





AUGT. 13—17, 2018 BEIJING

GOODOO

## 1. Map Information





#### Beijing International Convention Center (BICC)

Address: No.8 Beichen Dong Road, Chaoyang District, Beijing

- Airport Express → Subway Line 10 → Subway Line 8
- Airport Express Shuttle Bus Line
  5
- Airport Express → Subway Line 10 → Bus Route 380
- Airport Express → Subway Line 10 → Bus Route 82
- Take a taxi from the airport to BICC directly



## 1.1 Beijing Continental Grand Hotel





### BEIJING CONTINENTAL GRAND HOTEL





1.2 Beijing International Convention Center (BICC)







# 2. Schedule

Monday	09:30 - 20:00	Registration	Hotel Lobby
13 <sup>th</sup> August	18:30 - 20:30	Welcome Reception	Lijiang Restaurant
Tuesday	08:00 - 18:00	Registration	The corridor outside Conference Room 201
14 <sup>th</sup> August	08:20 - 08:50	Opening Ceremony	Conference Room 201
	08:50 - 09:10	Group Picture Taking	
	09:10 - 10:40	Keynote Presentations I II III	Conference Room 201
	10:40 - 11:00	Coffee Break	
	11:00 - 12:30	Keynote Presentations IV V VI	Conference Room 201
	12:30 - 13:30	Lunch	Lijiang Restaurant
	14:00 - 15:50	Technical Sessions	Conference Room 201A, 201B, 201C, 201D
	15:50 - 16:10	Coffee Break	
	16:10 - 17:30	Technical Sessions	Conference Room 201A, 201B, 201C, 201D
	17:30 - 18:30	Meeting for International Advisory Committee	Conference Room 201A
	18:30 - 20:00	Dinner	Lijiang Restaurant
Wednesday	09:30 - 20:00	Registration	The corridor outside Conference Room 201
15 <sup>th</sup> August	08:30 - 15:30	Technical Tour to Emaging	Tianjin City
	16:00 - 18:00	Visit to Kiev aircraft carrier	Tianjin City
	18:30 - 20:00	Dinner	Hilton Restaurant at Tianjin Eco-City
Thursday	08:00 - 18:00	Registration	The corridor outside Conference Room 201
16 <sup>th</sup> August	08:30 - 10:10	Technical Sessions	Conference Room 201A, 201B, 201C, 201D
	10:10 - 10:40	Coffee Break	
	10:40 - 12:00	Technical Sessions	Conference Room 201A, 201B, 201C, 201D
	12:00 - 13:00	Lunch	Lijiang Restaurant
	14:00 - 15:40	Technical Sessions	Conference Room 201A, 201B, 201C, 201D
	15:40 - 16:10	Coffee Break	
	16:10 - 17:50	Technical Sessions	Conference Room 201A, 201B, 201C, 201D
	18:30 - 20:30	Banquet and Closing Ceremony	Ball Room
Friday	08:00 - 12:00	Registration	The corridor outside Conference Room 201
17 <sup>th</sup> August	08:30 - 12:00	Technical Tour to Maglev Line S1	Shijingshan District, Beijing
	12:30 - 13:30	Lunch	Lijiang Restaurant

### ISMB16 Time Table

Monda	y, Aug. 13	
9:30	20:00	Registration @ the lobby of Beijing Continental Grand Hotel
9:30	18:00	Exhibition Move-in @ the corridor of Beijing International Convention Center, 2nd Floor
18:30	20:30	Welcome Reception @ Lijiang Restaurant, 2nd Floor, Beijing Continental Grand Hotel

Tuesday	y, Aug. 14											
8:00	18:00	Regist	ration @ Beijing Internation	nal Convention Center, Ro	oom No.201, 2nd Floor							
		Room 201A	Room 201B	Room 201C	Room 201D	Corridor						
8:20	8:50	Opening Ceremony										
8:50	9:10		Group Picture Taking									
9:10	10:40	Keynote Presentation I II III										
10:40	11:00		Coffee Break 20 min									
11:00	12:30	Keynote Presentation IV V VI										
12:30	13:30	Lunch 60 min @	Dijiang Restaurant, 2nd F	loor, Beijing Continental	Grand Hotel							
14:00	15:40	Design & Modeling I	Design & Modeling II	Applications I	Control I							
15:40	16:10		Coffee Break	30 min								
16:10	17:30	Design & Modeling III	PMBs I	Applications II	Control II							
17:30	18:30	Meeting for International Advisory Committee Members @ 201A Hotel										
18:30	20:00	Din	ner for All @ Lijiang Resta	urant, 2nd Floor, Beijing	Continental Grand							

Wednesday, Aug. 15

9:30	20:00	Registr	Registration @ Beijing International Convention Center, Room No.201, 2nd Floor										
		Room 201A	Room 201ARoom 201BRoom 201CRoom 201DCorridor										
8:30	18:00		Exhibition										
8:30	15:30	Technical Tour	to Emaging, Tianjin City(N	Meet @ the lobby of Bei	ijing Continental Grand H	otel)							
16:00	18:00		Visit to Kiev aircraft carrier, Tianjin City										
18:30	20:00		Dinner for All Visitors @	Hilton Restaurant at Tia	anjin Eco-City								

Thursda	y, Aug. 16												
8:00	18:00	Regist	Registration @ Beijing International Convention Center, Room No.201, 2nd Floor										
		Room 201A	Room 201B	Room 201C	Room 201D	Corridor							
8:30	10:10	Design & Modeling IV	Design & Modeling $V$	Applications III	Control III								
10:10	10:40		Coffee Break 30 min										
10:40	12:00	Design & Modeling VI Bearingless Motor I PMBs II Backup Bearings											
12:00	13:00	Lunch 60 min @ Lijiang Restaurant, 2nd Floor, Beijing Continental Grand Hotel Exhibition											
14:00	15:40	Design & Modeling VII Design & Modeling IX PMBs III Control IV											
15:40	16:10		Coffee Break	30 min									
16.10	17.50	Design & Modeling VII	Bearingless Motor II	Applications IV	Control V								
10.10	17.50		Dearingless Motor II	ripplications iv	Bearingless Motor III								
18:30	20:30	Banquet and	d Closing Ceremony @ Ball	room, 2nd Floor, Beiji	ng Continental Grand Hot	el							
18:30	20:30		Exhi	bition Move-out									
Friday	Δυσ 17												

Friday,	Aug. 17	
8:00	12:00	Registration @ Beijing International Convention Center, Room No.201, 2nd Floor
8:30	12:00	Technical Tour to Maglev Line S1(Meet @ the lobby of Beijing Continental Grand Hotel)
12:30	13:30	Farewell Party @ Lijiang Restaurant, 2nd Floor, Beijing Continental Grand Hotel

### **KEYNOTES**

Keynote Address I Time/Room : 9:10 - 9:40, Tuesday, Aug. 14 / Room 201A Chair: Zongli Lin

Passive and Active Magnetic Bearings: Past, State of the Art, Future

Hannes Bleuler, Director of Robotic Systems Lab, École Polytechnique Fédérale de Lausanne, Switzerland

ISMB has been held every two years since now 30 years. The overwhelming part of the work done in those 30 years on magnetic bearings has been on "active magnetic bearings", while "passive" magnetic bearings have found only little interest. It is nevertheless rewarding to discuss the distinction between these two types of magnetic bearings. Although the terms "active" and "passive" are usually quite clear from the context, studying this topic can lead to fresh insights. Concrete examples will be discussed to illustrate some aspects of both, "passive" and "active" magnetic bearing



research and realizations. Focus will be on relative advantages, drawbacks and potential for innovation of various application cases.

Keynote Address II Time/Room : 9:40 - 10:10, Tuesday, Aug. 14 / Room 201A Chair: Richard M.Stephan

# Development of an ultra-compact fully magnetically suspended ventricular assist device CH-VAD

Chen Chen, Soochow University, China

CH Biomedical Inc has been developing a proprietary ultra-compact fully magnetically suspended ventricular assist device (blood pump) CH-VAD since 2009. An enormous effort was made towards multidisciplinary design optimization of the pump packaging size, load capability of the suspension, blood flow path, driveline diameter, and other critical performance indices derived from clinical needs. The final version of CH-VAD design has been verified through extensive bench tests, biocompatibility evaluation,

animal study, and first-in-man clinical applications. The magnetic suspension yields a load capability with respect to transverse vibration and shock as well as angular speed of tilting about radial axes of the pump, to the level that allows patients to undertake physical activities of an active life. The electronic component for driving and controlling magnetic suspension and electric motor was miniaturized and placed inside the pump so that the percutaneous cable contains merely 4 wires and the cable size is greatly reduced, and thus the risk of infection mitigated. On top of that, a pump envelope size of 50 mm in diameter and 25 mm in thickness is attained. This group of performance indices of magnetic suspension significantly surpasses that of the other fully magnetically suspended blood pumps ever been developed in the world, including the only product that has received FDA approval for marketing in last year, the HeartMate 3. The first-in-man application of CH-VAD was extremely successful by saving three end stage heart failure patients at imminent risk of death and bringing them back to normal lives. These clinical outcomes together with the equally promising animal studies and in-vitro blood damage tests are attributed to the novel flow path design of the CH-VAD pump, which was made possible merely with magnetic suspension eliminating the constraints on the flow path design. Therefore, the CH-VAD experience has provided the field with further convincing evidence of superiority of the full magnetic suspension over the mechanical bearing or the hydrodynamic suspension in providing the potential for achieving a breakthrough in blood compatibility, i.e. less risk of blood clotting or abnormal bleeding. The CH-VAD is scheduled for the clinical trial in China in this year and the clinical trial in the US shortly thereafter to eventually validate its benefits and advantages.



### Keynote Address III

Time/Room : 10:10 - 10:40, Tuesday, Aug. 14 / Room 201A

Chair: Myounggyu D.Noh

### **Three-pole Active Magnetic Bearing: State of the Art**

Shyh-Leh Chen, Chung Cheng University, Chinese Taibei

The 3-pole active magnetic bearing (AMB) was proposed in view of the expensive cost and large energy loss of the conventional 8-pole system. Compared with the most popular 8-pole AMB, the 3-pole system requires only half of power amplifiers, produces less than half of copper and iron losses, and provides more space for heat dissipation, coil winding, and sensor installation. As a result, the overall cost can be reduced. The major difficulty of the 3-pole AMB lies in the strong magnetic flux coupling between the 3 poles, resulting in the strong nonlinear dynamics. In particular, it is a non-affine nonlinear system. Therefore, most conventional controller design methods cannot be applied



directly. Fortunately, a special structure inherent in the magnetic force model allows for a feedback linearization design, making many stable levitation controller designs possible. This talk will give a brief review of the past studies on the 3-pole AMB. The issues to be discussed include hardware design, dynamic modeling, controller design, self-sensing design, self-bearing design, and applications. Finally, the future directions for the 3-pole AMB will also be discussed.

### Keynote Address IV

Time/Room : 11:00 - 11:30, Tuesday, Aug. 14 / Room 201A Chair: Patric Keogh

# Research and Application of Maglev Technology in Large Central Air-conditioning

Yusheng Hu, Deputy Director of State Key Laboratory of Air-conditioning Equipment and System Energy Conservation, China

Energy saving, environmental protection and high efficiency are the main directions for the development of central air-conditioning. Centrifuge works as the high-end central air-conditioning product, which has an irreplaceable advantage in large-scale refrigeration applications. Traditional centrifuge supports the shaft through mechanical bearings, mechanical friction exists and a dedicated oil lubrication system is required. As a result, lubricating oil is easily mixed in the refrigeration system. The unit heat



exchange, the unit's comprehensive energy efficiency is limited. The magnetic suspension bearing has the characteristics of no oil, no friction and low loss. The application of it to the centrifuge can greatly increase the energy efficiency of the unit. The magnetic suspension centrifuge represents the development direction of large central air-conditioning, this keynote mainly introduces the research and application of maglev technology in large central air-conditioning.

Keynote Address V Time/Room : 11:30 - 12:00, Tuesday, Aug. 14 / Room 201A Chair: Wolfgang Amrhein

### Advances in magnetic suspension and derived technologies

Takeshi Mizuno, Saitama University, Japan

The suspension of an object with no visible means is still fascinating to most people. In magnetic suspension, magnetic force is used to achieve such suspension. Researches and developments on this unique technology have been intensively pursued for several decades, and it may be considered that this technology is rather mature now. However, to utilize this unique technology fully and to increase industrial applications more, advances including the invention of novel principles of suspension are still important. This keynote overviews innovations and advances in magnetic suspension technology and also its derived technologies. First, an



overview of technological fundamentals and trends is presented. Then, the recent activities, most of which have been conducted in our laboratory, are presented.

Keynote Address VI Time/Room : 12:00 - 12:30, Tuesday, Aug. 14 / Room 201A Chair: Jin Zhou

### Integrated Motor-Compressors for Oil and Gas Applications

Lei Zhu, Solar Turbines Incorporated, USA

This keynote speech introduces the typical configurations for integrated high-speed motor driven gas compressors supported by magnetic bearings. It further discusses the motor selection, benefits and challenges associated with integrated compressors for Oil and Gas applications. Finally, it presents an integrated compressor technology demonstration machine built by Solar Turbines and some of the test results.



Tuesday, A	ug. 14	Design & Modeling	1R	Design & Modeling II	10	Applications I	1D	Control I
Time/Room	ТА	14:00 - 15:40/ROOM 201A	ID	14:00 - 15:40/ROOM 201B	ю	14:00 - 15:20/ROOM 201C	ID	14:00 - 15:20/ROOM 201D
Session Chairs		Koichi Oka/Feng Sun		Lei Zhu/Satoshi Ueno		Hannes Bleuler/Yuanping Xu		Hubatka Michael/Adam Krzysztof Pilat
14:00 - 14:20	1A1 ID	Random Response Analysis of Magnetic Bearing Rotor System	1B1 ID	Sum-flux Rotor Position Sensor with Self-balancing Magnetic Bearing Concept	1C1 ID	Nanometer Resolution of Magnetic Levitation Stages for Planar and Linear Scan Application	1D1 ID	Performance of Flux Density Based Control Approaches for Active Magnetic Bearings – an Overview
	108	Jinping Chen, Li Zhang, Yanyan Luo, Haining Zhang, Jun Liu (AVIC Qing 'an Group Co., Ltd), China	206	Hubert Mitterhofer (Linz Center of Mechatronics), Austria, Mikhail Rakov (RLR Consulting), USA, Wolfgang Gruber (Johannes Kepler University Linz), Austria	129	Rainer Gloess, Alexander Goos (Physik Instrumente (PI) GmbH & Co.KG), Germany	140	Robin Liebfried, Wilfried Hofmann (Technische Universiät Dresden), Germany
14:20 - 14:40	1A2 ID 109	Study on Parametric Calculation of Magnetic Bearing Based on Modelica Jun Liu, Jinping Chen, Haining Zhang, Yanyan Luo, Li Zhang (AVIC Qingan group co., LTD), China	1B2 ID 215	Stability Analysis and Testing of the High-Speed Active Magnetic Bearing-Flywheel System in the Rotating Frame JinpengYu, Lei Zhao, Kai Zhang, Pingfan Liu (Tsinghua University), Yanbao Li (Shanghai Aerospace Control Technology Institute), Pengcheng Pu (Tsinghua University), China	1C2 ID 144	Commissioning and Testing of Active Magnetic Bearings for HTR Production Fuel Ball Blowers Zenglin Guo (Waukesha Magnetic Bearings), Minlong Qian(Shanghai Blower Works Co., Ltd.), Hong Wang (INET Tsinghua University), China, Andrea Masala (Waukesha Magnetic Bearings), UK Richard R. Shultz (Waukesha Magnetic	1D2 ID 161	Performance of AMB Suspended Energy Storage Flywheel Controllers in the Presence of Time Delays Xujun Lyu (Wuhan University of Technology), Long Di (ASML-HMI), Zongli Lin (University of Virginia), USA, Yefa Hu, Huachun Wu (Wuhan University of Technology), China
						Bearings), USA, Weichang Yang, Haifei Lu, Tao Yang (Shanghai Blower Works Co., Ltd.), China		
14:40 - 15:00	1A3	Variable Space Vector Modulation for Self-Sensing Magnetic Bearings	1B3	The Motion of the Rotor Acrossing Critical Speed Levitated by AMBs with Anisotropic Stiffness	1C3	Activities of ISO/TC 108/SC 2/WG 7 in the Development of Standards for AMB Systems	1D3	$H\infty$ Robust Differential Control for Electromagnetic Suspension Beam
	ID 112	Dominik Wimmer, Markus Hutterer, Matthias Hofer, Manfred Schrödl (Technische University Wien), Austria	ID 216	Hongwei Li, Jing Tian (Shandong University), Yixin Su (Tsinghua University), Wentao Yu (Shandong University), Suyuan YU(Tsinghua University), China	ID 146	Patrick Keogh (University of Bath), UK, Beat Aeschlimann (MECOS AG), Switzerland, Larry Hawkins (Calnetix Technologies), USA, Richard Jayawant (Waukesha Magnetic Bearings), UK, Bert-Uwe K öhler (Siemens AG), Germany, Eric Maslen (James Madison University), USA	ID 200	Peipei Wang, Changsheng Zhu (Zhejiang University), China
15:00 - 15:20	1A4	A Study about Turning Three-Phase	1B4	Analysis of the Effect of Air Gap on the Derformance of Solf inductors	1C4	Testing the High Speed Shaft of a	1D4	Fractional Order Surge Control of
	ID	Magnetic Bearings	ID	Displacement Sensor	ID	Magnetic Bearing Test Device	ID	Suspended Compressor
	116	Christian Tshizubu, Jos é Andr és Santisteban (Universidade Federal Fluminense,), Brazil	240	Rui Chen, Hongwei Li, Pinzhou Ye, Jing Tian, Wentao Yu (Shandong University), China	201	Andreas J. Prö (Johannes Kepler University Linz)l, Jiří Sloupenský (Rieter CZ s.r.o.), Peter Dirnberger (Linz Center of Mechatronics GmbH, Wolfgang Amrhein (Johannes Kepler University Linz), Austria	242	Parinya Anantachaisilp (Royal Thai Air Force Academy), Thailand, Zongli Lin(University of Virginia), USA
15:20 - 15:40	1A5 ID	5-Axis AMB Suspension Design for 300 HP Industrial Compressor Paul Allaire, Brad Nichols, Tim Dimond, Jianming Caol Rotor Pagring Solutions	1B5 ID	Nonparametric Identification of a Small AMB Test rig at Several Rotating Speeds				
	244	International), Xianhao Ma, Raojing Shang, Chunyan Wang, Huajun Wang(Suzhou Palboom Electric Co., Ltd.)	165	Diego Diaz, Fernando Pinto, Thiago Ritto, David Maldonado, Vinicius Côrtes (Federal University of Rio de Janeiro), Brazil				

Tuesday, A	ug. 14							
Session Time/Room	2A	<b>Design &amp; Modeling III</b> 16:10 - 17:30/ROOM 201A	2B	PMBs I 16:10 - 17:30/ROOM 201B	2C	Applications II 16:10 - 17:30/ROOM 201C	2D	<b>Control II</b> 16:10 - 17:30/ROOM 201D
16:10 - 16:30	2A1	Dynamic and Control Simulation of Rotor Suspended by Three Radial	2B1	Research on the Development of Permanent Magnetic Gas Suspension Rearing in ORC Waste	2C1	Development of Oil-Free Turbo-Chillers Equipped With Magnetically-Levitated	2D1	A Method of Suppressing Unbalance Vibration of AMBs Based on Flux Feedback Control
	ID 160	Ninds Discu on Multibody Dynamics Yixin Su (Tsinghua University), Yichen Yao (Tsinghua University, and Southeast University), Yanhui Ma (Tsinghua University), Hongwei Li, Wentao Yu (Shandong University), Suyuan Yu (Tsinghua University), China	ID 158	Heat Generator Gang Zhang, Caiqin Xie, Kunpeng Yuan, Xuan Song, Jinman Xu, Dian Zhou (Shanghai University), China	ID 142	Compressors Myounggyu D. Noh (Chungnam National University), Jinhee Jung, Nam Soo Lee, Sungmin Jang, Kiwook Lee, Soyoon Kimb (LG Electronics), Korea	ID 141	Wei Huang, Zhiquan Deng, Cong Peng, Kexiang Li, Kaiwen Cai (Nanjing University of Aeronautics and Astronautics), Lei Mei (Nanjing University of Technology), China
16:30 - 16:50	2A2 ID 177	The Model of Dynamics of Multispan Flexible Rotor on Active Magnetic Bearings Applied for Diagnostics Viktor Ovchinnikov, Mikhail Nikolaev, Vasily Litvinov (Research Institute of Mechanics Lobachevsky State University of Nizhny Novgorod), Russia	2B2 ID 186	Design, Analysis and Experiment Study of the Permanent Maglev Roller used in Belt Conveyor Li Zhang, Huachun Wu,Peng Li, Yefa Hu (Wuhan University of Technology and Hubei Provincial Engineering Technology Research Center for Magnetic Suspension),	2C2 ID 183	Novel System for Zero-Power, Orientation-Controlled Magnetic Levetation James Lin , Akinori Harada, Koichi Oka (Kochi University of Technology), Japan	2D2 ID 143	Tuning Guidelines for Generalized Notch Filters used for Unbalance Compensation for Magnetic Bearings Michael Hubatka, Beat Aeschlimann (Mecos AG), Switzerland
16:50 - 17:10	2A3	System Identification of AMB	2B3	Chuanyang Xu, Lei Wang, Ziyang Zhang (Shandong Haihui Environmental Protection Equipment Co., Ltd), China Force and Stiffness Calculation and	2C3	Condition Monitoring of AMBs on	2D3	Switching Control between 3-coil
	ID	Systems: Step Towards Automated Commissioning	ID	Optimization of Permanent Magnetic Thrust Bearing Used in Vessels	ID	the IoT	ID	and 5-coil modes for 6-pole Active Magnetic Bearings
	181	Alican Sahinkaya, Jerzy T. Sawicki (Cleveland State University), USA	221	Xingqian Zhao, Changgeng Shuai, Wei Xu (Naval University of Engineering and National Key Laboratory of Ship Vibration and Noise), Demin Chen (Magna Drive Corporation), Zechao Hu (Naval University of Engineering and National Key Laboratory of Ship Vibration and Noise), China	211	Alexander H. Pesch, Peter N. Scavelli (Hofstra University), USA	151	Satoshi Ueno, Masayuki Chiba, Changan Jiang (Ritsumeikan University), Japan
17:10 - 17:30	2A4 ID 182	Research on Coupling Property of Vertical and Transverse Force of Maglev Platform	2B4 ID 223	Reduction of Unbalanced Magnetic Forces in Planar Linear Actuators	2C4 ID 228	Magnetic Field Calculation and Characteristic Analysis on Double-acting VCM for Intelligent Vehicle Suspension	2D4 ID 157	A Novel Synchronous Rotating Frame Transformation for Complete Synchronous Vibration Force Suppression
	102	Yuzhe Zhang (Shandong University), Xue Bowen (Maintenance Division of Jiangsu Electric Power Company), Ting Gu, Shuqin Liu (Shandong University), China	223	Florian Poltschak, Markus Speletz. (Johannes Kepler University), Austria	220	Liguo Miao, Feng Sun, Wei Wei, Zhiyu Zhao, Qiang Li, Fangchao Xu, Fei Pan (Shenyang University of Technology), China, Xiaoyou Zhang (Nippon Institute of Technology), Japan	137	Qian Zhou, Cong Peng, Mengting Zhu, Zhiquan Deng (Nanjing University of Aeronautics and Astronautics), China

Thursday, Au	ıg. 16							
Session Time/Room	3A	<b>Design &amp; Modeling IV</b> 8:30 - 10:10/ROOM 201A	3B	<b>Design &amp; Modeling V</b> 8:30 - 10:10/ROOM 201B	3C	<b>Applications Ⅲ</b> 8:30 - 10:10/ROOM 201C	3D	<b>Control III</b> 8:30 - 10:10/ROOM 201D
Session Chairs		ShyhLeh Chen/Mochimitsu Komori		Yefa Hu/Elkin Rodriguez		Takeshi Mizuno/Parinya Anantachaisilp		Myounggyu D.Noh/Xujun Lyu
8:30 - 8:50	3A1 ID 103	A Fault-tolerant Drive System of Active Magnetic Bearing	3B1 ID 104	Vibration Mechanism Analysis of Magnetic Levitation Rotor System for Low Temperature Waste Heat Power Generation	3C1 ID 114	Development and Certification of a Skid Mounted AMB Controller for Hazardous Area Installation	3D1 ID 113	Optimal Vibration Control for a Centrifugal Compressor with Magnetic Bearings by a Phase-shift Notch Filter
		Dong Jiang, Tian Li , Xun Han (Huazhong University of Science and Technology), China		Li Ji (HOHAI University), Jin Zhou, HaiTong Wu (Nanjing University of Aeronautics and Astronautics), China		Richard Jayawant (Waukesha Magnetic Bearings), UK, Tadeh Avetian (L.A. Turbine), USA, Nigel McRobb, Richard Shultz (Waukesha Magnetic Bearings), UK		Jiaxi He, Zhiquan Deng, Cong Peng, Kexiang Li (Nanjing University of Aeronautics and Astronautics), China
8:50 - 9:10	3A2 ID 106	Comparison Criteria and Stability Analysis of Electrodynamic Thrust Bearings Joachim Van Verdeghem, Virginie Kluyskens,	Thur. 3B2 ID	Factors Influencing the Vibrations of a Magnetically Suspended Pump Yichen Yao (Tsinghua University and	3C2 ID 138	Magnetically Levitated Spindle for Long Term Testing of Fiber Reinforced Plastic Daniel Franz, Maximilian Schneider Michael	3D2 ID 118	Research of PID Control Simulation of Magnetic Bearing System Based on Labview Haining Zhang, Jinping Chen, JunLiuU,
		Bruno Dehez (Center for Research in Mechatronics , Institute of Mechanics, Materials and Civil Engineering,Université catholique de Louvain), Belgium	122	Southeast University), Yanhui Ma, Yixin Su, Suyuan Yu (Tsinghua University), China		Richter, Stephan Rinderknecht (Institute for Mechatronic Systems, TU Darmstadt), Germany		Yanyan Luo, Li Zhang (AVIC Qingan group co., LTD), China
9:10 - 9:30	3A3 ID 110	An Overview of the FMECA Technology of Magnetic Bearing System Li Zhang (AVIC Qingan group., LTD), Yafeng Ren (Northwestern Polytechnical University), Jinping Chen, Jun Liu, Yanyan Luo, Haining Zhang (AVIC Qingan group., LTD), China	3B3 ID 150	Considerations on the Mechanical Dynamics of Interconnected Flux Three-Pole Magnetic Bearings V.R. Vasco (Instituto de Pesquisas da Marinha), A.C. Del Nero Gomes (Universidade Federal do Rio de Janeiro), D.F.B.David, J.A. Santisteban (Universidade Federal Fluminense ), Brazil	3C3 ID 229	Development of an Active Load Cell Force Measurement Test Rig Paul Gancitano, Benstone Schwartz, Roger Fittro, Carl Knospe (University of Virginia), USA	3D3 ID 166	A Frequency Dividing Control Method Using Wavelet for Active Magnetic Bearing System Xuan Yao, Zhaobo Chen (Harbin Institute of Technology), Xiaoxiang Liu (Beijing Institute of Control Engineering), China
9:30 - 9:50	3A4 ID 171	Damping Strategies on a Horizontal Rotor Supported by Electrodynamic Bearings Qingwen Cui, Andrea Tonoli, Nicola Amati, Angelo Bonfitto, Luis Miguel Castellanos Molina (Politecnico di Torino), Italy	3B4 ID 187	Design and Analysis of Maglev Support System for Vacuum Tube Maglev Transportation Zhenyu Xiong, Yefa Hu, Huachun Wu, ZiHao Lin, Ming Li (Wuhan University of Technology and Hubei Provincial Engineering Technology Research Center for Magnetic Suspension), China	3C4 ID 225	Anti-fall-attract Control of a Permanent Magnetism Suspension System with Flux Path Control Jinghu Tang, Qiang Li, Feng Sun, Chuan Zhao, Junjie Jin, Yongquan Guo, Fangchao Xu (Shenyang University of Technology), China	3D4 ID 168	Model Predictive Control for Active Magnetic Bearings Guiping Ren, Xiang Huang, Yue Wu, Hai-Tao Zhang (Huazhong University of Science and Technology), China
9:50 - 10:10	3A5 ID 188	Variable Stiffness Approach to Reduce Vibration Induced in Passively-supported Directions of an Active Magnetic Suspension System Asief Javed, Takeshi Mizuno, Masaya Takasaki, Yuji Ishino, Daisuke Yamaguchi (Saitama University), Japan	3B5 ID 243	Spherical Magnetic Bearing With High Frequency and Dynamic Response Zhaojing Yin, Qiang Liu, Mingshi Zhao, Yong Zhao (Beijing Institute of Petrochemical Technology), China	3C5 ID 202	Study of a Magnetic Suspended Flywheel Energy Storage System for Pulsed Power Haoze Wang (School of Aeronautics and Astronautics SUN YAT-SEN University and Candela (Shenzhen) Technology Innovate Co.Ltd), Kun Liu(School of Aeronautics and Astronautics SUN YAT-SEN University), China	3D5 ID 175	Design and implementation of Control System based on DSP and FPGA for Magnetically suspended Control Moment Gyro Yang Zhang, Kun Liu, Jian Feng (National University of Defense Technology), Jingbo Wei (Naval University of Engineering), Zhizhou Zhang (National University of Defense Technology), China

Thursday, A	Aug. 16							
Session Time/Room	<b>4</b> A	<b>Design &amp; Modeling VI</b> 10:40 - 12:00/ROOM 201A	<b>4B</b>	<b>Bearingless Motor I</b> 10:40 - 12:00/ROOM 201B	<b>4</b> C	<b>PMBs II</b> 10:40 - 12:00/ROOM 201C	4D	<b>Backup Bearing</b> 10:40 - 12:00/ROOM 201D
Session Chairs		Masahiro Osa/Qingwen Cui		Wolfgang Amrhein/Richard Jayawant		Hyeong-Joon Ahn/Andreas J. Pröl		Jarir Mahfoud
10:40 - 11:00	4A1	Rotor Loss Optimization and Comprehensive Analysis of Lisch encod Magnetic Levitation	4B1	Design and Control of a Novel Four-degree of freedom Bearingless	4C1	Contribution to Design of Hybrid magnetic bearings	4D1	Radial and Axial Integrated Auxiliary Bearing Device for Active
	115	Turbine Generator	184	Flywheel Energy Storage System	164		117	Magnetic Dearing System
		Tianyu Gao, Jin Zhou, Chaowu Jin (Nanjing University of Aeronautics and Astronautics), China		Zhijia Jin, Xiaodong Sun, Zebin Yang (Jiangsu University), China		Jiri Pavelka, Pavel Kupka (CTU in Prague), Czech Republic		Wei Song, Chengtao Yu, Yuemei Sun, Xiuxiang Chen (Jiangsu University of Technology), China
11:00 - 11:20	4A2	A Review on Hysteresis in Magnetic Bearing-Rotor System	4B2	Experimental Investigations on a Heteropolar Electrodynamic Bearing-self-bearing Motor	4C2	Hybrid Axial Active Magnetic Bearing – design, modelling and prototype	4D2	Identification of Stiffness and Damping of Auto-eliminating Clearance Auxiliary Bearing
	ID 174		ID 195		ID 218		ID 139	Devices based on Finite Element Method
		Xiaoshen Zhang, Zhe Sun, Tianpeng Fan, Lei Zhao, Xunshi Yan, Jingjing Zhao, Zhengang Shi (Tsinghua University), China		Virginie Kluyskens, Joachim Van Verdeghem, Corentin Dumont, Bruno Dehez (Université catholique de Louvain) , Belgium		Bartlomiej Sikora, Adam Krzysztof Pilat (AGH University of Science and Technology), Poland		Guochang Li, Chaowu Jin, Jin Zhou, Junyu Xia (Nanjing University of Aeronautics and Astronautics), China
11:20 - 11:40	4A3	Model Establishment and Simulation Analysis of Permanent Maglev Vehicle	4B3	Controllability of Radial Displacement in Bearingless Switched Reluctance Motor with	4C3	Suspension Characteristics of a Zero-Power Permanent Magnet Suspension System With Flux Path	4D3	Planetary Backup Bearings for Flywheel Applications
	ID	8	ID	Bridge Configured Winding	ID	Control	ID	
	227		199		226		148	
		Chuan Zhao, Feng Sun, ,Junjie Jin, Fangchao Xu, Fei Pan (Shenyang University of Technology), China, Koich Oka (Koich University of Technology), Japan		Firdausa Ahmed, Karuna Kalita (Indian Institute of Technology Guwahati), India		Feng Sun, Ran Zhou,Mingyin Yan, Yongquan Guo, Junjie Jin (Shenyang University of Technology), China, Koich Oka (Kochi University of Technology), Japan		Lukas Quurck (Technical University Darmstadt), Germany, Raine Viitala(Aalto University School of Engineering), Finland, Daniel Franz, Stephan Rinderknecht (Technical University Darmstadt), Germany
11:40 - 12:00	4A4 ID	Study on Signal Processing Technology of Relative Position Detection Sensor for High Speed Magley Train	4B4 ID	Optimum Pole Number Combination for High-Speed High-Power BPM Bearingless Motor	4C4	Permanent Magnetic Eddy Current Flexible Technology and Application	4D4 ID	Performance Analysis of Auxiliary Bearing based on Four-contact-point Ball Bearing
	180	Cuicui Huang, Chunhui Dai, Guibin Luo (National University of Defense Technology), China	212	Zongwei Liu, Akira Chiba (Tokyo Institute of Technology), Japan		Chen Demin (MagnaDrive Corporation Limited.), China	163	Junyu Xia, Longxiang Xu, Chaowu Jin (Nanjing University of Aeronautics and Astronautics), Chengtao Yu (Jiangsu University of Technology), China

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Session	5A	Design & Modeling VI	5B	Design & Modeling IX	5C	PMBs III	5D	Control IV
Time/Room		14:00 - 15:40/ROOM 201A		14:00 - 15:40/ROOM 201B		14:00 - 15:40/ROOM 201C		14:00 - 15:40/ROOM 201D
Session Chairs		Patric Keogh		Alexander H. Pesch/Chaowu Jin		Dong Jiang /Pavelka Jiri		Jose Andres Santisteban/Cong Peng
14:00 - 14:20	5A1 ID 125	Rotor Dynamic Analysis in Power Lost Condition for Maglev High-speed Fluid Machinery Chaoyun Chen, Chung-Che Liu (Industrial Technology Research Institute), Aindri Yuliane, Yean-Der Kuan (National Chin-Yi University of Technology) Chinese Taihai	5B1 ID 107	High Speed Rotor Using SMBs Working in Vacuum Chamber M. Komori, K. Hara, K. Asami, N.Sakai (Kyushu Institute of Technology), Japan	5C1 ID 136	Axial Force Evaluation in Permanent Magnet Thrust Bearings Subject to Demagnetization and Temperature Effects Maxence Van Beneden, Virginie Kluyskens, Bruno Dehez (Universit é catholique de Louvain), Belgium	5D1 ID 105	Fitting of Dynamic Characters for Magnetic Bearing Control System by using Deep Neural Network Yanyan Luo, Jinping Chen, Li Zhang, Haining Zhang, Jun Liu (AVIC Qingan group co., LTD), China
14:20 - 14:40	5A2 ID 130	Dynamic Simulation of Maglev Water Pump on A Moving Base by Using Multibody Dynamics Method Yanhui Ma, Yixin Su (Tsinghua University), Yichen Yao(Tsinghua University and Southeast University), Suyuan Yu(Tsinghua University), China	5B2 ID 135	Vibration Analysis of a Superconducting Magnetic Bearing under Different Temperatures Elkin Rodriguez, Felipe Costa, Richard Stephan (Laboratory of Applied Superconductivity – LASUP / UFRJ), Brazil	5C2 ID 137	Passive Compensation of the Temperature Effect on Permanent Magnet Thrust Bearing in Hybrid System Maxence Van Beneden, Virginie Kluyskens, Bruno Dehez (Universit é catholique de Louvain), Belgium	5D2 ID 124	Control Investigations of Rotor Supported by AMBs During Severe Foundation Excitations Cl énent Jarroux, Jarir Mahfoud (Univ Lyon), Benjamin Defoy, Thomas Alban (GE Oil &Gas), France
14:40 - 15:00	5A3 ID 209	Unbalance Response of a Magnetically Suspended Dual-rotor System Dongxiong Wang, Nianxian Wang, Kuisheng Chen, Chun Ye (Wuhan University of Science and Technology), Shaolin Ran, Huachun Wu, chunsheng Song (Wuhan University of Technology), China	5B3 ID 185	Stabilization of Magnetic Repulsive Levitation System by Superconducting Magnetic Bearing Yiming Zhao, Iwanori Murakami, Makoto Shimizu, Yoshinori Ando (Gunma University), Japan	5C3 ID 152	Vertical-Axis Wind Turbines Using Permanent Magnet Attractive Type Passive Magnetic Bearings Mahmoud S. Mahmoud, Satoshi Ueno, Changn Jiang (Ritsumeikan University), Japan	5D3 ID 127	A Novel SVPWM Control Algorithm for Switching Power Amplifier of Active Magnetic Bearings Shiwen Li, Zhiquan Deng, Kexiang Li, Jiaxi He (Nanjing University of Aeronautics and Astronautics), China
15:00 - 15:20	5A4 ID 217	6 pole AMB as a drive of elliptic rotor – initial study supported by the Virtual Prototype Adam Krzystof Pilat(AGH University of Science and Technology, Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering), Poland	5B4 ID 241	Research on Influence of Annular Magnetic Pole on Airgap Magnetic Field and Bearing Capacity of Axial Magnetic Bearing Ting Gu, Yuzhe Zhang, Shuqin Liu (Shandong University), China	5C4 ID 162	Design of a Passively Magnetically Stabilized System with Viscoelastic Damping Support and Flexible Elements Josef Passenbrunner, Gerald Jungmayr (Linz Center of Mechatronics GmbH), Wolfgang Amrhein (Johannes Kepler University), Austria	5D4 ID 178	Design Method of Filter Cross Feedback Controller for Nutation Mode Suppression of AMBs-Rotors Maolin Sun, Shiqiang Zheng, Jinlei Li, Yifan Liu (Beihang University), China
15:20 - 15:40	5A5 ID 230	Analytic Models for Nonlaminated Active Magnetic Thrust Bearings Zachary Whitlow (Helmerich & Payne International Drilling Co.), Carl Knospe, Roger Fittro(University of Virginia), USA	5B5 ID 153	Position Estimation for Self-Sensing Magnetic Bearings using Artificial Neural Network Seong Jong You, Hyeong-Joon Ahn (Soongsil University), Korea	5C5 ID 231	Optimal Design of Magnetic Springs; Enabling High Life Cycle Elastic Actuators Branimir Mrak(Katholieke Universiteit Leuven and Flanders Make vzw), Bert Lenaerts, Walter Driesen (Flanders Make vzw), Wim Desmet (Katholieke Universiteit Leuven), Belgium	5D5 ID 198	Research on Fault Tolerant Operation of Multi-Winding Control Loop Failure in Active Magnetic Bearing System Wenjie Zhao , KeJian Jiang (Zhejiang Sci-Tech University), China

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Session Time/Room	6A	<b>Design &amp; Modeling VII</b> 16:10 - 17:50/ROOM 201A	6B	Bearingless Motor II	6C	Applications IV	6D	Control V Bearingless Motor III 16:10 - 17:30/ROOM 201D
Session Chairs		Richard M.Stephan/Li Zhang		Yetian Yu		Zixi Wang/Jinou Wang		Josef Passenbrunner/Sudan Huang
16:10 - 16:30	6A1 ID 102	A Common-leg Power Electronics Converter for Multi-axis Active Magnetic Bearing Drive	6B1 ID 123	Modeling of Bearingless Permanent Magnet Synchronous Motor Based on Mechanical to Electrical Coordinates Transformation	6C1 ID 134	Development of MC Type Magnetic Levitation System Using Resonance Type Contactless Power Supply	6D1 ID 126	Unbalance Control of Active Magnetic Bearings
		Zaidong Hu, Dong Jiang, Xun Han, Hongbo Sun, Ronghai Qu (Huazhong University of Science and Technology), China		Ying Xu, Huangqiu Zhu, Mengyao Wu (Jiangsu University), China		Yuto Oguri, Yusuke Kajisawa, Koichi Oka, Akinori Harada (Kochi University of Technology), Japan		Beat Aeschlimann, Michael Hubatka (Mecos AG), Switzerland
16:30 - 16:50	6A2 ID 120	Analysis of a Current Biased Eight Pole Radial Active Magnetic Bearing Regarding Self-Sensing Matthias Hofer, Dominik Wimmer, Manfred Schr ädl (Technische Universität Wien),	6B2 ID 145	Vibration Suppression of a Slotless Self-Bearing Permanent-Magnet Motor for Optical Applications Elias Doenni, Timon Achtnich, Christof Zwyssig (Celeroton AG), Switzerland	6C2 ID 147	Applicability of API 617 8 <sup>th</sup> ed. and ISO 14839-3 in evaluating the dynamics stability of AMB-supported compressors Rasish Khatri, Larry Hawkins (Calnetix Technologies), USA	6D2 ID 128	Field Dynamic Balancing for AMBs Supporting Rotor Shaft Based on Extended State Observer Kexiang Li, Zhiquan Deng, Cong Peng, Jiaxi He (Nanjing University of Armenutics of Attractics) China
16:50 - 17:10	6A3 ID 156	Stability Margin Evaluation of      AMB Rotor Systems Using Singular      Value Decomposition      Hyeong-Joon Ahn (Soongsil University),      Korea	6B3 ID 189	Development of Bearing-less Motor with Non-contact Power Supply-Levitation Performance Isao Tanii, Kazuma Makita, Koichi Oka, Akinori Harada (Kochi University of Technology), Japan	Thur. 6C3 ID 196	3Phase Linear Actuator in Magnetically Lavitated Linear Slider with Non-contact Power Supply Masahiro Tomida, Koichi Oka, Akinori Harada, James Lin Intelligent mechanical systems (Engineering Course Kochi University of Technology), Japan	6D3 ID 159	High-order Nonlinear Disturbance Observer Based Zero-bias Control for a Magnetic Suspended System Hai Rong, Kai Zhou, Feilong Mao (Tsinghua University), China
17:10 - 17:30	6A4 ID 197	Modeling of Levitation Force for a Wireless-Moving-Levitating Light with Multiple Magnetic Fields Guangzhong Cao, Jin-Chang Guo, Su-Dan Huang, Wen-Bo Li (Shenzhen University), China	6B4 ID 194	Magnetic Suspension PerformanceEnhancement of Ultra-compact5-DOF Controlled Self-bearingMotor for Rotary PediatricVentricular Assist DeviceMasahiro Osa, Toru Masuzawa, RyogaOrihara (Ibaraki University), EisukeTatsumi (National cerebral andcardiovascular center research institute),Japan	6C4 ID 213	Study on the Nonlinear Suspension Characteristic of Magnetic Suspended Vibration Isolator Weiwei Zhang, Cuicui Ji, Tingting Wang (Hohai University), China	6D4 ID 204	Optimization Framework for a Large, High Speed Bearingless Permanent Magnet Motor Yegu Kang, Eric L. Severson (University of Wisconsin-Madison), USA
17:30 - 17:50	6A5 ID 245	Auxiliary Bearing Design and Rotor Drop Analysis of High Speed Motor Compressor/AMB System Jianming Cao, Paul Allaire, Brad Nichols, Tim Dimond (Rotor Bearing Solutions International), Xianhao Ma, Raojing Shang, Chunyan Wang, HuajunWang (Suzhou Palboom Electric Co., Ltd.)	6B5 ID 210	Homopolar Bearingless Slice Motors Driving Reluctance Rotors Minkyun Noh(Massachusetts Institute of Technology), Wolfgang Gruber (Johannes Kepler University), Jeff Speakman, Mark J. Gartner(Ension, Inc.), David L. Trumper (Massachusetts Institute of Technology), USA	6C5 ID 219	Investigation of Programmable Automation Controller for AMB applications Adam Krzysztof Pilat(AGH University of Science and Technology, Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering), Jakub KLOCEK (OPTISTER, Krakow), Poland		

