*Microphysics Inc., USA*  
<sup>3</sup>*Hitachi Asia Ltd, Singapore*

11:30 – 11:55  
AA-3 **Nonlinear Dynamic Effect of Thermal Flying-Height Control Sliders at Touch-Down** 5  
S. K. YU, B. Liu, K. K. Ng, W. Hua, and W. D. Zhou  
*Data Storage Institute, Singapore*

12:00 – 13:30  
Lunch

Session AB  
Actuator and Microactuator (I)  
Session Chair: Kyoung-Su Park, *Yonsei University, South Korea*

13:30 – 13:55  
AB-1 **Three-Phase Electrostatic Rotary Stepper Motor for Skew Angle Compensation** 7  
E. Sarajlic, C. Yamahata, M. Cordero, and H. Fujita  
*University of Tokyo, Japan*

13:55 – 14:20  
AB-2 **Electrothermal Actuators for Hard Disk Drive Applications** 9  
James Bain, A. El-Ghazaly, D. Bromberg, G.K. Fedder, and W.C. Messner  
*Carnegie Mellon University, USA*

Session BA  
Head-Disk Interface and Tribology (II)  
Session Chair: F. E. Talke, *University of California, San Diego, USA*

14:20 – 14:45  
BA-1 **Lubricant Pickup on Ultra-thin PFPE Lubricants with Different Backbone Structure** 11  
H. Tani<sup>1</sup>, K. Iwasaki<sup>1</sup>, M. Nakayama<sup>1</sup>, Y. Maruyama<sup>2</sup>, I. Ota<sup>2</sup>, and N. Tagawa<sup>1</sup>  
<sup>1</sup>*Kansai University, Japan*  
<sup>2</sup>*Showa Denko, Japan*

Poster Session BP  
Head-Disk Interface and Tribology (III)

- 14:45 – 15:10  
BA-2 **Viscoelasticity of PFPE Lubricant Films on Magnetic Disk Surface Measured by Optical-Fiber-Based Nanorheometry** 13  
S. Itoh, K. Fukuzawa, Y. Hamamoto, and H. Zhang  
*Nagoya University, Japan*
- 15:10 – 15:35  
BA-3 **Lubricant Thickness Modulation and Recovery for Contact and Near Contact Recording Conditions** 15  
Sripathi Vangipuram Canchi, and David B. Bogy  
*University of California, Berkeley, USA*
- 15:35 – 16:00  
BA-4 **Lubricant Transfer in Disk Drives** 17  
Paul H. Kasai<sup>1</sup>, and Vedantham Raman<sup>2</sup>  
<sup>1</sup>*MORESCO Corp, Japan*  
<sup>2</sup>*Hitachi Global Storage Technologies, USA*

Session BB  
Airflow, Acoustics, Heat Transfer and Mechanics (I)

Session Chair: Masato Ikegawa, *Mechanical Engineering Research Laboratory, Hitachi, Japan*

- 16:00 – 16:25  
BB-1 **Thermal Analysis of Disk-Spindle Assembly on RRO in Computer Hard Disk Drives** 19  
Rana Noman Mubarak, Ali Afridi, and Jen-Yuan (James) Chang  
*Massey University, New Zealand*
- 16:25 – 16:50  
BB-2 **Track-Following High Frequency Lateral Motion of Flexible Media** 21  
V. Kartik, A. Pantazi, and M. A. Lantz  
*IBM Zurich Research Laboratory, Switzerland*

BP-8	<b>Novel soft lithography technique for fabrication of Ni nanodots for use as bit patterned media</b>	23
	Shivaraman Ramaswamy, K. R. Ganesh, and C. Gopalakrishnan <i>SRM University, India</i>	
BP-9	<b>A Flexible KFCI Compensation for Head/Media Optimization in Perpendicular Magnetic Recording Systems</b>	25
	P. Supnithi <sup>1</sup> , K. Bunsri <sup>1</sup> , and M. Novid <sup>2</sup> <sup>1</sup> <i>King Mongkut's Institute of Technology Ladkrabang, Thailand</i> <sup>2</sup> <i>Western Digital, USA</i>	
BP-10	<b>Parametric Studies of dimple-flexure slip at the moment of ramp contact in unloading process</b>	27
	Kyoung-Su Park, Geonyup Lim, No-Cheol Park, and Young-Pil Park <i>Yonsei University, Korea</i>	
BP-11	<b>Investigation of unloading performance for motor flying height change during emergency parking</b>	29
	Seokhwan Kim, Jaesung Park, Ki-Hoon Kim, No-Cheol Park, Young-Pil Park, and Kyoung-Su Park <i>Yonsei University, Korea</i>	
BP-12	<b>Simulation of the Eddy Current in the Thermal Flying Height Control Slider</b>	31
	Hui Li, and Kensuke Amemiya <i>Hitachi Asia Ltd, Singapore</i>	
BP-13	<b>On measurement accuracy of lubricant thickness on sliders by ellipsometry</b>	33
	J. M. ZHAO, M. S. Zhang, and M. C. Yang <i>Data Storage Institute, Singapore</i>	
BP-14	<b>Air Bearing Features on Patterned Media</b>	35
	W. HUA, B. Liu, S. Yu, W. Zhou, and K. S. Myo <i>Data Storage Institute, Singapore</i>	

Poster Session BR  
Airflow, Acoustics, Heat Transfer and Mechanics (II)

16:50 – 18:00

Riverfront Ballroom

- BR-1 (Invited, BB-1)  
Thermal Analysis of Disk-Spindle Assembly on RRO in Computer Hard Disk Drives  
Rana Noman Mubarak, Ali Afridi, and Jen-Yuan (James) Chang  
*Massey University, New Zealand*
- BR-2 (Invited, BB-2)  
Track-Following High Frequency Lateral Motion of Flexible Media  
V. Kartik, A. Pantazi, and M.A. Lantz  
*IBM Zurich Research Laboratory, Switzerland*
- BR-3  
Effect of Disk Clamping Conditions on the Operational Shock Response of Hard Disk Drives 37  
D. W. Shu<sup>1</sup>, F. F. Yap<sup>1</sup>, B. Gu<sup>1</sup>, and B. J. Shi<sup>2</sup>  
<sup>1</sup>*Nanyang Technological University, Singapore*  
<sup>2</sup>*Shandong Jianzhu University, China*
- BR-4  
Parametric Study of HDD Operational Shock with Disk – Ramp Contact 39  
R. Rai and D. B. Bogy  
*University of California, USA*

## Day 2

Thursday, 11 November 2010

Waterfront Ballroom

Morning Refreshment : 10:00  
Lunch : 12:00 – 13:30  
Afternoon Refreshment : 15:00  
Banquet Dinner : 19:00 – 22:00

08:15 – 08:45

Registration

### Session CA

#### Airflow, Acoustics, Heat Transfer and Mechanics (III)

Session Chair: Jen-Yuan (James) Chang, *Massey University, New Zealand*

09:00 – 09:25

CA-1 **Fluid Simulation and Measurement of Polygonal Airflow Pattern in HDD** 41  
M. Ikegawa, H. Mukai, T. Sugii, and M. Watanabe  
*Hitachi Ltd, Japan*

09:25 – 09:50

CA-2 **Flow Excitation and Damping Forces on Disk Flutter in Hard Disk Drives** 43  
T. Eguchi  
*Hitachi Ltd, Japan*

09:50 – 10:15

CA-3 **Actuator-Flex Cable Energy Harvester in Computer Hard Disk Drives** 45  
Jen-Yuan (James) Chang  
*Massey University, New Zealand*

### Session CB

#### Servo and Control (I)

Session Chair: Guo Guoxiao, *Western Digital, USA*

10:15 – 10:40

CB-1 **Fast Servo Track Writer Seek Control for Minimum Resonance Excitation** 47  
Hyun Jae Kang<sup>1</sup>, Kyung-Soo Kim<sup>2</sup>, Seung-Hi Lee<sup>1</sup>, and Chung Choo Chung<sup>1</sup>  
<sup>1</sup>*Hanyang University, Korea*  
<sup>2</sup>*KAIST, Korea*

10:40 – 11:05  
CB-2 **Final-State Control Using a Polynomial and Time-Series Data** 49  
**M. Hirata**, and **F. Ueno**  
*Utsunomiya University, Japan*

11:05 – 11:30  
CB-3 **Control Design of Hard Disk Drive Self-Servo Track Writing via  $H_2$  AND  $H_\infty$  CONTROL SYNTHESIS** 51  
**Jianbin Nie**, and **Roberto Horowitz**  
*University of California, Berkeley, USA*

11:30 – 11:55  
CB-4 **Mechanical Servo Simulation Platform for HDD Tracking Performance Studies** 53  
**Eng Teo Ong**, **Sari Shafidah Bte Shafiee**, **Mingjie Luke Ng**, **Wuzhong Lin**, **Eng Hong Ong**  
*Data Storage Institute, Singapore*

12:00 – 13:30  
Lunch

Session DA  
Motor and Bearing (I)  
Session Chair: **IY (Steve) Shen**, *University of Washington, USA*

13:30 – 13:55  
DA-1 **Motion of Air-Oil Interface of the FDBs of a HDD due to Non-Op Axial Shock** 55  
**K. M. Jung**, and **G. H. Jang**  
*Hanyang University, Korea*

13:55 – 14:20  
DA-2 **Performance of HDD Spindle Motor under Mobile Disturbance** 57  
**Ming Feng**, and **Weiyang Lu**  
*University of Science and Technology Beijing, China*

14:20 – 14:45  
DA-3 **High Frequency Radial Mode Vibration in Hard Disk Drives** 59  
**C.-P. R. Ku**, **J.-Y. Juang**, **X. Sun**, **L. Huang**, and **F.-Y. Huang**  
*Hitachi Global Storage Technologies, USA*

Session DB  
Future HDD Technologies (I)

Session Chair: Fu-Ying Huang, *Hitachi Global Storage Technologies, USA*

14:45 – 15:10

- DB-1 **Coupled Plasmonic Waveguides: Near Field Transducers for HAMR** 61  
E.J. Black, Y. Kong, S. Powell, M. Chabalko, Y. Luo, T.E Schlesinger, and James Bain  
*Carnegie Mellon University, USA*

15:10 – 15:35

- DB-2 **Light Delivery Mechanics with Si-submount for Terabit-Class Thermally-Assisted Magnetic Recording** 63  
I. Naniwa, T. Matsumoto, J. Shimizu, S. Arai, K. Nakamura, S. Sasaki, M. Kanamaru, and S. Nakamura  
*Hitachi Ltd, Japan*

15:35 – 16:00

- DB-3 **Patterned Media and Energy Assisted Recording Studied by Drag Tester** 65  
Siang Huei Leong, Joo Boon Marcus Travis Lim, Budi Santoso, Chun Lian Ong, Zhimin Yuan, Yunjie Chen, Tianli Huang, and Shengbin Hu  
*Data Storage Institute, Singapore*

16:00 – 16:25

- DB-4 **Relax Head Media Spacing by High Resolution Reader at Multi Tb/in<sup>2</sup>** 67  
Zhimin YUAN, Shengbin HU, Guchang HAN, Bo LIU  
*Data Storage Institute, Singapore*

Poster Session DP  
Airflow, Acoustics, Heat Transfer and Mechanics (IV)

16:25 – 18:00  
Riverfront Ballroom

DP-4	<b>Design of a Herringbone Groove Disk Damper for Effective Suppression of Axial Disk Vibration of HDD</b>	<b>69</b>
	M. H. Choi and Y. C. Rhim <i>Yonsei University, Korea</i>	
DP-5	<b>A New Fluid Structure Coupling Approach for High Frequency/Small Deformation Engineering Application</b>	<b>71</b>
	Ningyu LIU, Qide ZHANG, and Kannan Sundaravivelu <i>Data Storage Institute, Singapore</i>	
DP-6	<b>A Numerical Investigation of Particle Trajectory inside HDDs</b>	<b>73</b>
	N. LIU <sup>1</sup> , Z. He <sup>1</sup> , C. K. T. Chow <sup>2</sup> , and H. T. Loh <sup>2</sup> <sup>1</sup> <i>Data Storage Institute, Singapore</i> <sup>2</sup> <i>National University of Singapore, Singapore</i>	

Poster Session DQ  
Servo and Control (II)

16:25 – 18:00  
Riverfront Ballroom

- DQ-5  
**Reference Signal Shaping for Time-Optimal Track-Seeking in Hard Disk Drives** 75  
U. Boettcher<sup>1</sup>, D. Fetzner<sup>1</sup>, H. Li<sup>2</sup>, K. Amemiya<sup>2</sup>, R. A. de Callafon<sup>1</sup>, and F. E. Talke<sup>1</sup>  
<sup>1</sup>*University of California, USA*  
<sup>2</sup>*Hitachi Asia Ltd, Singapore*
- DQ-6  
**Limitations to Achieve High Bandwidth Control in Hard Disk Drive Servo Systems** 77  
Mohammadreza Chamanbaz, Venkatakrisnan Venkataramanan, Wang Qing-Guo, and Liew Yun Fook  
*Data Storage Institute, Singapore*
- DQ-7  
**Disturbance Rejection on Critical Resonant Mode in Hard Disk Drives** 79  
Gangquan Dai<sup>1</sup>, Fan HONG<sup>2</sup>, Chee Khiang Pang<sup>1</sup>, and Masaki Nagashima<sup>3</sup>  
<sup>1</sup>*National University of Singapore, Singapore*  
<sup>2</sup>*Data Storage Institute, Singapore*  
<sup>3</sup>*Naval Postgraduate School, Monterey, USA*

Poster Session DR  
Motor and Bearing (II)

16:25 – 18:00  
Riverfront Ballroom

- DR-4 **Vibration Reduction of a Single-phase Spindle Motor with Structural Refinement** 81  
Cheng-Tsung Liu<sup>1</sup>, Yen-Ming Chen<sup>1</sup>, and Alex Horng<sup>2</sup>  
<sup>1</sup>*National Sun Yat-Sen University, Taiwan R.O.C.*  
<sup>2</sup>*Sunonwealth Electric Machine Industry Co., Ltd., Taiwan R.O.C.*
- DR-5 **Fast Calculation of Maximum Torque Performance for SPM Motors Used in HDD** 83  
Ming Feng, and Liang Qu  
*University of Science and Technology Beijing, China*
- DR-6 **Study of Saturation Effects in Brushless DC Spindle Motors Using Harmonics Analysis Method** 85  
J. T. LI<sup>1</sup>, Z. J. LIU<sup>2</sup>, and C. BI<sup>2</sup>  
<sup>1</sup>*Xi'an Jiaotong University, China*  
<sup>2</sup>*Data Storage Institute, Singapore*

Poster Session DS  
Future HDD Technologies (II)

16:25 – 18:00  
Riverfront Ballroom

- DS-5  
**Operation Shock Analysis of a Thermally Assisted Magnetic Recording Suspension considering the Thermal Effects** 87  
Ki-Hoon Kim, Seokhwan Kim, No-Cheol Park, Young-Pil Park, and Kyoung-Su Park  
*Yonsei University, Korea*
- DS-6  
**Micropatterning of SU-8 Pillars by X-Ray Lithography** 89  
C. Sripung<sup>1</sup>, K. Chokprasombat<sup>2</sup>, and C. Sirisathitkul<sup>2</sup>  
<sup>1</sup>*Synchrotron Light Research Institute, Thailand*  
<sup>2</sup>*Walailak University, Thailand*
- DS-7  
**Slider posture effects on air bearing in heat assisted magnetic recording system** 91  
K. S. Myo, W. Zhou, B. Liu, S. Yu, and W. Hua  
*Data Storage Institute, Singapore*

DS-8

Lubricant Pickup under Laser Irradiation Condition

Rong Ji<sup>1</sup>, T. K. L. Dao<sup>1</sup>, B. X. Xu<sup>1</sup>, J. W. Xu<sup>2</sup>, B. L. Goh<sup>3</sup>, Emelyn Tan<sup>3</sup>, H. Q. Xie<sup>1</sup>, and T. Liew<sup>1</sup>

<sup>1</sup>*Data Storage Institute, Singapore*

<sup>2</sup>*Institute of Materials and Research, Singapore*

<sup>3</sup>*National University of Singapore, Singapore*

93

Banquet Dinner

19:00 – 22:00

Riverfront Ballroom

## Day 3

Friday, 12 November 2010

Waterfront Ballroom

Morning Refreshment : 10:00  
Lunch : 12:20 – 13:30  
Afternoon Refreshment : 15:00

08:15 – 08:45

Registration

### Session EA

#### Motor and Bearing (III)

Session Chair: Roger Ku, *Hitachi Global Storage Technologies, US*

09:00 – 09:25

- EA-1 **Estimating Bearing Coefficients of Fluid-Dynamic Spindle Motors Using Sub-Resonant Frequency Response** 95  
I. Y. Shen, and Erik M. Ladd  
*University of Washington, USA*

09:25 – 09:50

- EA-2 **Cogging Torque of Brushless DC Motors due to the Interaction between Unevenly Magnetized Permanent Magnet and Teeth Chamfering** 97  
S. J. Sung<sup>1</sup>, S. J. Park<sup>2</sup>, and G. H. Jang<sup>1</sup>  
<sup>1</sup>*Hanyang University, Korea*  
<sup>2</sup>*Samsung Electro-Mechanics Co. Ltd., Korea*

09:50 – 10:15

- EA-3 **Back-EMF ZCP Error Induced by EM Structure of Spindle Motor** 99  
Chao Bi, Nu Phyu Hla, Quan Jiang, and Cheng Su Soh  
*Data Storage Institute, Singapore*

### Session EB

#### Future HDD Technologies (III)

Session Chair: Yuan Zhimin, *Data Storage Institute, Singapore*

10:15 – 10:40

- EB-1 **Investigation of Dynamic Characteristics of Thermal Assisted Magnetic Recording Light Delivery** 101  
Kyoung-Su Park, Ki-Hoon Kim, No-Cheol Park, and Young-Pil Park  
*Yonsei University, Korea.*

10:40 – 11:05		
EB-2	<b>Challenges of Patterned Media</b> S. N. Piramanayagam <i>Data Storage Institute, Singapore</i>	103

### Session EC

#### Head-Disk Interface and Tribology (IV)

Session Chairs: David Bogy, *University of California, Berkeley, USA*

11:05 – 11:30		
EC-1	<b>Development and Investigation of Disk Lubricants for Heat Assisted Magnetic Recording Systems</b> H. J. Kang <sup>1</sup> , M. Gauvin <sup>2</sup> , H. Zheng <sup>2</sup> , B. Suen <sup>2</sup> , and F. E. Talke <sup>2</sup> <sup>1</sup> <i>Dankook University, Korea</i> <sup>2</sup> <i>University of California, USA</i>	105
11:30 – 11:55		
EC-2	<b>Characterization of Intermittent Contact Head Disk Interface</b> Man Yijun <sup>1</sup> , Liu Bo <sup>1</sup> , Zhang Mingsheng <sup>1</sup> , Ng Kang Kee <sup>1</sup> , Sinha Sujeet Kumar <sup>2</sup> , and Lim Seh Chun <sup>2</sup> <sup>1</sup> <i>Data Storage Institute, A*STAR, Singapore</i> <sup>2</sup> <i>National University of Singapore, Singapore</i>	107
11:55 – 12:20		
EC-3	<b>Development and Evaluation of Super Smooth Probes Applicable to Pin-On-Disk Tests for Measuring Surface Forces</b> H. Tani <sup>1</sup> , Y. Mitsuya <sup>2</sup> , T. Kitagawa <sup>3</sup> , and N. Tagawa <sup>1</sup> <sup>1</sup> <i>University of Kansai, Japan</i> <sup>2</sup> <i>Nagoya Industrial Science Research, Japan</i> <sup>3</sup> <i>Nomura Plating Co., Ltd., Japan</i>	109

12:20 – 13:30  
Lunch

Poster Session EP  
Motor and Bearing (IV)

12:20 – 13:30  
Foyer

- EP-4      **Source and Reduction of Uneven Magnetization of a Permanent Magnet of a HDD Spindle Motor**      111  
C. J. Lee, C. I. Lee, and G. H. Jang  
*Hanyang University, Korea*
- EP-5      **Optimal Design of FDBs of a HDD to Minimize Friction Torque**      113  
J. H. Lee, and G. H. Jang  
*Hanyang University, Korea*

Poster Session EQ  
Future HDD Technologies (IV)

12:20 – 13:30  
Foyer

- EQ-3 **A double-vortex magnetic memory cell** 115  
A. Ruotolo, N. Wang, and X. Wang  
*City University of Hong Kong SAR, China*
- EQ-4 **Reduction in the de-magnetization effect in bit patterned media using WO<sub>3</sub> nanowires** 117  
C. Gopalakrishnan<sup>1</sup>, K. R. Ganesh<sup>1</sup>, Shivaraman Ramaswamy<sup>1</sup> and K. Jegannathan<sup>2</sup>  
<sup>1</sup>*SRM University, India*  
<sup>2</sup>*Bharathidasan University, India*

Poster Session ES  
Servo and Control (III)

12:20 – 13:30

Foyer

- |      |   |     |
|------|---|-----|
| ES-1 | <b>(Invited, FA-1)</b><br><b>Adaptive Cancellation of Self-Induced Vibration</b><br>T. Semba, M. T. White, and F-Y. Huang<br><i>Hitachi Global Storage Technologies, USA</i>  | 119 |
| ES-2 | <b>(Invited, FA-2)</b><br><b>Low Frequency Vibration Detection and Compensation</b><br>Wen-Jun Cao, JianYi Wang, MingZhong Ding, Qiang Bi, and KianKeong Ooi<br><i>Seagate Technology R&amp;D Centre, Singapore</i> | 121 |
| ES-3 | <b>Servo Format Trend and Servo Channel Improvement for High Areal Density</b><br><b>Guoxiao Guo</b> , and Jie Yu<br><i>Western Digital Corporation, USA</i>  | 123 |

Poster Session ET  
Actuator and Microactuator (III)

12:20 – 13:30

Foyer

- ET-1 **(Invited, FB-1)** 125  
**Model Prediction Based Dual-Stage Actuator Control**  
Choong Woo Lee, Cheol-Soon Kim, and Sang Min Suh  
*Samsung Electronics, Korea*
- ET-2 **(Invited, FB-2)** 127  
**A Thermal Driven Microactuator for Hard Disk Drive**  
Seong-Hun Choe, Hitoyuki Tomotsune, Takehiko Eguchi, Masatoshi Kanamaru, Takanori Aono,  
Shigeo Nakamura, and Akira Koide  
*Hitachi Ltd, Japan*
- ET-3 **(Invited, FB-3)** 129  
**Smart Material Actuators for Micro Optical Zoom Lens Driving Systems**  
Baek-Chul Kim<sup>1</sup>, S. T. Choi<sup>2</sup>, Y. Lee<sup>1</sup>, Jae-Do Nam<sup>1</sup>, Hyungpil Moon<sup>1</sup>, Hyouk Ryeol Choi<sup>1</sup>, and  
J. C. KOO<sup>1</sup>  
<sup>1</sup>*Sungkyunkwan University, Korea*  
<sup>2</sup>*Samsung, Korea*