



**SETC  
2013**



# 19th Small Engine Technology Conference

October 8-10, 2013

**Taipei, Taiwan**



**FINAL PROGRAM**





# SCALEXIO

## SCALEXIO® – Running Successfully

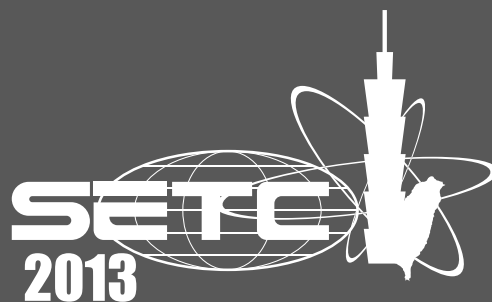
SCALEXIO, the dSPACE system for hardware-in-the-loop simulation, is up and running in many areas. Here are a few examples:

- Body electronics and vehicle dynamics
- Applications for internal combustion engines, electric motors, and transmissions
- HIL integration test systems and single ECU test systems
- The commercial vehicle, passenger car and aviation industries

SCALEXIO – It's already a success!



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# PROGRAM AT-A-GLANCE

Time\Date	October 7, 2013 Monday	October 8, 2013 Tuesday	October 9, 2013 Wednesday	October 10, 2013 Thursday
08:00-09:00	Technical Visits 08:00-16:30			
09:00-10:00		Opening Ceremony & Keynote Speech 09:00-10:30 (Room 201BCDE, 2F)	Technical Sessions 08:30-10:00 (Room 201A, 201B, 201C, 201D, 201E, 2F)	Technical Sessions 08:30-10:00 (Room 201A, 201B, 201C, 201D, 201E, 2F)
10:00-11:00		Coffee Break 10:30-11:00	Coffee Break, Brief Presentation of Poster Session 10:00-10:30	Coffee Break, Brief Presentation of Poster Session 10:00-10:30
11:00-12:00		Technical Sessions 11:00-12:00 (Room 102, 103, 1F; 201A, 201F, 2F)	Technical Sessions 10:30-12:00 (Room 201A, 201B, 201C, 201D, 201E, 2F)	Technical Sessions 10:30-12:00 (Room 201A, 201B, 201C, 201D, 201E, 2F)
12:00-13:00		Lunch 12:00-13:30 (Banquet Hall, 3F)	Lunch 12:00-13:30 (Banquet Hall, 3F)	Lunch, Award & Closing Ceremony 12:00-14:00 (Banquet Hall, 3F)
13:00-14:00		Technical Sessions 13:30-15:30 (Room 201A, 201B, 201C, 201D, 201E, 2F)	Technical Sessions 13:30-15:30 (Room 201A, 201B, 201C, 201D, 201E, 2F)	
14:00-15:00				
15:00-16:00		Coffee Break, Brief Presentation of Poster Session 15:30-16:00	Coffee Break 15:30-15:45	
16:00-17:00		Technical Sessions 16:00-18:00 (Room 201A, 201B, 201C, 201D, 201E, 2F)	Plenary Session 15:45-18:05 (Room 102, 1F)	
17:00-18:00				
18:00-19:00		Welcome Reception 18:30-20:30 (33F, TWTC)	Banquet 18:30-21:00 (Banquet Hall, 3F)	
19:00-20:00				
20:00-21:00				

# INTRODUCTION OF SETC2013

## *Theme: Challenges for Energy Conservation*

Since the first event in 1989, the Small Engine Technology Conference (SETC) continues to be the international technology conference for small engines and related products. SETC is jointly sponsored each year by the Society of Automotive Engineers of Japan, Inc. (JSAE) and SAE International.

JSAE is pleased to organize the 19th SETC that will be held from October 8 to October 10, 2013 at Taipei International Convention Center in Taipei, Taiwan. The event is co-organized by SAE International Taipei Section and also supported by Japan Land Engine Manufacturers Association (LEMA), Japan Marine Industry Association (JMIA) and Taiwan Automotive Research Consortium (TARC).

SETC2013 is themed, "Challenges for Energy Conservation". Due to growing expansion of world economy, we see rapid increase in demand for energy while that for small power source rising because of useful and affordable machines. Energy conservation is a key issue to foresee future potential of small power sources.

Technical visits and plenary session are planned for enlarging experience to the conference attendees besides exhibition and poster session. Technical exhibition will link technical activities with support to presentation of work in progression various fields, while poster session designed to promote technological information exchange between academia and business industry.

## SETC HISTORY

Conference	City	Country
SETC1989	Milwaukee	USA
SETC1991	Yokohama & Hamamatsu	Japan
SETC1993	Pisa	Italy
SETC1995	Milwaukee	USA
SETC1997	Yokohama	Japan
SETC1999	Madison	USA
SETC2001	Pisa	Italy
SETC2002	Kyoto	Japan
SETC2003	Madison	USA
SETC2004	Graz	Austria
SETC2005	Bangkok	Thailand
SETC2006	San Antonio	USA
SETC2007	Niigata	Japan
SETC2008	Milwaukee	USA
SETC2009	Penang	Malaysia
SETC2010	Linz	Austria
SETC2011	Sapporo	Japan
SETC2012	Madison	USA
SETC2013	Taipei	Taiwan



**This event is organized under FISITA patronage**

FISITA is the international federation linking the national automotive engineering societies in 37 countries. FISITA was founded in 1948 as a neutral forum for the exchange of technical knowledge on every aspect of vehicle design, development and manufacture. FISITA is a non-profit organization committed to helping create efficient, affordable, safe and sustainable automotive transportation.

# CONFERENCE INFORMATION

## 19TH SMALL ENGINE TECHNOLOGY CONFERENCE

**Date:** October 8 – 10, 2013

**Venue:** Taipei International Convention Center

**Main Theme:** Challenges For Energy Conservation

**Lead Organized By:** Society Of Automotive Engineers Of Japan, Inc.

**Joint Organized By :** SAE International

**Co-organized By:** SAE International Taipei Section

**Supported by:**



Japan Land Engine Manufacturers Association



Japan Marine Industry Association



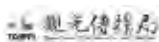
Taiwan Automotive Research Consortium



National Science Council



Bureau of Foreign Trade, Ministry of Economic Affairs



Department of Information and Tourism, Taipei City Government



Ministry of Education



Ministry of Foreign Affairs



Department of Mechanical Engineering, National Taiwan University



Department of Vehicle Engineering, National Taipei University of Technology



# COMMITTEE MEMBERS

## JSAE

### HONORARY COMMITTEE

**Chair: Takaaki Kimura (Yamaha Motor Co., Ltd.)**

Sadayuki Inobe	(SUZUKI MOTOR CORPORATION)
Yuji Marui	(Honda R&D Co., Ltd.)
Yoshiaki Namboku	(Japan Land Engine Manufacturers Association)
Hideo Shoji	(Nihon University)
Yasushi Tsuritani	(Japan Marine Industry Association)
Kohei Yamada	(Kawasaki Heavy Industries, Ltd.)

### ORGANIZING COMMITTEE

**Chair: Minoru Iida (Yamaha Motor Co., Ltd.)**

Masayuki Baba	(Honda R&D Co., Ltd.)
Shosaku Chiba	(Honda R&D Co., Ltd.)
Shigeru Fujii	(Yamaha Motor Co., Ltd.)
Masaaki Ishibashi	(Honda R&D Co., Ltd.)
Ryosuke Ishikawa	(SUZUKI MOTOR CORPORATION)
Yohei Kurihara	(SUZUKI MOTOR CORPORATION)
Makoto Matsuo	(Kawasaki Heavy Industries, Ltd.)
Yasuo Moriyoshi	(Chiba University)
Yuh Motoyama	(Yamaha Motor Co., Ltd.)
Yasuyuki Muramatsu	(Yamaha Motor Co., Ltd.)
Yutaka Nitta	(SUZUKI MOTOR CORPORATION)
Tadao Okazaki	(LEMA*/Kubota Corporation)
Hideyuki Okumura	(JMIA** / Yamaha Motor Co., Ltd.)
Koji Yoshida	(Nihon University)
Makoto Yoshida	(Yamaha Motor Co., Ltd.)

### TECHNICAL COMMITTEE

**Chair: Yutaka Nitta (SUZUKI MOTOR CORPORATION)**

Minoru Iida	(Yamaha Motor Co., Ltd.)
Hiromi Deguchi	(SUZUKI MOTOR CORPORATION)
Toshimi Kobayashi	(Kawasaki Heavy Industries, Ltd.)
Hiroataka Kurita	(Yamaha Motor Co., Ltd.)
Takeshi Maeda	(Honda Motor Co., Ltd.)
Takashi Mitome	(SUZUKI MOTOR CORPORATION)
Yasuo Moriyoshi	(Chiba University)
Yasuyuki Muramatsu	(Yamaha Motor Co., Ltd.)
Shusuke Okada	(LEMA*/YANMAR Co., Ltd.)
Tadao Okazaki	(LEMA*/Kubota Corporation)
Hideyuki Okumura	(JMIA**/Yamaha Motor Co., Ltd.)

Hiroshi Omote (LEMA\*/YANMAR Co., Ltd.)  
Tomoo Shiozaki (Honda R&D Co., Ltd.)  
Koji Yoshida (Nihon University)

*\*LEMA: Japan Land Engine Manufacturers Association*

*\*\*JMIA: Japan Marine Industry Association*

## **SAE INTERNATIONAL TECHNICAL COMMITTEE**

**Chair: Robert Kee (Queen's University Belfast)**

William Attard	(MAHLE Powertrain)
Kai W. Beck	(MOT GmbH)
Glenn Bower	(University of Wisconsin-Madison)
Brian Callahan	(Achates Power)
Renzo Capitani	(University of Florence)
LUCA Carmignani	(PIAGGIO & C.S.p.A.)
James Carroll	(Southwest Research Institute)
Paolo Citti	(Università Guglielmo Marconi)
Derek Cleasby	(Bosch Engineering GmbH)
Brent Dohner	(Lubrizol UK)
Roy Douglas	(Queen's University Belfast)
Ken Fosaaen	(Kerdea Technologies Inc.)
Roberto Gentili	(University of Pisa)
Jaal Ghandhi	(University of Wisconsin-Madison)
Peter Kaub	(Re-Sol, LLC)
Ken Kicinski	(Harley-Davidson Motor Company)
Paul Litke	(AFRL)
Joe Lominaco	(Harley-Davidson Motor Company)
Nagesh Mavinahally	(Meggitt Control Systems)
Geoff McCullough	(Queen's University Belfast)
Jay Meldrum	(Michigan Technological University)
Scott Miers	(Michigan Technological University)
Dan Nehmer	(John Deere Company)
David Palmer	(BRP)
Marco Pierini	(ATA- Associazione Tecnica dell' Automobile & University of Florence)
Giuseppe Pozzana	(Polo of Innovation for Mechanics & Vehicle of the Tuscany Region)
Thorsten Raatz	(Robert Bosch LLC)
Enrico Rebaudo	(Continental Automotive Italy SpA)
Paul Richards	
Stephan Schmidt	(Graz University of Technology)
Sebastian Strauss	(STIHL Inc.)
David Thornhill	(Queen's University Belfast)
Tony Szczotka	(Robert Bosch Corp.)



## **SAE INTERNATIONAL TAIPEI SECTION**

### **ORGANIZING COMMITTEE**

**Chair: Han-Ying Wang (Industrial Technology Research Institute of Taiwan, R.O.C.)**

Shyue-Bin Chang	(Kao Yuan University)
Ching-Ya Chen	(China Motor Corporation)
Hung-Wei Chen	(China Motor Corporation)
Bo-Liang Chen	(Industrial Technology Research Institute of Taiwan, R.O.C.)
Chia-Jui Chiang	(National Taiwan University of Science and Technology)
Rong-Fang Horng	(Kun Shan University)
Shih-Fang Hsieh	(Automotive Research & Testing Center)
Wen-Hsien Hsu	(Automotive Research & Testing Center)
Chih-Shan Hsu	(China Motor Corporation)
Sih-Wei Huang	(National Taipei University of Technology)
Wen-Fang Hwang	(Taiwan Transportation Vehicle Manufacturers Association)
Hsin-Ya Lee	(China Motor Corporation)
Ching-Chiu Liao	(Automotive Research & Testing Center)
Han-Ching Lin	(China Motor Corporation)
Hai-Ping Lin	(Da-Yeh University)
Tyng Liu	(National Taiwan University)
Jiunn-Yje Lu	(Ford Lio Ho Motor Co., Ltd.)
Jau-Huai Lu	(National Chung Hsing University)
Yuh-Yih Wu	(National Taipei University of Technology)
Chin-Chang Wu	(Taiwan Transportation Vehicle Manufacturers Association)

### **TECHNICAL COMMITTEE**

**Chair: Yuh-Yih Wu (National Taipei University of Technology)**

Shyue-Bin Chang	(Kao Yuan University)
Hai-Ping Lin	(Da-Yeh University)
Jau-Huai Lu	(National Chung Hsing University)
Chia-Jui Chiang	(National Taiwan University of Science and Technology)
Rong-Fang Horng	(Kun Shan University)

# OPENING CEREMONY

09:00-09:30, TUESDAY, OCTOBER 8, 2013  
ROOM 201BCDE, 2F

## WELCOME REMARKS - JSAE



### MR. TAKAO KUBOZUKA

Japan

Executive Director

Society of Automotive Engineers of Japan, Inc. (JSAE)

Vice President – Asia, FISITA

Graduated from University of Tokyo, Japan March 1976, Mr. Takao Kubozuka earned a bachelor degree in the field of Aeronautics and Astronautics, Engineering Department.

His professional career began with Nissan Motor Co., Ltd. at Nissan Research Center from April in the same year.

Mr. Kubozuka held a number of roles within Nissan as Manager, Engineering Department from 1993-1995; Manager, Vehicle Research Laboratory from 1995-1999; Deputy General Manager, Technological Planning Department from 1999-2001 and as General Manager, Vehicle Research Laboratory from 2001-2008.

In May 2008 Mr. Kubozuka joined the Society of Automotive Engineers of Japan, Inc. as Executive Director and held the position of FISITA Deputy Vice President Asia at the same time. Mr. Kubozuka worked closely with FISITA and is currently serving as the Vice President – Asia, FISITA.

## WELCOME REMARKS – SAE INTERNATIONAL



**DR. NAGESH S. MAVINAHALLY**

USA

General Committee Chair, SETC2013, SAE International

Principal Engineer, Meggitt Control Systems

Dr. Nagesh Mavinahally obtained his PhD in I.C. Engines from Indian Institute of Technology, Madras, in 1992, MS from National Institute of Technology, Srinivasnagar, and BS from National Institute of Engineering, Mysore. He completed the post-doctoral fellowship at the University of New Orleans in 1994. He has extensive experience in the design, development, and manufacturing of small engines and fuel injection system. He has led projects to develop engines ranging from 30cc two and four-stroke engines for hand held applications to large displacement natural gas miller cycle engines for power generation.

Dr. Mavinahally has published technical papers in SAE and ASME Journals. He has many issued and pending patents. Over the years Dr. Mavinahally has developed alternative engine architectures including a cam shaft-less mono-shaft four-stroke engine, pump-less lubrication system, all attitude four-stroke engines, and mono-shaft extended expansion engine (Atkinson engine).

Dr. Mavinahally has held positions as Director of Advanced Product Development at Cummins, Director of Advanced Engine Technologies at Homelite, Founder/President of MavinTech, LLC., and is a Principal Engineer at MEGGITT.

Nagesh has been involved in SETC since 1993.

## WELCOME REMARKS – SAE INTERNATIONAL TAIPEI



**MR. CHING YA CHEN**

Taiwan

President, SAE Taipei Section

Vice President China Motor Corporation

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### **Professional Experience:**

- 1988 Engineer, Chassis Section, Yulon Engineering Center, Yulon Motor Co., Ltd.
- 1992 Section Chief, Chassis Section, Yulon Engineering Center, Yulon Motor Co., Ltd.
- 1994 Section Chief, Electrical & Electronics Section, Yulon Engineering Center, Yulon Motor Co., Ltd.
- 1995 Assistant General Manager, Procurement Division, China Motor Corporation
- 1996 Project General Manager, Oversea Business Division, China Motor Corporation
- 1999 Project General Manager, Sales Division, China Motor Corporation
- 2000 General Manager, Oversea Business Division, China Motor Corporation
- 2002 General Manager, Parts Development Division, China Motor Corporation
- 2006 Vice President, Technology Development Group, China Motor Corporation

## WELCOME REMARKS – TAIPEI CITY GOVERNMENT



**DR. LUNG-BIN HAU**

Taiwan

Mayor, Taipei City Government

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### Education:

- Ph.D. in Food Science and Technology, 1983, University of Massachusetts, Amherst, MA, U.S.A.
- B.S. in Agricultural Chemistry, 1975, National Taiwan University, Taipei, Taiwan, R.O.C.

### Professional Experience:

- 2004.04-2006.01: Secretary General, The Red Cross Society of The Republic of China .
- 2001.03-2003.10: Minister, Environmental Protection Administration, R.O.C.
- 1996.02-2001.03: Legislator, Legislative Yuan, R.O.C.
- 1998.02-1998.05: Caucus Convener, New Party.
- 1997.09-1998.02: Deputy Caucus Convener, New Party.
- 1997.02-1997.05: Chair, Technical Association, Legislative Yuan, R.O.C.
- 1996.09-1997.02: Co-Chair, Education Committee, Legislative Yuan, R.O.C.
- 1988-1996: Professor, Graduate Institute of Food Science and Technology, National Taiwan University, Taipei, Taiwan, R.O.C.
- 1983-1988: Associate Professor, Graduate Institute of Food Science and Technology, National Taiwan University, Taipei, Taiwan, R.O.C.

### Honors:

- Award for Excellence in Teaching, National Taiwan University, R.O.C.
- Award for Excellence in Research, National Science Council, Executive Yuan, R.O.C.
- Award for Excellence in Research, Commission of Atomic Energy, Executive Yuan, R.O.C.
- Chiang-Hsu Lian-Jen Merit Award for Research in Food Science and Technology, Society of Food Science and Technology, R.O.C.

# KEYNOTE SPEECH

09:30-10:30, TUESDAY, OCTOBER 8, 2013  
ROOM 201BCDE, 2F

## SPEAKERS

**SUBJECT: LIGHT, SLIM, COMPACT - KEYWORD TO REVS YOUR HEART**



**MR. KUNIHICO MIWA**

Japan

Senior Executive Officer of the Second Business Unit  
Motorcycle Business Operations, Yamaha Motor Co., Ltd.

Kunihiro MIWA started his professional career in 1978 at Yamaha Motor Co., Ltd. as a development engineer of motorcycle. After the experience of development of road race motorcycle, he became a project leader of motorcycle production model in the category of supersport in 1993. In 2002, he joined the management of Yamaha Motor Co., Ltd. as the manager of the product management division of the Motorcycle Business Operations. In 2009, he became an executive officer as the senior general manager of the commuter vehicle unit of the Motorcycle Business Operations. He is now the senior executive officer of the 2nd Business unit of the Motorcycle Business Operations. He also has experience to stay in Taiwan as the president of Yamaha Motor R&D Taiwan Co., Ltd between 2006 and 2008.

During his career, his contribution to motorcycle development is very deep and broad: from small commuter to high performance supersport: from production to racing motorcycle.

## SUBJECT: SIMPLE IDEAS MAKE BETTER SMALL ENGINES



**PROF. ROBERTO GENTILI**

Italy

Professor, Università di Pisa

Roberto Gentili graduated in Mechanical Engineering from the University of Pisa in 1974. In 1976 and 1977 he spent his first two years of research activity at the University of Florence. In 1978 he joined the University of Pisa, where he holds the position of Full Professor, chairs the Council for the Master's Degree Course in Vehicle Engineering and is teaching Fluid Machines and Internal Combustion Engines.

In very large prevalence the scientific activity of Roberto Gentili regards engines for land vehicles (cars and motorcycles) and is aimed at developing solutions that are often original and involve a multidisciplinary approach, thanks to the contribution of specialists of other fields. A number of studies takes advantage of the cooperation with prestigious Italian and foreign research institutes and universities.

More than one hundred papers, published on proceedings of conferences and scientific reviews, as well as several patents, prove this activity, that in addition finds acknowledgment in the roles of chairman or organiser that Gentili had in several national and international conferences, besides various invitations to meetings and conventions on I.C. engines and motor vehicles.

Several times Gentili has coordinated research groups for research supported by CNR (Italian National Research Council), by Pisa University, by Italian Ministries and by agreements with industrial companies. He was member of several commissions for university contests. In the three-year period 1984-'86 he served on CUN (National University Council) 09 Advisory Committee for the assignment of M.P.I. (Public Instruction Ministry) 40% funds for scientific research. Since 1994 he has been SAE member. He is currently Vice President of ATA (Technical Association of Automobile) Tuscany, which he chaired from 2009 to 2012 and on the guiding board of which he has been serving for over twenty years.



## SUBJECT: OVERVIEW OF TAIWAN CLEANER PROPULSION SYSTEM TECHNOLOGY DEVELOPMENT



**DR. JET P.H. SHU**

Taiwan

Advisor, Science & Technology, DoIT, Ministry of Economic Affairs (MOEA)

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**Date of Birth:** July 10, 1954

**Education:** Ph. D. Degree, Aerospace Engineering, Auburn University, USA

**Work Experience:**

- 1976~1985: Assistant & Associate Researcher of Rocket Science & Propulsion System Technology Projects, CSIST & NASA.
- 1985~1991: Engineer & Manager of Automotive Product Engineering, Ford Motor Company, US & Taiwan.
- 1991~2006: Deputy General Director of Powertrain Engineering, Auto-Electronics, and Electric Scooter Technology, ITRI.
- 2006~2008: VP & CEO of Auto-Electronics System Development, Manufacturing, Sales, and Marketing, Liteon Automotive & EPS Co..
- 2008~Now: Visiting Industry Professor, Mechanical Engineering of Taiwan University & Automotive Engineering of Taipei Tech.
- 2009~Now: Advisor, Science & Technology, DoIT, MOEA

# PLENARY SESSION

*Theme: Motorcycles in Asian Region*

15:45 - 18:05, WEDNESDAY, OCTOBER 9, 2013

ROOM 102, 1F

## MODERATOR



**PROF. NORIMASA IIDA**

Japan

Department of System Design Engineering  
Faculty of Science and Technology, Keio University Japan

Norimasa Iida is a Professor in the Faculty of Science and Technology at Keio University, Japan. He obtained his PhD in 1983 from Keio University on the topics of propagation and extinction mechanisms of premixed flames flowing into a narrow channel from a combustible-gas-charged chamber, from where he started his career.

Norimasa Iida spent a very productive year as a Visiting Assistant Professor working at the Engine Research Center, University of Wisconsin-Madison, USA.

He headed a project "Low Heat Rejection Ceramics Two-stroke Methanol Engine" at Kanagawa Academy of Science and Technology in Japan.

Norimasa Iida has contributed his research work in the combustion and emission of internal combustion engines with his special interests in life cycle assessment for next generation vehicles. He, as a leader in HCCI combustion research, has published more than 100 papers on the subject, most of which are presented at SAE International, JSAE and JSME.

Norimasa Iida is currently serving as Vice Chair of JSAE Technology Board.

- 1973 Graduated from Department of Mechanical Engineering, Faculty of Engineering, Keio University, Japan
- 1980 Earned Doctor of Engineering at Keio University
- 1983 Became Assistant, Faculty of Science and Technology, Keio University
- 1985 Became Assistant Professor, Faculty of Science and Technology, Keio University  
was appointed Visiting Professor in Mechanical Engineering Department, University of Wisconsin, Madison, USA
- 1990 Headed Ceramics Methanol Engine Project, Kanagawa Academy of Science and Technology, Japan
- 1991 Became Associate Professor, Faculty of Science and Technology, Keio University
- 1997 Became Professor, Faculty of Science and Technology, Keio University

## SPEAKERS



### **PROF. ICHIRO KAGEYAMA**

Japan

Professor, Dr. of Engineering

- Nihon University, College of Industrial Technology, Department of Mechanical Engineering, Japan
- Director of Nihon University Center for Automotive Research (NU-CAR)
- Academic Affairs in Charge for College of Industrial Technology, Nihon University

Prof. Kageyama was born in 1949 in Tokyo, Japan. He graduated from Nihon University, College of Science and Technology in 1972. Then, he went on to the graduate school, and he took the doctor degree in 1977 from Nihon University. Since 1977, he has engaged in Nihon University, College of Industrial Technology, Department of Mechanical Engineering.

His research fields are vehicle dynamics and control, human interface, motorcycle dynamics and control, articulated vehicle dynamics and control, and so on. From 1989 to 1990, he had been a visiting researcher on the Technical University of Delft, in the Netherlands.

Since 1994, he has been a professor of Nihon University. He had been a visiting researcher on the National road and traffic research institute, in Sweden for 6 months in 2004. He founded the Nihon University Center for Automotive Research (NU-CAR) in 2010, and he has been the director up to now.



## **MR. CHUN-PING KO**

Taiwan

- Executive Vice-President and CFO of Kwang Yang Motor Co., Ltd.
- Director of Kwang Yang Motor Co., Ltd.
- Director of Taiwan Transportation Vehicle Manufacturers Association
- Deputy Managing Director of Motorcycles Manufacturing Committee
- Director of Eternal Chemical Co., Ltd.

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### **Profile**

- Comprehensive experience in sales, marketing, financial management and new business development, including strategic planning, business environmental analysis, new business investment, and new business negotiation.
- Proven ability to grow sales through proficient management of sales professionals.
- Skilled in recruiting, hiring and training sales professionals to successfully manage an independent network of dealers with consistent emphasis on increased productivity.
- Proficient in executive and large group financial management.

### **CFO and Executive Vice President**

**September 2006 to Present**

Executive Rooms, Kymco

Promoted to CFO and Executive Vice President in 2006 with direct responsibilities include all aspects of financial management and support to CEO/ President. Achieve domestic market share from 36.3% to 41.8% during 2006 to 2012. Successfully expanded distribution channel to overseas and build up overseas subsidiaries such as Kymco USA Inc., Kymco Luxembourg S.A., Kymco Philippines Inc., and Kymco Healthcare UK Inc..

### **Vice president March 2002 to August 2006**

Sales and Management Center, Kymco

Promoted to Vice President of Sales and Management Center in 2002 with direct responsibilities include whole company administration management and all aspects of global/domestic sales management and advertisement for 2/4 wheelers business. Achieve domestic market share from 33.8% to 36.3% during 2002 to 2006. Successfully build OEM/ ODM business and relationships to Arctic Cat, BMW, Duetz, and Kawasaki during these periods.

### **Experience Summary**

#### **General Manager**

**March 1994 to March 2002**

Strategy and Planning Division, Kymco

Division leader focused on strategic planning, new business investment and financial management to the company. Successfully build 6-8 J/V businesses in China. Become the Director of Taiwan Transportation Vehicle Manufacturers Association during this period.

### **Education**

Master of Management Sciences

**Tamkang University** Taipei, Taiwan, R.O.C.



## **MR. YEIN-RUI HSIEH**

Taiwan

Director General

Department of Air Quality Protection and Noise Control,  
Environmental Protection Administration Executive Yuan, R.O.C.

---

### **Education**

1985 B.A. in Agricultural Engineering, National Taiwan University

1987 M.S. in Civil Engineering, National Central University

### **Career**

1989 Engineer, Bureau of Housing and Urban Development,  
Taiwan Provincial Government

1990 Specialist, Environmental Protection Administration  
Executive Yuan, R.O.C.

1995 Section Chief, Environmental Analysis Laboratory

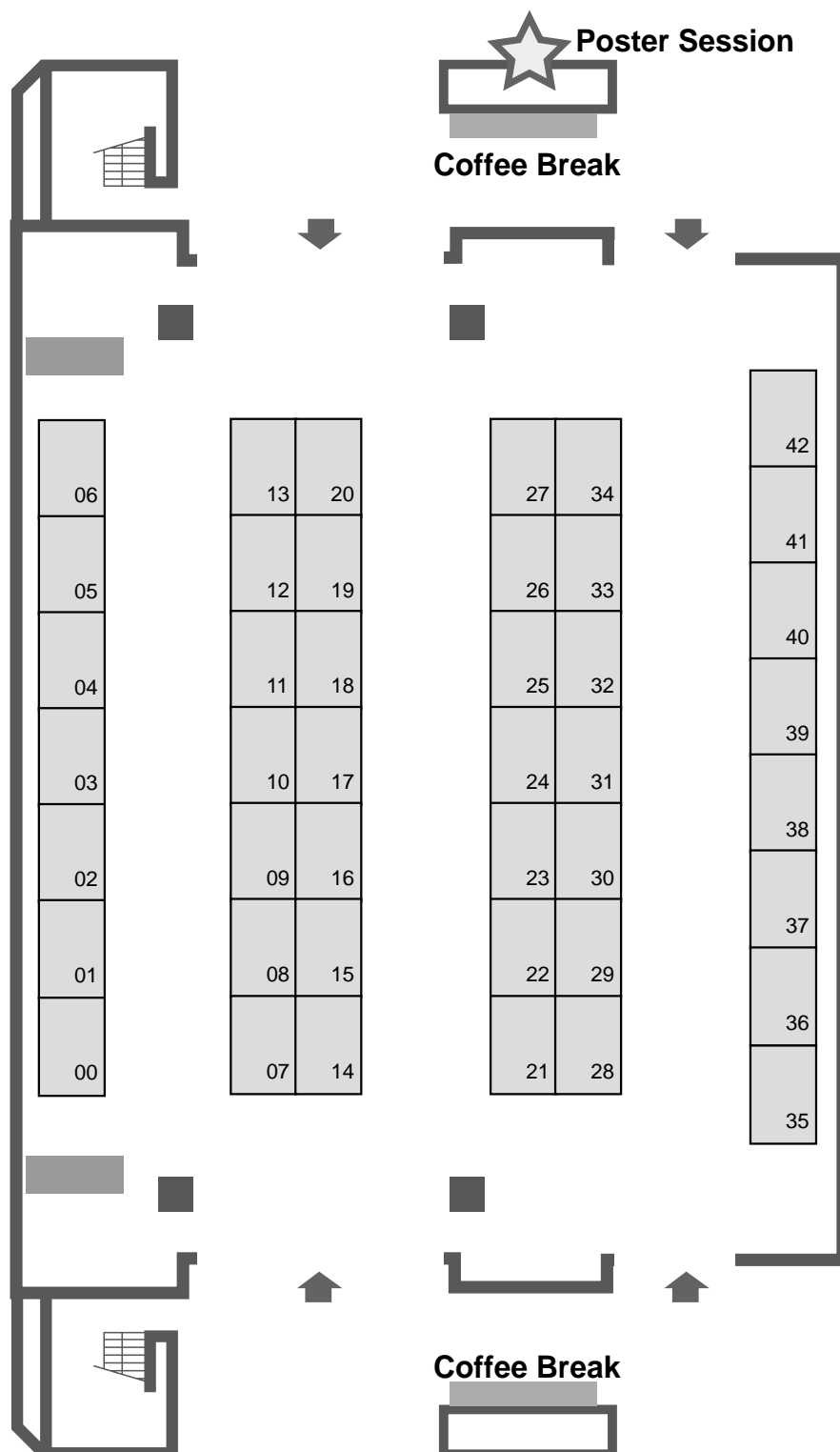
2002 Senior Director, Department of Air Quality Protection and Noise Control, EPA R.O.C.

2007 Deputy Director, Department of Air Quality Protection and Noise Control, EPA R.O.C.

2009 Director General, Department of Air Quality Protection and Noise Control, EPA R.O.C.

# EXHIBITION & POSTER SESSION

OCTOBER 8-10 AT ROOM 101



## EXHIBITION OPENING HOURS

10:30-17:00, Tuesday, October 8, 2013

10:00-17:00, Wednesday, October 9, 2013

10:00-12:00, Thursday, October 10, 2013

## EXHIBITION

0	ISID
1-6	Taiwan Automotive Research Consortium
7	Cambustion Limited
8	Magna Powertrain
9	MathWorks
10	AVL List GmbH
11	dSPACE Japan K.K.
12, 13	A & D Technology
14	SCSK Corporation
15, 16	ETAS Automotive Technology (Shanghai) Co., Ltd.
17	PRÜFREX Innovative Power Products GmbH
18	I. C. M. Inc.
19, 20	Freescall Semiconductor, Inc.
21	Lubrizol
22	HUX
23	Currawong Engineering
24	Standard Motor Corporation
25-27	China Engine Corporation
28	Lubrizol
29	Heraeus Precious Metals GmbH & Co. KG
30, 31	Tai Ling Motor Co., Ltd. (Suzuki Motor)
32-34	Yamaha Motor Taiwan Co., Ltd.
35, 36	China Motor Corporation
37, 38	Honda R&D Co., Ltd.
39, 40	Kawasaki Heavy Industries, Ltd.
41, 42	Kwang Yang Motor Co., Ltd.



## POSTER SESSION

OCTOBER 8-10 AT (North Corridor, 1F)

Brief Presentation (Poster session will be held at 1st floor.)

8th Oct. 15:30-16:00 (During Coffee Break) Poster number 1, 2, 3, 4 and 5

9th Oct. 10:00-10:30 (During Coffee Break) Poster number 6, 7, 8 and 9

10th Oct. 10:00-10:30 (During Coffee Break) Poster number 10, 11, 12 and 13

8th Oct.	1	<b>Graz University of Technology</b>	Franz Winkler Institute for Internal Combustion Engines and Thermodynamics
		An Innovative Two-Stroke Twin-Cylinder Engine Layout for Range Extending Application	
	2	<b>Graz University of Technology</b>	Hermann Edtmayer, Research Area Design Institute for Internal Combustion Engines and Thermodynamics
		Investigation of a Standard Lawn Mower Engine in Real World Operation	
	3	<b>Nihon University</b>	Tomomi Miyasaka, Iijima Lab. Department of Mechanical Engineering, College of Science and Technology
9th Oct.		Visualization and Spectroscopic Analysis of the Knocking in Spark Ignition Engine	
	4	<b>Kanazawa University</b>	Shogo Kunioka, Internal Combustion Engine Lab. Graduate School of Natural Science and Technology
		Observation of Luminous Flame with Fuel Droplet Array	
	5	<b>Chiba University</b>	Syunsuke Goto, Moriyoshi and Kuboyama Lab. Graduate School of Engineering
		Reduction in Knocking Intensity by Spatial Temperature Stratification of Mixture	
9th Oct.	1	<b>Graz University of Technology</b>	Franz Winkler Institute for Internal Combustion Engines and Thermodynamics
		An Innovative Two-Stroke Twin-Cylinder Engine Layout for Range Extending Application	
	2	<b>Graz University of Technology</b>	Hermann Edtmayer, Research Area Design Institute for Internal Combustion Engines and Thermodynamics
		Investigation of a Standard Lawn Mower Engine in Real World Operation	
	3	<b>Nihon University</b>	Tomomi Miyasaka, Iijima Lab. Department of Mechanical Engineering, College of Science and Technology
9th Oct.		Visualization and Spectroscopic Analysis of the Knocking in Spark Ignition Engine	
	6	<b>Nihon University</b>	Yasuhide Abe, Iijima Lab. Department of Mechanical Engineering, College of Science and Technology
		A Study of Supercharged HCCI Combustion using Spectroscopic Techniques and Chemical Kinetic Calculation	
	7	<b>Nagasaki University</b>	Noritsune Kawaharada, Ueki and Sakaguchi Lab. Graduate School of Engineering
		Characterization of Near - Nozzle Diesel Sprays by Using L2F	
10th Oct.	8	<b>Kanazawa University</b>	Hiroataka Nozue, Internal Combustion Engine Lab. Graduate School of Natural Science and Technology
		Effect of Generated Gas Component Fluctuation from Wood Biomass Gasifier on Small Spark Ignition Engine Speed	
	9	<b>Nihon University</b>	Masayuki Yamasawa, Yoshida Lab. Department of Mechanical Engineering, College of Science and Technology
		An Application of Cellulosic Liquefaction Fuel for Diesel Engine	
	1	<b>Graz University of Technology</b>	Franz Winkler Institute for Internal Combustion Engines and Thermodynamics
10th Oct.		An Innovative Two-Stroke Twin-Cylinder Engine Layout for Range Extending Application	
	2	<b>Graz University of Technology</b>	Hermann Edtmayer, Research Area Design Institute for Internal Combustion Engines and Thermodynamics
		Investigation of a Standard Lawn Mower Engine in Real World Operation	
	10	<b>Kun Shan University</b>	Rong-Fang Horng, Vehicle Energy Lab. Department of Mechanical Engineering
		Investigation on the Re-Starting Characteristics of a Motorcycle Engine Performing an Idle-Stop Approach	
10th Oct.	11	<b>Hokkaido University</b>	Qian Xiong, Applied Thermal Engineering Lab. (Ogawa Lab.) Graduate School of Engineering
		Improvements in Thermal Efficiency of Premixed Diesel Combustion with Low Distillation Temperature Fuels	
	12	<b>Nihon University</b>	Akira Iijima, Iijima Lab. Department of Mechanical Engineering, College of Science and Technology
		Visualization and Spectroscopic Measurement of Knocking Combustion Accompanied by Cylinder Pressure Oscillations in an HCCI Engine	
	13	<b>Nihon University</b>	Koji Yoshida, Yoshida Lab. Department of Mechanical Engineering, College of Science and Technology
10th Oct.		An Influence of Non-Uniform Electric Field on Premixed Flame Propagation	

# SPECIAL EVENTS

## WELCOME RECEPTION

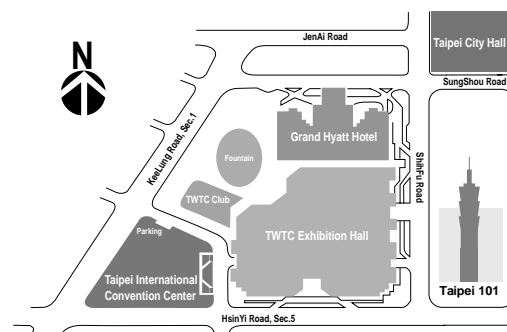
**Date:** Tuesday, October 8, 2013

**Time:** 18:30-20:30

**Venue:** 33F, Taipei World Trade Center (TWTC)



Attend free and enjoy magnificent night view of Taipei City.  
Serve standing-buffet.



## BANQUET

**Date:** Wednesday, October 9, 2013

**Time:** 18:30-21:00

**Venue:** Banquet Hall, 3F, Taipei International Convention Center

Fee NT\$2,400/coupon

Seated buffet

Apply online registration website.

The seats will be reserved on first-come & first-served basis and application may be declined or put on a waiting list when they are fully booked.



The Banquet is located at the same venue of the conference. It is a nice opportunity to socialize and network with all the colleagues and friends, and enjoy local cuisine and experience the cultural performance.

# LUNCH, AWARD AND CLOSING CEREMONY

## **CLOSING CEREMONY**

Thursday, October 10th, 12:00 – 14:00 at Banquet Hall, 3F

The Closing Ceremony will take place in the latter half of Lunch time.

## **CHAIR**

Mr. Yutaka Nitta (SUZUKI MOTOR CORPORATION)

Dr. Robert Kee (Queen's University Belfast)

Prof. Yuh-Yih Wu (National Taipei University of Technology)

Mr. Minoru Iida (Yamaha Motor Co., Ltd.)

## **SUMMARY OF THE CONFERENCE**

### **COMMENDATION CONFERMENT**

1. High Quality and Best Paper Awards
2. High Quality Presentation Award
3. Best Collegiate Event Award
4. Best Poster Award
5. Taiwanese Special Award

### **INTRODUCTION OF SETC2014**

Mr. Stefano Giovannelli, General Director of Tuscany Economic Promotion Agency (TEPA)

Mr. Giuseppe Pozzana, Direttore, Pont-Tech srl

# TECHNICAL VISITS

*Monday, October 7, 2013*

Two routes will be arranged for technical visits to be held on Monday, October 2013 for all day long. JSAE and SAE International Taipei Section would like to express special thanks to DELTA Electronics, Inc., National Taiwan University, SYM (Sangyang Industry Co., Ltd.) and ITRI (Industry Technology of Research Institute) to provide us with valuable visit experience.

All day long

Fee NT\$1,500/coupon (lunch inclusive)

- ◉ The conference registered attendees only
- ◉ Apply from online Registration website with first-come & first-served basis
- ◉ Time schedule including departure place will be informed to the applicant in due course

## ROUTE A: TAIPEI

**Time: 08:00-16:30**

<b>08:00</b>	Departure from Lobby, 1F, TICC
	DELTA (DELTA Electronics, Inc.)
	National Taiwan University
	Lunch
	National Palace Museum
<b>16:30</b>	Taipei 101(dismiss)



### DELTA

DELTA is a leading world-class provider of:

- Power management solutions
- IT, telecom, consumer and automotive electric components
- Visual displays including microdisplay PTVs
- Networking and wireless solutions.



### NATIONAL TAIWAN UNIVERSITY

Being the first integrated and most prestigious institution of higher education in Taiwan area, National Taiwan University has taken up the responsibility of promoting the level of academic research study and teaching in Taiwan.



### NATIONAL PALACE MUSEUM

The National Palace Museum (NPM) in Taipei is home to one of the foremost collections of Chinese art and objects in the world. The extensive range includes bronzes, jades, ceramics, lacquerware, curios, calligraphy, painting, rare books, documents, and many others.



## ROUTE B: HSINCHU

Time: 08:00-16:30

08:00	Departure from Lobby, 1F, TICC
	SYM (Sanyang Industry Taiwan Co., Ltd.)
	ITRI (Industrial Technology Research Institute of Taiwan, R.O.C.)
	Lunch
	Taiwan Pavilion
16:30	Taipei 101(dismiss)



### SYM

SYM is proud of leading the powered vehicle industry in Taiwan. The full line up contains Scooters, Mopeds, Motorcycles and ATVs. Now SYM is a well-known brand for its worldwide distribution with advanced technology and design.



### ITRI

ITRI is a nonprofit R&D organization engaging in applied research and technical services. Founded in 1973, ITRI has played a vital role in transforming Taiwan's economy from a labor-intensive industry to a high-tech industry. Numerous well-known, high-tech companies in Taiwan, such as leaders in the semiconductor industry TSMC and UMC, can trace their origins to ITRI.



### TAIWAN PAVILION

Taiwan pavilion begins its operation in February, 2013. It is re-established in Hsinchu with an area about 4.3 hectares, along with the plan of an industrial innovation park which also includes Taiwan Street.

# SESSION TIMETABLE

		SETC2013 Session Timetable		(20minute-presentation & 10minute-discussion / each paper)	
9:00-10:30		Opening Ceremony & Keynote Speech (at Room 201BCDE, 2F)			
10:30-11:00		Coffee Break			
Room	201A	201F	102	103	
	Alternative Fuels I	Engine Components I	Engine Technology I	Fuel Supply Systems I	
	Chair : H. Omote	Chair : T. Kobayashi	Chair : H. Okumura	Chair : M. Iida	
11:00-12:00	Co-Chair : M. Bertsch	Co-Chair : K. Fosaen	Co-Chair : N. Mavinahally	Co-Chair : R. Kee	
	20139038/2013-32-9038	20139016/2013-32-9016	20139015/2013-32-9015	20139047/2013-32-9047	
	20139059/2013-32-9059	20139073/2013-32-9073	20139104/2013-32-9104	20139122/2013-32-9122	
12:00-13:30	Lunch (at Banquet Hall, 3F)				
Room	201A	201B	201C	201D	201E
	Alternative Fuels II	Two Stroke Engine	Engine Technology II	Fuel Supply Systems II	Measurement & Simulation I
	Chair : H. Omote	Chair : Y. Motoyama	Chair : H. Okumura	Chair : M. Iida	Chair : T. Okazaki
	Co-Chair : S. Frigo	Co-Chair : B. Callahan	Co-Chair : N. Mavinahally	Co-Chair : R. Kee	Co-Chair : S. Schmidt
13:30-15:30	20139080/2013-32-9080	20139036/2013-32-9036	20139032/2013-32-9032	20139128/2013-32-9128	20139023/2013-32-9023
	20139097/2013-32-9097	20139078/2013-32-9078	20139060/2013-32-9060	20139126/2013-32-9126	20139124/2013-32-9124
	20139115/2013-32-9115	20139133/2013-32-9133	20139081/2013-32-9081	20139167/2013-32-9167	20139125/2013-32-9125
	20139131/2013-32-9131	20139143/2013-32-9143	20139084/2013-32-9084		20139127/2013-32-9127
15:30-16:00	Coffee Break, Brief Presentation of Poster Session				
	Materials I	Diesel Engine	Engine Technology III	Hybrids, Electric Drives & Fuel Cells I	Measurement & Simulation II
	Chair : H. Kurita	Chair : T. Maeda	Chair : M. Nakagawa	Chair : Y. Muramatsu	Chair : S. Fujii
	Co-Chair : K. Fosaen	Co-Chair : B. Callahan	Co-Chair : S. Frigo	Co-Chair : G. Bower	Co-Chair : S. Schmidt
16:00-18:00	20139012/2013-32-9012	20139021/2013-32-9021	20139105/2013-32-9105	20139006/2013-32-9006	20139034/2013-32-9034
	20139110/2013-32-9110	20139022/2013-32-9022	20139160/2013-32-9160	20139009/2013-32-9009	20139043/2013-32-9043
	20139049/2013-32-9049	20139103/2013-32-9103	20139161/2013-32-9161	20139018/2013-32-9018	20139044/2013-32-9044
	20139029/2013-32-9029	20139112/2013-32-9112	20139114/2013-32-9114	20139035/2013-32-9035	20139096/2013-32-9096

SETC2013 Session Timetable		(20minute-presentation & 10minute-discussion / each paper)			
Room	201A	201B	201C	201D	201E
8:30-10:00	Alternative Fuels III	Lubricants	Engine Technology IV	Collegiate Events	Measurement & Simulation III
	Chair : Yuh-Yih Wu	Chair : H. Kurita	Chair : S. Chiba	Chair : T. Miltone	Chair : T. Okazaki
	Co-Chair : K Beck	Co-Chair : B. Dohner	Co-Chair : N. Mavinahally	Co-Chair : G. Bower	Co-Chair : S. Schmidt
	20139174/2013-32-9174			20139100/2013-32-9100	20139079/2013-32-9079
	20139134/2013-32-9134	20139033/2013-32-9033	20139169/2013-32-9169	20139118/2013-32-9118	20139162/2013-32-9162
	20139156/2013-32-9156	20139063/2013-32-9063	20139093/2013-32-9093	20139176/2013-32-9176	20139157/2013-32-9157
10:00-10:30	Coffee Break, Brief Presentation of Poster Session				
10:30-12:00	Materials II	Engine Components II	Engine Controls I	Hybrids, Electric Drives & Fuel Cells II	Advanced Combustion I
	Chair : Le-Min Wang	Chair : T. Kobayashi	Chair : M. Uno	Chair : Jung-Ho Chen	Chair : K. Yoshida
	Co-Chair : S. Gurchinoff	Co-Chair : F. Auriemma	Co-Chair : T. Raatz	Co-Chair : G. Bower	Co-Chair : K. Fosaen
	20139046/2013-32-9046	20139102/2013-32-9102	20139041/2013-32-9041	20139132/2013-32-9132	20139002/2013-32-9002
	20139082/2013-32-9082	20139163/2013-32-9163	20139061/2013-32-9061	20139071/2013-32-9071	20139030/2013-32-9030
	20139111/2013-32-9111	20139068/2013-32-9068	20139037/2013-32-9037	20139072/2013-32-9072	20139144/2013-32-9144
12:00-13:30	Lunch (at Banquet Hall, 3F)				
13:30-15:30	Emissions I	HCCI I	Engine Controls II	Hybrids, Electric Drives & Fuel Cells III	Advanced Combustion II
	Chair : H. Deguchi	Chair : Y. Moriyoshi	Chair : M. Uno	Chair : Y. Muramatsu	Chair : K. Yoshida
	Co-Chair : K Beck	Co-Chair : M. Bertsch	Co-Chair : T. Raatz	Co-Chair : G. Bower	Co-Chair : K. Fosaen
	20139058/2013-32-9058	20139031/2013-32-9031	20139062/2013-32-9062	20139119/2013-32-9119	20139116/2013-32-9116
	20139050/2013-32-9050	20139054/2013-32-9054	20139042/2013-32-9042	20139045/2013-32-9045	20139117/2013-32-9117
	20139052/2013-32-9052	20139098/2013-32-9098	20139040/2013-32-9040	20139120/2013-32-9120	20139123/2013-32-9123
	20139055/2013-32-9055	20139166/2013-32-9166	20139066/2013-32-9066	20139087/2013-32-9087	
15:30-15:45	Coffee Break				
15:45-18:05	Plenary Session "Motorcycles in Asian Region" (at Room102, 1F)				



		SETC2013 Session Timetable		(20minute-presentation & 10minute-discussion / each paper)		
		201A	201B	201C	201D	201E
Room		Emissions II	HCCI II	Engine Controls III	Vehicle Dynamics & Safety I	
		Chair : H. Deguchi	Chair : T. Shiozaki	Chair : T. Mitome	Chair : M. Baba	
		Co-Chair : K Beck	Co-Chair : R. Gentili	Co-Chair : T. Raatz	Co-Chair : B. Dohner	
		20139057/2013-32-9057				
		20139053/2013-32-9053	20139070/2013-32-9070	20139065/2013-32-9065	20139026/2013-32-9026	
8:30-10:00		20139064/2013-32-9064	20139083/2013-32-9083	20139003/2013-32-9003	20139106/2013-32-9106	
	Coffee Break, Brief Presentation of Poster Session					
10:00-10:30		Emissions III	HCCI III	Engine Controls IV	Vehicle Dynamics & Safety II	NVH Technology
		Chair : H. Deguchi	Chair : T. Shiozaki	Chair : Bo-Chiuan Chen	Chair : M. Baba	Chair : T. Okazaki
		Co-Chair : K Beck	Co-Chair : B. Callahan	Co-Chair : T. Raatz	Co-Chair : R. Kee	Co-Chair : R. Kirchberger
10:30-12:00		20139091/2013-32-9091	20139069/2013-32-9069	20139007/2013-32-9007	20139165/2013-32-9165	20139001/2013-32-9001
		20139130/2013-32-9130	20139171/2013-32-9171	20139020/2013-32-9020	20139173/2013-32-9173	20139148/2013-32-9148
		20139150/2013-32-9150	20139172/2013-32-9172	20139094/2013-32-9094	20139175/2013-32-9175	20139164/2013-32-9164
12:00-14:00	Lunch, Award & Closing Ceremony (at Banquet Hall, 3F)					

October 10th  
Thursday

# ABSTRACT OF TECHNICAL SESSION

**Tuesday, October 8, 11:00-12:00 at Room 201A**

## **Alternative Fuels I**

Chair: Hiroshi Omote (LEMA / YANMAR Co., Ltd.), Co-Chair: Markus Bertsch (MOT GmbH)

[20139038 / 2013-32-9038]

### **Diesel Fuel by Scrap-Tyre Thermal-Mechanical Pyrolysis**

*Stefano Frigo, Roberto Gentili, Maurizia Seggiani, Monica Puccini (University of Pisa)*

Current energy policies are encouraging the near-term use of fuels derived from civil and industrial waste residues, giving new perspectives for their disposal. The possibility of using, in Diesel engines, a liquid fuel derived from waste synthetic polymeric matrices, such as scrap tyres, is evaluated in this paper. The fuel is obtained by means of an innovative technology based on a thermomechanical cracking process at moderate temperatures and pressures. A preliminary investigation was carried out on a 440 cm<sup>3</sup> single-cylinder Diesel engine for stationary applications using a commercial automotive Diesel fuel (UNI-EN 590:2010) and two mixtures of automotive Diesel fuel and tyre pyrolysis oil (TPO): the first one containing 20% TPO by volume, the other containing 40% TPO. With the first mixture, test bench results in terms of engine torque, power, specific fuel consumption and exhaust emissions are similar to the ones relative to automotive Diesel fuel, whereas the use of the mixture with 40% TPO leads to a general worsening in engine combustion features. Lubricant oil analysis, made at the end of the tests, proves a certain level of lube oil dilution due to fuel leaking into the oil sump. The toxicity levels of the exhaust particulate matter were analysed and result to be the same using automotive Diesel fuel and both the mixtures of Diesel fuel and TPO. No meaningful mechanical inconvenience occurred during the engine tests. Nevertheless, long-time reliability of the injection system, as well as of the entire engine, has to be verified.

[20139059 / 2013-32-9059]

### **Study on Operation Characteristics of Gasohol Biofuel in Motorcycle Engine**

*Yuh-Yih Wu, Jhih-Si Syu, Meng-Chieh Li (National Taipei University of Technology), Zong-Da Lin (Industrial Technology Research Institute)*

The fossil fuel is consumed faster than last century. However, the fossil fuel reserves might be depleted due to its limited resources. Many researchers have started to seek alternative of fossil fuels for vehicles. Biofuels are regarded as a short-term solution which synthesizes some additive fuel from bio-materials into fossil fuel to reduce fossil fuel consumption and can be applied on original fuel supplying system of vehicles that becomes another advantage. This paper focuses on studying the operation characteristics of using gasohol biofuel in a production motorcycle engine.

Engine experiments with various test conditions are designed to investigate the operation characteristics with different concentration of ethanol. The ethanol concentrations considered in this paper include 10%, 20%, 50%, 65%, and 80% by weight, which are then compared with the results from pure gasoline. The engine test conditions cover engine speed ranging from 2000 to 7000rpm and with different operation loads. Experimental results are analyzed on maximum engine torque, cylinder pressure, combustion rate, fuel consumption, exhaust temperature, and emissions. Consequently, experimental results show that the gasohol biofuel performs similar operation characteristics as compared with pure gasoline, which means that the gasohol biofuels can be employed as an alternative fuel for vehicles.

**Tuesday, October 8, 11:00-12:00 at Room 201F**

**Engine Components I**

Chair: Toshimi Kobayashi (Kawasaki Heavy Industries, Ltd.), Co-Chair: Ken Fosaaen (Fosaaen Technologies, LLC.)

[20139016 / 2013-32-9016]

**Design Methodology and Advantages of Centrifugal Type Decompression Device of Engine**

*Pochun Liu, Chih-Wen Yu and Yuwei Ning (Sanyang Industry Co., Ltd)*

With the development of high compression ratio or large-size engine, the cranking torque is getting higher, which causes the durability problem of starting system. Specifically, the starting motor and the one-way clutch are the most frequently wore parts. This kind of durability problem is also occurred in Stop and Go system, due to its frequently restarting process. Therefore, it is possible by using decompression device to reduce the cranking torque and to enhance the endurance capacity of the starting system. Furthermore, by reducing the cranking torque, engineers can miniaturize the starting motor and choose smaller capacity battery, and it also makes easier for kick start.

A 150cc scooter was chosen as the example. The design, analysis and measurement with centrifugal type decompression device (CTDD) were discussed in this study. The systematic design procedures and tools were also provided to develop the product quickly. Finally, this study developed a decompression device in which the cranking torque was successfully reduced 42% and the cranking noise was also highly suppressed.

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[20139073 / 2013-32-9073]

**Experimental Investigations of Forced Air Cooling for Continuously Variable Transmission (CVT)**

*Abhishek Lakhanlal Vaishya, Sachin Phadnis (TVS Motor Company Limited)*

In the recent past, the non-geared (step less) transmission scooters are becoming more popular mainly due to ease of driving without gear shift hassle. Typically these scooters transmit the power through a continuously variable transmission commonly called as CVT. The CVT of a scooter is generally air cooled and located in a protective chamber. This chamber reduces the heat transfers between the CVT and the atmosphere. The temperature reached inside the chamber during the operation of the CVT is quite high, especially when the CVT is operated in hot environment. This may reduce the service life of the drivebelt since it generally decreases when the average operating temperature increases. Along with V belt, high temperature inside CVT chamber also deteriorates durability of centrifugal clutch liner, bush, centrifugal rollers and other CVT parts. Therefore, it is necessary to limit the operating temperature of the CVT system.

The main objective of this research is to investigate temperature of CVT parts and optimize the air flow path and air flow rate inside CVT chamber. Tests were carried out to measure the surface temperature distribution of CVT parts and air temperature distribution inside CVT chamber under different vehicle test conditions. This study has contributed to measure the temperature and identify the main causes affecting CVT cooling. Results with improved CVT chamber cooling were also plotted.

**Tuesday, October 8, 11:00-12:00 at Room 102**

**Engine Technology I**

Chair: Hideyuki Okumura (JMIA / Yamaha Motor Co., Ltd.), Co-Chair: Nagesh Mavinahally (Mavin Tech, LLC.)

[20139015 / 2013-32-9015]

**High Performance Characteristics of a Motorcycle Powered by a Four-Stroke Small 50cc-125cc Engine at the Expense of a Positive Displacement Air Compressor as a Supercharger**

*Konstantin Evgenievich Starodetko, Simon Simand, Tcheslav Bronislavovich Drobychevskij, Vladimir Jurievich Belyaev, onstantin Nikolaevich Yurchuk (International Academy of Information Technologies), Aliaksandr Aliaksandrovich Vitsiaz (Bereza Motor Rebuilt Plant), Dmitry Vasilievich Kuzmenkov (Tascotrade Company)*

There are several problems with small motorcycle (moped, scooter) engines of 50cc-125cc displacement, and even up to 200cc for special applications. Lack of engine power and design complexity of a multi-valve cylinder head are the most important problems. Despite some isolated attempts and several patented works the small engines of 50cc to 350cc displacement undeservedly remain without adequate air charging means – neither superchargers nor turbochargers are offered to the market. This article presents a theoretical basis on how to improve high performance characteristics of a motorbike by supplying a working cylinder with additional compressed air under certain conditions. A few versions of a positive displacement air compressor (supercharger) have been developed, built, and used for engine boosting. Road tests of the pitbike motorcycle equipped with our small rotorvane compressor were performed. The results exceed expectations of the supercharger's performance and efficiency. Thus, to reach 50km/h for the motorcycle powered by the 50cc four-stroke engine equipped with the supercharger, 40% less time is needed than for the same motorcycle powered by a naturally aspirated...

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[20139104 / 2013-32-9104]

**Development of New Industrial Spark Ignited Bi-Fuel Engine**

*Koji Fujimura, Shinji Kishi, Takeshi Kawasaki, Takahiro Tokunaga, Kentaro Shiraishi (KUBOTA Corporation)*

Recently in North America, natural gas such as shale gas has gained much attention, and industrial SI engines are expected to fit in various fuels such as gasoline, LPG, and natural gas. Also tightened exhaust emissions regulations require industrial SI engines to adopt feedback fuel injection systems with three way catalysts. In response to these requirements of customers, we have developed a bi-fuel engine model which can be operated on any of gasoline, LPG, and natural gas. In this paper, approaches and technologies used for the development of the model are explained. On the gasoline version of the model, the locations of fuel injectors and the design of the inlet manifold with a surge tank were optimized by using Computational Fluid Dynamics (CFD). And we sought the optimum arrangement of an inlet manifold, a fuel delivery pipe, and plug-on type ignition coils. In addition, the variants which can be operated on LPG or natural gas are equipped with the gas delivery devices that are arranged within a small space. By these approaches, all of these variants have the profile which is interchangeable with the original diesel fueled model. The exhaust emission performance to satisfy the transient mode regulations and the optional small catalytic muffler which can be used in any desired orientations expand the ability of the model to fit within various OEM applications.

**Tuesday, October 8, 11:00-12:00 at Room 103**

**Fuel Supply Systems I**

Chair: Minoru Iida (Yamaha Motor Co., Ltd.), Co-Chair: Robert Kee (Queen's University of Belfast)

[20139047 / 2013-32-9047]

**Development of Plastic Fuel Hose with Pressure Pulsation Reduction**

*Kota Nakauchi, Atsushi Ito, Takeshi Ohara, Hideaki Kato, Hisayoshi Ogura, Shosuke Suzuki (Honda R&D Co., Ltd., Motorcycle R&D Center)*

Recently, the electronic fuel injection systems have been widely applied to small motorcycles including scooters. In the high pressure fuel lines, plastic hoses have been increasingly used instead of conventional rubber hoses. As the plastic hose is less elastic than the rubber hose, the fuel pressure pulsates more in the plastic hose. To cope with this issue, we have conducted researches on how the fuel pressure pulsation in the plastic hose affects the accuracy of fuel injection. Keeping our eyes on the pulsation damping effects derived from the changes of volume due to the expansion and contraction of hose when the pressure changes, we have established the analysis method for optimization of the inner diameter and the thickness of the hose utilizing CAE analysis. The newly-developed plastic hose is applicable to motorcycles having a single cylinder 250 cm3 engine using an injector of a high static flow rate.

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[20139122 / 2013-32-9122]

**Evaluation of value proposition and interactive features for motorcycles with electronic fuel injection for Indian market**

*Pradeep R, Pramod R, Ajay Shetty, Prabhu Panduranga M. (Robert Bosch India Limited)*

Growth and mobility expectation in India has increased competition in the Indian two wheeler industry. Value proposition targeting improved performance, fuel economy, user-friendly features are being seen as key differentiators. The expected introduction of EFI (Electronic Fuel Injection) leads to additional system cost which needs to be justified from tangible end-customer benefits. The previous SAE papers [1] [2] attempted to provide an insight into the carbureted engine vs. fuel injection systems from fuel efficiency, combustion quality perspective and also enumerated the benefit of fuel economy to end user. To increase the benefit to the end customers, the authors propose to provide insight into innovative system concepts with interactive features. The evaluation targets the commuter segment where the implementation and acceptance potential is high. The results thus derived on the motorcycle under consideration are promising and has high potential to meet the needs of the end user. Throttle enabled start, start-stop, bypass less throttle body, operating mode selection, "battery dead" ignition are a few of the features which can be implemented for a EFI bike increasing the value proposition and reducing the overall system cost for the OEM.

**Tuesday, October 8, 13:30-15:30 at Room 201A**

**Alternative Fuel II**

Chair: Hiroshi Omote (LEMA / YANMAR Co., Ltd.), Co-Chair: Stefano Frigo (University of Pisa)

[20139080 / 2013-32-9080]

**Combustion Characteristics of a DI Diesel Engine with Short and Medium Chain Saturated Fatty Acid Methyl Esters**

*Eiji Kinoshita, Kazuyo Fushimi (Kagoshima University), Yasufumi Yoshimoto (Niigata Institute of Technology)*

This paper describes the fuel properties, combustion characteristics and exhaust emissions of the methyl esters of saturated fatty acid with 6 to 10 carbons in the molecule chain. The fuels blend (50/50 mass%) of three saturated fatty acid methyl esters (methyl caproate, methyl caprylate, methyl caprate); with methyl laurate as a base fuel are tested using a DI diesel engine. From the experimental results, the blend of saturated fatty acid methyl ester with a lower carbon number has a lower kinematic viscosity, pour point and smoke emission, though having longer ignition delay, the same as long chain saturated fatty acid methyl ester.

[20139097 / 2013-32-9097]

**Effect of Butanol Isomer on Diesel Combustion Characteristics of Butanol/Gas Oil Blend**

*Kazuyo Fushimi, Eiji Kinoshita (Kagoshima University), Yasufumi Yoshimoto (Niigata Institute of Technology)*

To utilize bio-butanol as an alternative diesel fuel, the effect of butanol isomer, where 1-butanol, 2-butanol and isobutanol were studied except for tert-butanol, on the combustion characteristics and exhaust emissions of butanol/gas oil blend was investigated using a DI diesel engine without modification of engine parameters. First, to understand the effect of butanol content on the diesel combustion, engine test was carried out using blends of 1-butanol which contents were 10 to 50 mass%. With increasing 1-butanol content, the Smoke emission reduces although the ignition delay gets longer and the HC and CO emissions increase especially at low load. The engine operation is stable except for full load with 1-butanol 50 mass% blend. From the above experimental results, butanol isomer blending ratio is set to 40 mass%. In order of 1-butanol/gas oil, 2-butanol/gas oil...

[20139115 / 2013-32-9115]

**Effects of Spark Ignition Timing on Exhaust Gas Component and Temperature with Wood Biomass Gasifier**

*Hiroshi Enomoto, Hirotaka Nozue, Noboru Hieda (Kanazawa University)*

Small wood biomass gasifier was developed and co-generation system supplying electric power and heat with small spark ignition internal combustion engine (SI-ICE) was investigated. The balance of electric power and heat flux will be controlled with ignition timing and the exhaust gas components were discussed. The wood biomass gasifier (downdraft type) had 105mm in inner diameter and 1000mm in length and the reaction zone temperature was 900deg-C at 68NL/min in intake air flow. The SI-ICE had 290cc in displacement and 8.4 in compression ratio and was driven at 1500rpm. The ignition angle was changed from 30deg-BTDC to 25deg-BTDC with almost same exhaust gas components. The exhaust gas temperature was from 520deg-C...

[20139131 / 2013-32-9131]

**Optimization of Waste Chicken Fat Pre-Treatment Process for Biodiesel Production**

*Naresh Kumar Gurasala, Arul Mozhi Selvan V, Ajay Balan, Shreyas Athreya (National Institute of Technology, Tiruchirappalli, Tamil Nadu)*

Biodiesel production from the waste oils and fats are the cost effective methods and prevents the environmental pollution by proper disposal techniques. Converting waste oils/fat into biodiesel using alkaline catalyst is difficult, as it contains more than one percent Free Fatty Acid (FFA) which will form soap during the transesterification process. Hence, it is desirable to reduce the level of FFA lower than one percent for biodiesel production using the pre-treatment process. In the present research work, ferric sulfate (solid catalyst) is used as a catalyst, because it converts FFA efficiently than the homogeneous acid catalyst which is corrosive in nature and takes longer reaction time. The parameters used in the pre-treatment process are, amount of catalyst varying from 0.5 to 2% by weight, amount of methanol in moles ranging 3 to 15 to one mole of waste chicken fat (molar ratio), temperature ranges from 45°C to 65°C and the reaction time of 30 min to 150 min to find the effective conversion of FFA. The Response Surface Methodology (RSM), a statistical tool with the fitted...

**Tuesday, October 8, 13:30-15:30 at Room 201B**

### **Two Stroke Engine**

Chair: Yuh Motoyama (Yamaha Motor Co., Ltd.), Co-Chair: Brian Callahan (Achates Power & Basco)

[20139036 / 2013-32-9036]

#### **Development of Test Bench and Characterization of Performance in Small Internal Combustion Engines**

*Joseph K. Ausserer, Paul J. Litke (United States Air Force), Jon-Russell Groenewegen (University of Dayton Research Institute), Alexander Rowton, Marc Polanka (Air Force Institute of Technology), Keith Grinstead (Innovative Scientific Solutions Incorporated)*

Small internal combustion engines (ICEs), (<7.5 kW), possess low thermal efficiencies due to high thermal losses. As the surface area to volume ratio increases beyond 1.5 cm<sup>2</sup>/cc, the increase in thermal losses leads to a drop off of engine efficiency and power. This effort describes the development and validation of a test stand to characterize thermal losses of small ICEs, optimize combustion phasing, and eventually enable heavy fuel operation. The test stand measures torque, rotational speed, brake power, intake air mass flow, up to 48 temperatures (including ambient, intake, cylinder head, fuel, and exhaust), 8 pressures (including ambient, intake, and exhaust), throttle position, and fuel and air mass flows. Intake air temperature and cylinder head temperature are controlled and adjustable. Three geometrically similar engines with surface area to volume

[20139078 / 2013-32-9078]

#### **Engine Scavenging Tuning for In-Field Product Expectations of a 45cc Stratified Two-Stroke Power Head**

*M Bergman, R Sundkvist (Husqvarna AB)*

Because of today's new emissions legislation, a new 45cc Husqvarna trimmer/clearing saw power head was needed. When reducing emissions in a conventional two-stroke engine or a stratified scavenged engine, it is important that the tuning and basic scavenging characteristics of the standard engine are maintained. A dual charge intake system is necessary for the stratified engine but it also creates air fuel delivery issues compared to a standard two stroke engine. With increasing trapping efficiency more spent gases mix with the fresh charge, creating less favorable combustion properties and thermal loading on the engine. On top of this the sequential stratified scavenging technology introduces a spatial inhomogeneous mix problem between scavenging fresh air, new mixture and spent gases. This all adds sensitivity to long term stability due to deposits of carbon both in

[20139133 / 2013-32-9133]

#### **An Innovative Two-Stroke Twin-Cylinder Engine Layout for Range Extending Application**

*A. Abis, F. Winkler, C. Schwab, R. Kirchberger, H. Eichlseder (Graz University of Technology)*

Global trends show an increasing approval of electrified mobility due to advantages like local zero emission and low noise. But range anxiety, missing comprehensive availability and high costs significantly obstruct the acceptance and growth of electro mobility. Extended research on finding innovative solutions focus on the elimination of the disadvantages of pure electric drivetrain systems. Therefore an ICE range extended electric vehicle is a promising approach. Commonly, small-capacity gasoline engines with low cylinder numbers are used for range extending applications. Targets are low emissions, efficient packaging, good NVH behaviour and low costs. In this paper the layout and design of an innovative two-stroke twin-cylinder engine with a capacity of one litre is presented. Compared to conventional single- or twin-cylinder four-stroke engines a two-stroke

[20139143 / 2013-32-9143]

#### **Is a High Pressure Direct Injection System a Solution to Reduce Exhaust Gas Emissions in a Small Two-Stroke Engine?**

*Markus Bertsch, Kai W. Beck, Thomas Matousek, Ulrich Spicher (MOT GmbH)*

Small gasoline engines are used in motorcycles and handheld machinery, because of their high power density, low cost and compact design. The reduction of hydrocarbon emissions and fuel consumption is an important factor regarding the upcoming emission standards and operational expenses. The scavenging process of the two-stroke engine causes scavenging losses. A reduction in hydrocarbon emissions due to scavenging losses can be achieved through inner mixture formation using direct injection (DI). The time frame for fuel vaporization is limited using two-stroke SI engines by the high number of revolutions. A high pressure DI system was used to offer fast and accurate injections. An injection pressure of up to 140 MPa was provided by a common rail system,



**Tuesday, October 8, 13:30-15:30 at Room 201C**

**Engine Technology II**

Chair: Hideyuki Okumura (JMIA/Yamaha Motor Co., Ltd.), Co-Chair: Nagesh Mavinahally (Mavin Tech, LLC.)

[20139032 / 2013-32-9032]

**Extension of Lean Burn Range by Intake Valve Offset**

*Hideki Saito, Takamori Shirasuna, Tomokazu Nomura (Honda R&D Co., Ltd.)*

Using a 109.2 cm<sup>3</sup>, four-stroke, single-cylinder, two-valve gasoline engine, improvement of fuel economy by extension of lean burn range has been attempted with invented way to intensify tumble flow from a simple mechanical arrangement. With a part of the intake valve was jugged out beyond the perimeter of the cylinder bore, the masking effects from the valve recess on top of the cylinder sleeve created a strong tumble flow, which enabled lean burn at an air fuel ratio leaner than the conventional design by two points. The motorcycle equipped with this engine attained better fuel economy by 5.7% to the base model when measured in Indian Driving Cycle (IDC)...

[20139060 / 2013-32-9060]

**An Investigation on Cranking Torque Reduction for Four-Stroke Motorcycle Engine**

*Yong-Jing Zou, Yuh-Yih Wu, Yao-Chung Liang, Hsin-Hong Lin (National Taipei University of Technology)*

This study focuses on developing a cranking torque reduction strategy for a motorcycle with idling-stop system. At first, experiments are done to measure the electric current consumption of starting motor which is then converted into cranking torque by the motor torque constant. The experimental results also indicate that the piston position, after the engine is stopped, always remains at the bottom dead center of compression stroke. This will further increase the cranking torque for the next engine start due to static friction and compression pressure. This paper, therefore, proposes to retrofit the original generator of motorcycle as a motor/generator with the same operation power...

[20139081 / 2013-32-9081]

**Numerical Investigations of Overexpanded Cycle and Exhaust Gas Recirculation for a Naturally Aspirated Lean Burn Engine**

*Denis Neher, Maurice Kettner, Fino Scholl (University of Applied Sciences Karlsruhe), Markus Klaissle, Danny Schwarz (SenerTec Kraft-Wärme-Energiesysteme GmbH), Blanca Giménez Olavarria (University of Valladolid)*

A large number of small size gas-fired cogeneration engines operate with homogenous lean air-fuel mixture. It allows for engine operation at high efficiency and low NO<sub>x</sub> emissions. As a result of the rising amount of installed cogeneration units, however, a tightening of the governmental emission limits regarding NO<sub>x</sub> is expected. While engine operation with further diluted mixture reduces NO<sub>x</sub> emissions, it also decreases engine efficiency. This leads to lower mean effective pressure, in particular for naturally aspirated engines. In order to improve the trade-off between engine efficiency, NO<sub>x</sub> emissions and mean effective pressure, numerical investigations of an alternative combustion process for a series small cogeneration engine were carried out...

[20139084 / 2013-32-9084]

**Development of an Novel Non-eccentric Rotational Engine "Ishino Engine" (Fundamental Configuration and Characteristics)**

*Yojiro Ishino, Keisuke Teshima, Hiroyuki Fujii, Yusaku Yamamoto, Yu Saiki (Nagoya Institute of Technology)*

A novel rotational internal combustion engine is invented and investigated. In this engine, no eccentric Rotational component is used, resulting in vibration-free operation. For this characteristics, this engine will be suitable for usage in silent environment, e.g. co-generation house plant, handy usage and so on. The engine mainly consists of a rotor casing and two types of rotor; cycloid rotor and trochoid rotor. The shape of the cycloid rotor is characterized by epicycloid surface and lobes, and the trochoid rotor also superior-epitrochoid surface and concaves. As mentioned above, fundamental process of intake, compression, ignition, expansion and exhaust for working gas is automatically performed by the constant speed rotation of both of rotors. In this paper, first, the typical configuration including two designing procedure of the rotors are described in detail. Next the cyclic behavior of the working process is explained. Furthermore the design drawing of the prototype engine is given...

**Tuesday, October 8, 13:30-15:30 at Room 201D**

**Fuel Supply Systems II**

Chair: Minoru Iida (Yamaha Motor Co., Ltd.), Co-Chair: Robert Kee (Queen's University of Belfast)

[20139128 / 2013-32-9128]

**Evaluating the behavior of carbureted engines using a fast response fuel consumption measurement device with minor impact on engine characteristics**

*Jürgen Tromayer, Gerd Neumann, Alexander Trattner, Roland Kirchberger (Graz University of Technology), Hans van den Hoevel (AVL Deutschland)*

Meeting future legislative targets for SI engines by means of low cost technologies is a big challenge for engineers. Despite the use of simple and cost efficient components these engines have to fulfill customer requirements in terms of power and fuel economy, representing the most important selling arguments. Without the possibility of integrating modern technologies like fuel injection systems for mixture preparation instead of simple carburetors, it is very complex to find viable solutions that enable the achievement of these targets. A main key to improve emission behavior, fuel economy and performance on carbureted engines is to get an insight in the mixture preparation process, especially under transient conditions. Therefore, the Institute for Internal Combustion Engines and Thermodynamics of Graz University of Technology together with AVL Germany investigated possibilities to measure the fuel mass flow with a flexible, quick responding device that does not influence the carburetor itself. Comparisons of different fuel flow measurement tools on several engine applications were done to find out which one delivers the information required for advanced carburetor setup tasks in the best possible way. This should serve as a basis for future mixture preparation development on the test bench and especially for in-field optimization.

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[20139126 / 2013-32-9126]

**Spray Characteristics of Local-contact Microwave-heating Injector Fueled with Ethanol**

*Lukas Kano Mangalla, Hiroshi Enomoto (Kanazawa University)*

A microwave-heating system is integrated in a port-injector to minimize the cold-start problems and exhaust emissions of engine. This paper report the experimental investigations of spray characteristics and numerical simulation of fuel temperature inside port-injector. Fuel flow inside port-injector is heated using microwave-heating and this system is called "local-contact microwave-heating injector" (LMI). LMI can be used to increase temperature of ethanol near boiling point (351.5K) before injected into room temperature. Injection pressure of fuel was operated constant at 0.3MPa. Characteristics of fuel spray were observed experimentally using high speed camera, CMOS camera and LDSA. Numerical simulation was conducted to verify the effect of local heating on spray distribution. 2-D geometry of injector with finer quadrilateral mesh (56,000 meshes) was solved numerically on pressure based solver in CFD simulation code. Conservation equations of mass, momentum and energy were modelled on time dependent using Pressure-Implicit with Splitting of Operation (PISO) algorithm. The result shows good agreement between numerical and experimental measurement of temperature distribution. An increasing of fuel temperature inside port injector is considerably improving Sauter Mean Diameter (SMD) of ethanol spray. Pre-heating fuel system by LMI can improve spray quality ...

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[20139167 / 2013-32-9167]

**Measurement of fuel liquid film under the different injection pressure**

*Keiji Muramatsu, Kenji Yamamoto, Naoki Jinno, Kenjiro Nakama (SUZUKI MOTOR CORPORATION), Shinya Okamoto, Tsuneaki Ishima (Gunma University)*

The purpose of this study was to measure the distribution and volume of liquid film adhering to the walls after the injection of fuel by an injector of a port-injection engine using the laser induced fluorescence (LIF) method while changing the fuel pressure and the angle of injection, and to consider how adhesion can be reduced in order to decrease the exhaust emission of gasoline engine. Using a high-speed camera, we filmed the adhesion and evaporation of liquid film in time series. Perylene, used here as a fluorescence dye, was blended with a fuel comprising toluene and n-heptane, and the mixture was injected onto a solid surface using a port-injection injector. UVLED with a maximum output wavelength of 375 nm was used as the exciting light. To more accurately measure the volume of fuel adhesion, it was necessary to correct the unevenness of the light source. For this purpose, we filmed the unevenness of the light source using a fluorescent plate, and using the image as the reference, corrected the images of liquid film adhesion. Through these methods, we evaluated the behavior of liquid film under different injection pressures and injection angles. The results showed that by increasing the fuel pressure, we can reduce the liquid film adhesion and that the smaller the angle of injection...

**Tuesday, October 8, 13:30-15:30 at Room 201E**

**Measurement & Simulation I**

Chair: Tadao Okazaki (LEMA / Kubota Corporation), Co-Chair: Stephan Schmidt (Graz University of Technology)

20139023 / 2013-32-9023

**A Comparative Study on Map Based and Closed Loop Simulation Model of Coolant Circuit for a Two Wheeler Liquid Cooled Engine**

*N. Karthikeyan, Anish Gokhale (Mahindra 2 Wheelers Limited)*

The basic requirement of a vehicle cooling system is to ensure that the components of the engine are adequately cooled under vehicle operating conditions. Engine life and effectiveness can be improved with effective cooling. In designing process, simulation plays a vital role. A clear understanding of the coolant flow and pressure developed within the cooling system is important in designing the coolant circuit. The efficiency of the cooling system depends on the flow delivered by the impeller. The work aims at the study of performance characteristics of a backward curved impeller in a two wheeler cooling system. The objective is to compare the operating points such as pressure drop, flow delivered and power consumed from mapped Computational Fluid Dynamics (CFD) simulation and closed loop CFD simulation. Moving Reference Frame (MRF) model was used to simulate...

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[20139124 / 2013-32-9124]

**Real World Operation of a Standard Lawn Mower Engine from a Scientific Perspective**

*Hermann Edtmayer, Alexander Trattner, Stephan Schmidt, Roland Kirchberger (Graz University of Technology) Jakob Trentini, Johann Weiglhofer (Viking GmbH)*

This paper introduces a research project on a spark ignition engine used in non-road applications. The aim is to illustrate the present situation as basis for comparison. Furthermore to identify possible improvement potential in terms of performance, efficiency or exhaust and noise emissions. The study is carried out in two steps. First a standard walk-behind lawn mower is equipped with measuring instrumentation for recording the cutting forces and the engine variables during real world operation. The tests are carried out on three different lawn types and two different blade types are investigated. Consequently, in a second step the engine is analysed on the engine test bench in stationary and transient operating mode. A complete engine mapping is done regarding all relevant variables. Additionally to the outdoor tests, fuel consumption and engine out emissions are measured...

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[20139125 / 2013-32-9125]

**Start/Stop Strategies for Two-Wheelers in the Emerging Markets**

*Bernd Heinzmann, Simon Scholz (Robert Bosch GmbH) Pramod R, Prashanth Anantha (Bosch India Ltd)*

Fuel economy of two-wheelers is an important factor influencing the purchasing psychology of the consumer within the emerging markets. Additionally, air pollution being a major environmental topic, there is a rising concern about vehicle emissions, especially in the big cities and their metropolitan areas. Potentially, the relatively expensive engine management systems are providing more features and value in comparison to the carburettor counterpart. The combustion system analysis is carried out on a 125 cm<sup>3</sup> motorcycle engine and the subsequent numerical simulation comparing the carburettor and the Electronic (Port) Fuel Injection which provides a basis to establish the fuel consumption benefit for the electronic injection systems. In order to add more flexibility to the engine management systems and provide additional fuel economy benefit...

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[20139127 / 2013-32-9127]

**Development of a Thermal Model within a Complete Vehicle Simulation for Motorcycles and Powersport Applications**

*P. Rieger, J. Girstmair, St. Schmidt, R. Almbauer, R. Kirchberger (Graz University of Technology)*

This publication covers the development process of a thermal model within a complete longitudinal vehicle simulation. Therefore a dynamic/forward simulation within MATLAB Simulink is used. The modeling of the heat transport in the cooling circuit and the lubrication system as well as the heat input by the internal combustion engine is the focus of research. In the first part various possible numerical solution methods for the heat transport model are analyzed and evaluated with regard to the accuracy of the system description and real time capability. The latter is important as functionalities should be able to be subsequently implemented in an engine control unit. In addition, a method for the modeling of the heat input of the internal combustion engine is evaluated. Finally, a validation of the heat transport and heat input model is performed, using a ...

**Tuesday, October 8, 16:00-18:00 at Room 201A**

**Materials I**

Chair: Hirotaka Kurita (Yamaha Motor Co., Ltd.), Co-Chair: Ken Fosaaen (Fosaaen Technologies, LLC)

[20139012 / 2013-32-9012]

**High Performance Polymers for Small Engine Applications**

*Stephen Gurchinoff, Duane Fish, Brian Stern (Solvay Specialty Polymers)*

High performance polymers (HPPs) consist of a group of materials that perform in more demanding applications than more commonly known plastic materials. These materials have been used to replace metals in the automotive industry in a number of applications. HPP's offer specific strengths in line with cast metals and offer some benefits in certain chemical environments over metals. The use of these materials in fuels has a long history and continues to expand as the capabilities become better understood, HPP's are of particular interest in areas where alcohol is present in fuel mixtures and causes corrosion on metals. HPP's have also been developed to serve as a low cost solutions to fuel permeation in fuel tanks by using two or three layer blow molded constructions. Ethylene glycol, oils, and other automotive fluids also have little effect on the mechanical properties of HPP's. Higher temperature capable HPP's (up to 300° C) exhibit outstanding friction and ...

[20139110 / 2013-32-9110]

**Creep Resistance of 2024 Aluminum Alloy**

*Le Min Wang, Chih-Jrn Tsai (National Defense University)*

Long term soaking creep rupture tests of a 2024 aluminum alloy in the T4 condition were performed at 100 °C and 130 °C under stresses ranged from 235 MPa to 370 MPa. It appears that the longer creep life can be obtained through the beneficial effect of underaging resulting in the GPB zones being retained in the matrix rather than dissolving and additional dynamic precipitation of S' precipitates during testing; especially at the condition of 325 MPa at 100 °C, the alloy exhibits longer creep life of at least 14,604 h due to most fully developed very fine precipitates dispersion. When creep test at higher temperature (130°C), the grown S' precipitates lead to significant reduction of creep rupture life. The correlation of applied stress, creep temperature, creep rupture time, and microstructure evolution were discussed.

[20139049 / 2013-32-9049]

**Corrosion resistance improvement technology of anodic oxide films on aluminum alloy that uses a lithium hydroxide solution**

*Masahiro Fujita, Hiroomi Tanaka, Hitoshi Muramatsu (SUZUKI MOTOR CORPORATION), Sachiko Ono, Hidetaka Asoh (Kogakuin University)*

The anodic oxide films are formed to improve the corrosion resistance on aluminum alloy that used as the parts of engines and car bodies. Because these films are porous structure, it is necessary to seal the pores to further improve the corrosion resistance. The pores are sealed with hydrated alumina by treating the films in boiling water or solution that added sealing additives. These hydration sealing has a problem that energy consumption is large because of long sealing time and high temperature of solution.

In this study, the authors have developed a new sealing treatment (Lithium sealing) using a lithium hydroxide solution to solve above problem. Lithium sealing mainly sealed the pores with lithium aluminate double salt ( $\text{LiH}(\text{AlO}_2)_2 \cdot 5\text{H}_2\text{O}$ ). This salt was rapidly formed in strong alkaline solution at room temperature, so that the sealing time was reduced to about 1/10 compared with the conventional sealing. After this sealing

[20139029 / 2013-32-9029]

**Suction flow improvement of Plasma spray cylinder in Outboard Motor**

*Hideya Kumagai (Yamaha Motor Co., Ltd.)*

The two-stroke engines were in the main stream of the outboard motors, but they have been replaced with the fourstroke counterparts reflecting the environmental protection movement in recent years. Yamaha outboard motors F300B and VF250A, of which the production started in the year 2009, are equipped with four-stroke engines, and yet achieved the light weight equivalent to their two-stroke counterparts. The production volume of these models reached 20,000 units. The sleeveless cylinder block produced by utilizing the thermal spraying technology has successfully reduced the distance between the cylinders, and has contributed to realize smaller and lighter-weight components used in the cylinder block and the related areas.

**Tuesday, October 8, 16:00-18:00 at Room 201B**

**Diesel Engine**

Chair: Takeshi Maeda (Honda R&D Co., Ltd.), Co-Chair: Brian Callahan (Achates Power & Basco)

[20139021 / 2013-32-9021]

**Effect of Spray/Wall Interaction on Diesel Combustion and Soot Formation in Two-Dimensional Piston Cavity**

*Kuichun Li, Masaki Ido, Yoichi Ogata, Keiya Nishida, Baolu Shi (University of Hiroshima), Daisuke Shimo (Mazda Motor Corporation)*

The effects of spray/wall interaction on diesel combustion and soot formation in a two-dimensional piston cavity were studied with a high speed color video camera in a constant volume combustion vessel. The two-dimensional piston cavity was applied to generate the impinging spray flame. In the cavity, the flat surface which plays a role as the cylinder head has a 13.5 degree angle with the injector axis and the impinging point was located 30 mm away from the nozzle tip. Three injection pressures of 100, 150, and 200 MPa and a single hole diesel injector (hole diameter: 0.133mm) were selected. The flame structure and combustion process were examined by using the color luminosity images. Two-color pyrometry was used to measure the line-of sight soot temperature and concentration by using the R and B channels of the color images. The soot mass generated by impinging....

20139022 / 2013-32-9022

**Combustion Characteristics of Emulsified Blends of Water and Diesel Fuel in a Diesel Engine with Cooled EGR and Pilot Injection**

*Hideyuki Ogawa, Gen Shibata and Takaki Kato (Hokkaido University), Hari Setiaprja (The agency for assessment and application of technology), Kosuke Hara (YANMAR Co., Ltd.)*

Water and diesel fuel emulsions containing 13% and 26% water by volume were investigated in a modern diesel engine with relatively early pilot injection, supercharging, and cooled EGR. The heat release from the pilot injection with water emulsions is retarded toward the top dead center due to the poor ignitability, which enables larger pilot and smaller main injection quantities. This characteristic results in improvements in the thermal efficiency due to the larger heat release near the top dead center and the smaller afterburning. With the 26% water emulsion, mild, smokeless, and very low NO<sub>x</sub> operation is possible at an optimum pilot injection quantity and 15% intake oxygen with EGR at or below 0.9 MPa IMEP, a condition where large smoke emissions are unavoidable with regular unblended diesel fuel. Heat transfer analysis with Woschni's equation did not...

[20139103 / 2013-32-9103]

**CFD Modeling of a Turbo-charged Common-rail Diesel Engine**

*Guan-Jhong Wang, Chia-Jui Chiang, Yu-Hsuan Su (National Taiwan University of Science and Technology), Yong-Yuan Ku (Automotive Research and Testing Center)*

In this study, a single cylinder diesel engine model is built via the ANSYS FLUENT CFD solver to simulate the phenomenon during each stroke. The initial conditions and boundary conditions are set based on experimental data obtained from a turbo-charged common-rail diesel engine developed by Mitsubishi. The variables that can be observed from the CFD model include cylinder pressure, gas velocity, cylinder temperature, fuel particle tracks, and mass fraction of cylinder gas components. The simulation results display the effects of the fuel injection timings on the combustion heat release process, cylinder pressure and cylinder temperature at different engine operation conditions. The pure diesel (C<sub>10</sub>H<sub>22</sub>) is adopted in this simulation study.

[20139112 / 2013-32-9112]

**Study on Combustion and Soot Emission of Ethanol or Butanol Blended with Gas Oil in a Direct Injection Diesel Engine**

*Shohei Yamamoto, Shotaro Watanabe, Keisuke Komada, Daisaku Sakaguchi, Hironobu Ueki, Masahiro Ishida (Nagasaki University)*

In order to utilize bio-alcohols as the fuel for diesel engines, combustion characteristics of alcohol blended with gas oil were compared between ethanol and n-butanol in a direct injection diesel engine. In the case of the same cetane number between ethanol and butanol blends, the time-history of combustion, in other words, the ignition delay, the diffusion combustion and the combustion duration, coincided almost completely in both blend fuels. However, the smoke density of the butanol blend was smaller than that of the ethanol blend. This result must be caused by difference in soot formation process between ethanol and butanol blends. Thus, it is difficult to predict the trend of the soot emission in combustion of alcohol blends only by using the existing phenomenological model of the soot formation in the combustion of gas oil. In the present study, the concept ...

**Tuesday, October 8, 16:00-18:00 at Room 201C**

**Engine Technology III**

Chair: Michihisa Nakagawa (Kawasaki Heavy Industries, Ltd.), Co-Chair: Stefano Frigo (University of Pisa)

[20139105 / 2013-32-9105]

**Investigation on Friction Behaviour of a Single Cylinder Gasoline Engine**

*T Sukumaran Vipin, Joseph Sumith, Allwyn Dias, K Chandra Reddy, S Saju, Mohan D Umate (TVS Motor Company Ltd.)*

In order to improve the performance and fuel economy of a reciprocating engine, it is important to reduce the overall engine frictional losses. In this paper, author conducts an experimental study on the friction characteristics due to pumping loss, valve-train system, piston assembly, auxiliaries and transmission for a 110cc, single cylinder 4-stroke gasoline engine using frictional strip-down analysis. Friction strip-down method is commonly used to investigate the frictional contribution of various engine elements at high speeds and for better understanding of the make-up of the total engine friction. The engine friction measurements for the particular engine are carried out on a motoring test rig at different engine speeds...

[20139160 / 2013-32-9160]

**The Numerical Investigation on the Performance of Rotary Engine with Leakage, Different Fuels and Recess Sizes**

*Dun-Zen Jeng, Ming-June Hsieh, Chih-Chuan Lee (Chung-Shan Institute of Science and Technology), Yu Han (National Chung Hsing University)*

This study investigates the influence of leakage through the apex seal, fuel type and recess size on the performance of a Rotary Engine. A commercial CFD software, Fluent, was applied and a two-dimensional model was constructed to predict the engine performance. Air and fuel flow into the chamber by two separate ducts in this model were used to simulate fuel-air mixing. Three different apex seal clearances (0mm, 0.4mm, 0.5mm) were simulated. The computations with two types of fuel, CH<sub>4</sub> and C<sub>8</sub>H<sub>18</sub>, were performed and put in result comparison in this study. The recess sizes were based on three compression ratios, 8.33, 9.55 and 10.18. To simplify rotor mesh construction in the model with leakage, a porous region was generated to model this quite small gap...

[20139161 / 2013-32-9161]

**The Intake and Exhaust Pipe Effect on Rotary Engine Performance**

*Dun-Zen Jeng, Ming-June Hsieh, Chih-Chuan Lee (Chung-Shan Institute of Science and Technology), Yu Han (National Chung Hsing University)*

This article is to investigate the inlet and exit pipe effect on a rotary engine performance. A 1-dimensional, threecylinder reciprocating engine model was adopted to simulate the operation of a rotary engine with three separate chambers. The chamber volume variation in this model was identical to a real rotary engine. The test data of the real rotary engine were used as a benchmark test for this model. Various parameters are then studied, including pipe length, pipe diameters, and pipe shape with convergent/divergent angles. In the performance analysis, the results showed that the averaged performance data (BSFC, brake work, brake torque, pressure distribution) was within 5 % in tolerance...

[20139114 / 2013-32-9114]

**Effects of EGR on Knock-level of Small Spark Ignition Engine with Gasoline-base Kerosene-mixed Fuel**

*Hiroshi Enomoto, Hirotaka Nozue, Noboru Hieda (Kanazawa University)*

In emergency, it is not easy to get enough fuel for generator and the usage of kerosene with small spark ignition engine for normal gasoline was investigated. As too much kerosene will cause knock, EGR (exhaust gas recirculation) system was used to reduce the knock strength. The displacement was 290cc and the compression ratio was 8.4. The knock strength was evaluated with a highpass-filtered strain sensor and 0.6V was measured at MBT (Minimum advance for Best Torque) with normal gasoline, 1800rpm, 10Nm. The engine speed was almost 1800±100rpm and the torque was almost 10±0.1Nm. As a result, the EGR system could reduce the knock strength in any kerosene mixture fuel with the control of the ignition timing.

**Tuesday, October 8, 16:00-18:00 at Room 201D**

**Hybrids, Electric Drives & Fuel Cells I**

Chair: Yasuyuki Muramatsu (Yamaha Motor Co., Ltd.), Co-Chair: Glenn Bower (University of Wisconsin-Madison)

[20139006 / 2013-32-9006]

**Development of a New Regenerative Braking System**

*Takahiro Noyori, Setsuko Komada, Hirobumi Awakawa (SUZUKI MOTOR CORPORATION)*

Our new technology, the first technology in the small vehicle industry, achieves the fuel economy improvement due to the electricity through the highly efficient electricity generation and charge by the regenerative braking energy obtained during vehicle decelerating or coasting. The newly developed technologies is the regenerative braking system, which minimizes electricity generation during vehicle driving, while maximizes it during vehicle decelerating or coasting. Regenerative braking is the function to generate electric power using with the regenerative braking energy obtained during vehicle decelerating or coasting through the accelerator pedal released or the brake pedal applied. The kinetic energy from the vehicle in motion is recaptured as the electric power to be used for the electric component operation.

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[20139009 / 2013-32-9009]

**Design and Analysis of Single-cylinder 22 HP Hybrid Powertrain for Motorcycles**

*Chun-Hsien Wu, Wei-Ming Su, Pei-Jen Wang (National Tsing Hua University)*

A single-cylinder engine of 22 HP plus 10 HP hybrid powertrain for motorcycles is proposed in this paper. An electric DC brushless motor, connected via crankshaft to the 249.4cc four-stroke internal combustion engine (ICE), drives a continuous variable transmission (CVT) to the rear wheel for propulsion of vehicle. A rule-based controller structure is established for management of power from both the ICE and motor to reduce fuel consumption and achieve charge sustaining. With the help from Matlab/Simulink programs, simulations and assessment of the efficacy in emission reduction of the proposed hybrid motorcycle under ECE-R40 driving cycle are analyzed.

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[20139018 / 2013-32-9018]

**Adaptive-Learning Regeneration Controller Design for Electric Vehicles**

*Chien-An Chen, Ming-Chih Lin (Automotive Research & Testing Center)*

An adaptive-learning regeneration control strategy to enhance the regeneration quality for electric vehicles (EV) is proposed. In recent years, several kinds of EV are equipped with regeneration function. For example, i-MiEV, the EV of Mitsubishi motors, whose energy regeneration ratio is adjusted via the gear shift for standard using, increasing energy regeneration ratio and decreasing energy regeneration ratio. In Taiwan, the TOBE W' car and Luxgen MPV EV, whose energy regeneration ratios are adjusted by a knob and a shaft, respectively. However, the above-mentioned methods are not adaptively to be adjusted to adapt the various customs of drivers. There are some drawbacks, such as manually adjusting energy regeneration ratio and constant energy regeneration ratio, etc. Therefore, an adaptive-learning regeneration control strategy is proposed to account for the above-mentioned drawbacks.

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[20139035 / 2013-32-9035]

**A Research on the Application Layer Protocols of Wireless Communication of Electric Vehicle**

*Yen-Chun Lai (Automotive Research & Testing Center)*

On electric vehicle monitoring, there is no application layer standard to support the wireless communication. As a developing target, there are more varieties on the signal combination as the modules or unit carried by an electric vehicle change. Protocols between the transmission unit and the reception server are made to change frequently, so are the programs on both the transmission unit and the reception server, and results in the difficulty to the development and maintenance of the whole system.

Since electric motorcycle and electric bicycle are also developing with hybrid type, same problems would occur to them. It would be favorable to find a protocol with endurance to such variability. ASN.1 is introduced as a valuable candidate. An effort is made to apply ASN.1 to wireless communication of electric vehicle, to see how well it is to adjust to the variability of signals. Also a new method is developed to ...

**Tuesday, October 8, 16:00-18:00 at Room 201E**

**Measurement & Simulation II**

Chair: Shigeru Fujii (Yamaha Motor Co., Ltd.), Co-Chair: Stephan Schmidt (Graz University of Technology)

[20139034 / 2013-32-9034]

**Stress prediction of engine components resulting from an engine vibration**

*Masahiro Akei, Kouich Kouzato, Toshiyuki Uyama (YANMAR Co., Ltd.)*

This paper describes how we predict the stress of engine components resulting from vibration of engine, using MBD (Multi Body Dynamics) and FEA (Finite Element Analysis). In a development of industrial engine, many engine models which are installed on various machines are developed. Depending on operating condition of machine, many kinds of components are designed. Therefore, in order to shorten a development period, it is important to predict accurately stress of components and evaluate its durability in the design phase. In this study, for exhaust silencer, the stress of engine components which are caused from of engine vibration is calculated by FEA and MBD and the accuracy of prediction is confirmed as compared with the experiment result. In addition, the stress of oil suction pipe is predicted. As vibrational characteristic of oil suction pipe is influenced by lube oil, virtual mass method is used in order to take into consideration the influence ...

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[20139043 / 2013-32-9043]

**Development of Strength Analysis Method for Off-Road Motorcycle Radiator Assembly**

*Masakazu Yamaya, Akihiro Chiba, Yuuki Murayama (Yamaha Motor Co., Ltd.)*

The radiator assembly for a liquid-cooled off-road motorcycle is generally attached to the side of the frame. Therefore, if the motorcycle topples over, the radiator may strike the ground and receive an impact through the plastic side cover. This may deform the radiator, reducing its cooling performance or leading to a coolant leak. The strength of the radiator and plastic side cover was designed so that the radiator assembly will not deform easily if the motorcycle topples over at low speeds. However, due to the complex behavior of the radiator assembly in strength tests, a degree of trial-and-error may be necessary to incorporate strength countermeasures by tests alone. Therefore, a strength test simulation method was developed to help design the required strength of radiator assemblies.

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[20139044 / 2013-32-9044]

**Application of FEM Analysis Using Loads Predicted from Strain Measurement in Motorcycle Frame Development**

*Mitsuo Hirai, Takashi Ueno, Youhei Iwaki, Shojiro Oohama (Yamaha Motor Co., Ltd.)*

This paper presents an approach for efficiently evaluating motorcycle main frame strength using external loads predicted from measured strain data in our development process. The loads are calculated by simple matrix inversion, and can be used as boundary conditions of static analysis that resembles actual phenomena. The advantage of this method is that it allows relatively precise reproduction of actual boundary conditions without the data usually needed for dynamic simulation such as tire and suspension characteristics which often take large amount of time and man-hour to obtain. Although this approach is simple and common practice, there are a lot of things to be concerned for gaining useful results in a broad range of stages in the motorcycle main frame development process. How we effectively make use of this approach is going to be introduced here.

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[20139096 / 2013-32-9096]

**Development of Estimation for Strain in Damages of Motorcycle Engine Parts When Tipped Over from Stationary State**

*Shigesato Nakamura, Hisayoshi Ogura, Kota Noguchi, Yasuhiro Miyazaki (Honda R&D Co., Ltd.)*

In this research, a simulation method was developed in which it was able to estimate, in the early stage of design, the strains that potentially lead to damages to motorcycle engine parts when tipped over from a stationary state. Splitting a series of phenomena from the start of tilting of motorcycle from the upright position up to the end of collision of engine parts after the contact on the ground to two groups by before and after the contact of engine parts on the ground, we applied the multi body dynamics analysis to the first group, and the elasto-plastic FEM analysis to the latter one. In the computer simulation of collision using the elasto-plastic FEM analysis, we minimized the FEM models from the entire motorcycle models and treated others as a solid model to shorten the computation period. It is also realized that the strains occurring in the engine parts can be simulated by considering only the mass of the parts which are rigidly mounted on the engine. The developed simulation method allows remarkable reduction of analysis time while assuring a high accuracy...



Wednesday, October 9, 08:30-10:00 at Room 201A

**Alternative Fuels III**

Chair: Yuh-Yih Wu (National Taipei University of Technology), Co-Chair: Kai W. Beck (MOT GmbH)

[20139174 / 2013-32-9174]

**An Application of Cellulosic Liquefaction Fuel for Diesel Engine -Improvement of Fuel Property by Cellulosic Liquefaction with Plastics -**

*Kohei Suzuki, Akira Iijima, Hideo Shoji, Koji Yoshida (Nihon University)*

There are few investigations to change wood biomasses to the industrially available energy, so that a new conversion technology of biomass to liquid fuel has been established by the direct liquefaction process. However, cellulosic liquefaction fuel (for short CLF) could not mixed with diesel fuel. In this study, the plastic was mixed with wood to improve the solubility of CLF to diesel fuel. CLF made by the direct co-liquefaction process could be stably and completely mixed with diesel fuel in any mixing ratio and CLF included 2 wt.% of oxygen. The test engine was an air-cooled, four-stroke, single cylinder, direct fuel injection diesel engine. In the engine starting condition test, the ignition timing of 5 wt.% CLF mixed diesel fuel was slightly delayed at immediately after the engine started, however the ignition timing was almost the same as diesel fuel after the engine was warmed-up. In ordinary engine performance test, the combustion characteristics, engine performances and exhaust gas emissions were almost similar to those of diesel fuel up to mixing ratio of CLF of 20 wt%. However, THC was decreased as the weight mixing ratio of CLF increased. Therefore, CLF can be practically used as a good additive for diesel engine.

[20139134 / 2013-32-9134]

**The Feasibility Study of Low-concentration Butanol as Fuel on Motorcycle**

*Ta-Chuan Liu, Zong-Da Lin, Chia-Yun Yeh, Yun-Yang Chen (Industrial Technology Research Institute)*

This paper describes the test results of low concentration butanol gasoline as fuel on motorcycle. It contains an immerse test to study material compatibility of 50% nbutanol gasoline (nB50) with some rubber, thermoplastics and Aluminum alloy usually used on motorcycle engine fuel system. An engine dyno test which is to compare the combustion characteristics of 20% n-butanol-gasoline (nB20) and gasoline. And an vehicle emission and fuel test which is to evaluate nB20 fuel emission characteristics and compliance of Taiwan motorcycles emission standards. The results shown there is no malfunction concern to use nB20 as fuel on the fuel injection motorcycle designed for gasoline. However, the NOx exhaust increase is a common issue of Alcohol alternative fuels on motorcycle

[20139156 / 2013-32-9156]

**Development of Alternative Fuel Content Estimation Method and Apparatus**

*Masayoshi Uno, Takashi Abe, Shinichi Kuratani (Kawasaki Heavy Industries, Ltd.)*

Environmental and energy independence concerns have stimulated the development of an apparatus for alternative fuel. It estimates the ethanol content in the fuel in order to perform a reliable combustion. One means for measuring the ratio of ethanol present in the fuel tank is to provide a fuel composition sensor. However, such a fuel composition sensor increases the number of parts and causes the cost issues in motorcycles. We used an oxygen sensor disposed to the exhaust pipe to estimate the ethanol content without increasing the parts and costs. The common method of the estimation is the oxygen feedback in stoichiometric air fuel ratio condition. Unfortunately, two-wheel vehicles are often operated in rich conditions and have less chance of stoichiometric condition. In this study, we used a one-liter four-cylinder motorcycle, and have developed a practical method to estimate the ethanol content even in the not-stoichiometric condition. A newly developed method uses two lambda variables (ratio of actual air-fuel ratio to stoichiometric air-fuel ratio) and provides more chance of the oxygen feedback for motorcycles. Using an engine dynamometer and a chassis dynamometer, we conducted some verification examinations for this method and the apparatus. The results showed the method's applicability from 0% to 100% ethanol content.

**Wednesday, October 9, 09:00-10:00 at Room 201B**

**Lubricants**

Chair: Hirotaka Kurita (Yamaha Motor Co., Ltd.), Co-Chair: Brent Dohner (The Lubrizol Corporation)

[20139033 / 2013-32-9033]

**Highly Efficient Lubricant for Sport Motorcycle Application –Fuel Economy and Durability Testing**

*Gianluigi Zoli, May Turner, Cliff Newman (Castrol Ltd.)*

As a result of extremely competitive market environment and severe emission legislation, motorcycle manufacturers are giving increased focus to the lubricant as a potential tool to improve engine performance reducing at same time tailpipe emissions and fuel consumption. However, due to very specific hardware constraints, application of highly efficient low viscosity oils to modern motorcycle requires careful formulation approach and thorough testing procedure. Previous work carried out by Castrol and described in SAE paper # 2011-32-0513 indicated that optimized, low viscosity motorcycle engine oils, formulated with dedicated technology to combine optimum clutch compatibility with engine and gearbox protection, can bring significant increase in engine power and acceleration in comparison with commercially available lubricants. This paper describes the progress of the development work, aiming at further understanding potential benefits and constraints arising from the application of low viscosity, highly efficient engine oils to current motorcycle engine technology. The work included the evaluation of the fuel economy potential for experimental low viscosity formulations using a sport tourer motorcycle fitted on chassis dynamometer, followed by extended high speed engine durability evaluation of one of the formulations on two different super sport motorcycle engines, representative of latest generation hardware technology. Results of Fuel Economy tests showed that carefully formulated low viscosity lubricants can provide reduction in fuel consumption when compared with conventional, commercially available products. Both the durability test programs were successfully completed with key engine and driveline components in good conditions at end of test, confirming potential applicability of low viscosity engine oils to modern high performance sport bikes.

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[20139063 / 2013-32-9063]

**Improving Fuel Efficiency of Motorcycle Oils**

*Brent Dohner, Alex Michlberger, Chris Castanien (The Lubrizol Corporation), Ananda Gajanayake (Lubrizol Japan Ltd.), Sumitaka Hirose (Honda R&D Co., Ltd.)*

As the motorcycle market grows, the fuel efficiency of motorcycle oils is becoming an important issue due to concerns over the conservation of natural resources and the protection of the environment. Fuel efficient engine oils have been developed for passenger cars by moving to lower viscosity grades and formulating the additive package to reduce friction. Motorcycle oils, however, which operate in much higher temperature regimes, must also lubricate the transmission and the clutch, and must provide gear protection. This makes their requirements fundamentally very different from passenger car oils. Developing fuel efficient motorcycle oils, therefore, can be a difficult challenge. Formulating to reduce friction may cause clutch slippage and reducing the viscosity grade has limitations in motorcycles due to the need for gear protection. Additionally, in high temperature motorcycle engines, low viscosity oils are more prone to oil consumption, which will hurt fuel economy, and deposit formation, which may reduce overall performance.

The lowest viscosity grade oil currently recommended by Honda for motorcycle applications is a 10W-30. This study describes the development of a new 5W-30 motorcycle oil to deliver enhanced fuel efficiency in Honda motorcycle engines. The key target of this development was to deliver enhanced fuel efficiency with a 5W-30 while not compromising any of the performance of the current high quality 10W-30 oil. Testing was conducted to validate oil consumption, clutch performance, oxidation resistance, wear protection, gear protection, and engine cleanliness in modern Honda motorcycle engines. In all aspects, the newly developed 5W-30 oil performed equivalent or better than the high quality 10W-30 reference oil. As the final proof of performance, the new 5W-30 oil was compared with the 10W-30 reference oil in a motored Honda motorcycle engine friction torque test and clearly demonstrated the desired enhanced fuel efficiency.

Wednesday, October 9, 09:00-10:00 at Room 201C

**Engine Technology IV**

Chair: Shosaku Chiba (Honda R&D Co., Ltd.), Co-Chair: Nagesh Mavinahally (Mavin Tech, LLC.)

[20139169 / 2013-32-9169]

**Predictive Simulation of PFI Engine Combustion and Emission**

Hisashi Goto, Takeshi Morikawa, Mineo Yamamoto, Minoru Iida (Yamaha Motor Co., Ltd.)

This paper reports a methodology to estimate combustion pattern and emission by predictive simple simulation with good accuracy on various conditions of PFI engine. 3D-CFD code VECTIS has been applied for this simulation, its settings and methods are as follows. RANS equation with linear k-epsilon model has been used as the turbulence model. Turbulent burning velocity equation contains not only turbulent velocity term but also laminar burning velocity term. For ignition model, we use a predictive model called DPIK. We iterate cycle calculation until wallfilm behavior is stabilized to get the reasonable mixture formation. We have applied this methodology to 125cc engine of motorcycle. As a result, we have obtained heat release curve and pressure curve with good accuracy on various operating conditions such as engine speed, engine load, air fuel ratio, wall temperature, and spray direction. CO and NOx calculated simultaneously have also been acceptable. CO formation is based on chemical equilibrium, and NOx formation is based on the extended Zeldovich mechanism. Using these results obtained by this methodology, optimal air-fuel distribution that affects heat release pattern and emission formation is suggested.

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[20139093 / 2013-32-9093]

**Investigation on the Re-starting Characteristics of a Motorcycle Engine Performing an Idle-stop Approach**

Rong Fang Horng, Chiu Wei Cheng, Wu Dong Han, Liao Cheng Hsun, Yo Fu Peng (Kun Shan University), Tsai Chien Hsiung, Tseng Chyuan Yow (Pingtung University of Science and Technology)

In this study, the re-starting characteristics of a motorcycle engine with idle-stop were investigated. Generally when turning off the engine, there is; or when restarting engine, the air-fuel mixture will become rich to cause the incomplete combustion. When the restarting period is shortened, the aforementioned phenomena would be improved. The aim of this study was to shorten the engine re-starting time during start-up. In the initial stage of the study, the gear ratio of the starter was changed, and the parameters of the engine speed and cylinder pressure were measured and analyzed. The results showed that supplying the additional fuel injection duration of 3 milliseconds into the combustion chamber before the engine was stopped would give the quicker restarting characteristics.

**Wednesday, October 9, 08:30-10:00 at Room 201D**

**Collegiate Events**

Chair: Takashi Mitome (SUZUKI MOTOR CORPORATION), Co-Chair: Glenn R. Bower (The University Wisconsin Madison)

[20139100 / 2013-32-9100]

**Aerodynamic design for SR11 (Formula SAE racing car)**

*Tetsuya Fujimoto, Takashi Suzuki (Sophia University)*

Nowadays, cornering performance of FSAE (Formula SAE) cars are dramatically improved due to less mass, kinematic developments and tires. In such circumstance, under high speed conditions, aerodynamical devices work better. It had been decided to attach aerodynamical devices that consist of front wing, rear wing, diffuser (floor) and deflector for SR11 (Fig.1, Table1), a FSAE car developed by Sophia Racing (Japan). To start with developing aerodynamical devices, it had been assumed that how they work. Lap time simulation had been done with VI-car-real-time, which shows the laptime could be shorten by 2 seconds of 60 seconds for a usual FSAE endurance course with 60kgf at 60km/h down-force. Dragforce had been assumed to work well while once, it had been supposed to have a bad influence for laptime. The reason why it works well is at high speed, it works as extra braking force even without tires doesn't contact with ground or unfavorable load distribution. Then, 60kgf downforce was a target, while no target with dragforce. ....

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[20139118 / 2013-32-9118]

**Improving the Fuel Economy of Supercharged Engine**

*Yoshiki Fukuhara, Naoya Kimata, Takashi Suzuki (Sophia University)*

The paper reviews the experimental development of fuel economy of engine powering the 2012 Formula SAE single seat race car of the University of Sophia. The balance of high power and low fuel consumption is biggest challenge of racing engine. It was found that improving the efficiency of engine by supercharging as a way to achieve that. In order to adapt the supercharger for the engine, the important design points are below:

It was found that intake air blow-by gas at combustion chamber is increased in low engine speed. To improve that, the valve overlap angle was changed to adopt supercharged engine and improve effective compression ratio. Typically the racing engine demands maximum torque for performance but that does not imply that the air fuel ratio should be rich than theoretical. The point is the maximum torque of the engine is proportional to the amount of air intake. Therefore, supercharged engine is possible to increase the supercharging pressure for bigger torque. But the base engine is not prepared for bigger torque, the damage of the engine was considered....

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[20139176 / 2013-32-9176]

**Developing Best Available Technology in a Flex-Fuel Snowmobile by using a Lean-Burn Miller Cycle**

*Matt Birt, Gregory W. Davis (Kettering University)*

Clean snowmobile technology has been developed and applied to a commercially available two cylinder, four-stroke snowmobile. The goals of this effort included reducing exhaust and noise emissions to levels below the U.S National Parks Service (NPS) Best Available Technology (BAT) standard while increasing vehicle dynamic performance with a 50 percent peak power increase over the original equipment version. Engine thermal efficiency has been increased through Late Intake Valve Closure (LIVC) valve timing modification for Miller cycle operation, while high load power was increased through the implementation of a turbocharger and variable electronic boost control. An electronic throttle was also implemented in combination with a "performance/economy" mode switch to limit speed and increase fuel efficiency per the rider's demands. Additionally, a new exhaust system featuring a three-way catalytic converter and a simple, lightweight muffler utilizing a passive acoustic valve has been developed to reduce chemical and noise emissions. This snowmobile was modified to run the full range of ethanol-blended fuels using an affordable flex-fuel sensor and custom controls, including closed-loop wideband exhaust oxygen feedback. Excellent fuel efficiency was achieved with the lean-burn Miller cycle powertrain in addition to an exhaust emissions improvement of 13 percent from the original equipment version.

Wednesday, October 9, 08:30-10:00 at Room 201E

**Measurement & Simulation III**

Chair: Tadao Okazaki (LEMA / Kubota Corporation), Co-Chair: Stephan Schmidt (Graz University of Technology)

[20139079 / 2013-32-9079]

**CFD Scavenging Simulation & Verification of a Sequentially Stratified Charged Two-Stroke Engine**

*M Bergman, N Enander, M Lawenius (Husqvarna AB)*

To effectively use Computational Fluid Dynamics (CFD) for engine emission development it is necessary to be able to simulate the scavenging flow in an engine. The CFD model for a stratified charged two-stroke engine is even more complex. This model have been tuned and finally validated with engine tests. A CFD model has been made of the Husqvarna 560XP two-stroke stratified charged chainsaw engine. The model contains piston, cylinder, inlet system ducting and exhaust silencer. The simulation runs with moving deforming mesh with all ports active. The airflow levels have been fine tuned with inlet restrictions similar to those in the air filter holder, which is not completely included in the present model. The results and behaviour of the CFD model has a very good match to the measured values of the finished product. This gives us confidence in the model and several aspects can now be studied that is virtually impossible to capture by other means.

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[20139162 / 2013-32-9162]

**Evaluation Method for Motorcycle Mode Fuel Consumption using a One-Dimensional Engine Simulation**

*Masahito SAITOU, Kenji INOUE, Motohiko NISHIMURA, Hidekazu IWASAKI, Takashi YOSHIYAMA, Atsushi HISANO and Daisuke SAKOU (Kawasaki Heavy Industries, Ltd)*

Motorcycle has broad spectrum of developments, such as excellent engine performance, low fuel consumption, emission and noise reduction. As global warming become a serious issue internationally, reduction of fuel consumption is especially of importance. In this study, an evaluation method for the WMTC mode fuel consumption using a one-dimensional engine simulation is investigated. The fuel consumption for the WMTC mode can be predicted in a short time without a complicated vehicle model to simulate transient behavior. The proposed method mostly showed good agreement with measured data for middle-class motorcycle using a chassis dynamometer.

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[20139157 / 2013-32-9157]

**Prediction of the Cavitation Effect on the Flow Around the Outboard Motor Propeller Blade Hydrofoil Section Using CFD**

*Akira Kamiya (Yamaha Motor Co., Ltd.)*

The propeller blade hydrofoil section is one of the factors that determines the propeller performance. In the development of the hydrofoil, repeatedly performed experiments using many foil models and the cavitation tunnel involve extended time and high cost. This is why there are expectations for the numerical simulation to realize shorter development time and cost cutback. On the other hand, a technique for reproducing the hydrofoil characteristics taking account of the cavitation effect using CFD (Computational Fluid Dynamics) has hardly been established. There is no example of performance prediction especially for a hydrofoil section of the outboard motor propellers in which the trailing edge is cut off. This paper describes the results of the prediction of hydrodynamic characteristics performed in regard to the two differently shaped outboard motor propeller blade hydrofoil sections taking account of the cavitation effect. Calculation was performed by commercial finite volume method CFD code. One-fluid type cavitation model was employed, which is calculated simultaneously with RANS (Reynolds-Averaged Navier-Stokes) equations. The numerical calculation results were compared with experimental data taken in the cavitation tunnel to show their effectiveness and the limit of application.

**Wednesday, October 9, 10:30-12:00 at Room 201A**

## **Materials II**

Chair: Le-Min Wang (National Defense University), Co-Chair: Stephen Thomas Gurchinoff (Solvay Specialty Polymers)

[20139046 / 2013-32-9046]

### **The effect of surface morphology of cylinder bore surface on anti-scutting property made by high pressure die-casting process using hyper-eutectic Al-Si alloy**

*Takehiro Uhara, Hirotaka Kurita (Yamaha Motor Co., Ltd.)*

A monolithic type aluminum (Al) cylinder made of hypereutectic Aluminum-Silicon alloy has been widely used for motorcycle applications. It has a lightweight structure and a superior cooling ability owing to its material property and surface finishing. The cylinder bore surface is required for tribological properties such as an anti-scutting property, an anti-wear property, and a low friction. Among these tribological properties, the anti-scutting property is quite important to assure the reliability and the safety of the motorcycles.

Usually the cylinder bore surface of the monolithic type Al cylinder is finished by an etching process or a honing process in order to expose silicon (Si) particles from aluminum (Al) matrix for the improvement of the tribological properties. The morphology of the cylinder bore surface including the exposure of Si particles is supposed to make an important effect on its tribological properties, especially on the anti-scutting property.

In this research, the anti-scutting property of three kinds of cylinder bore finishing, an etched surface, a Si exposure honed surface and a conventional plateau honed surface is evaluated with using a reciprocated type wear tester. The experimental results are analyzed by using Weibull analysis. The relevance of the application of the Weibull analysis is discussed. It is shown that the experimental data of the anti-scutting property can be evaluated quantitatively by Weibull analysis. Then the effect of surface morphology on the anti-scutting ...

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[20139082 / 2013-32-9082]

### **Application of Vacuum Assisted Carbide Dispersion Carbonitriding to Connecting Rods**

*Tsuyoshi Kubota (Yamaha Motor Co., Ltd.)*

In four-cycle single-cylinder motorcycle engines, high Hertzian stress is generated on and beneath the big-end surface of the connecting rod. If the surface strength were improved, the diameter of the big-end could be made smaller, making the entire engine smaller and lighter.

Therefore, application of carbide dispersion carbonitriding using a vacuum furnace (hereinafter referred to as "vacuum CD carbonitriding") on the big-end surface was investigated. Vacuum CD carbonitriding was carried out by three processes. The first was a CD carburizing process. This process is done to obtain granular cementite, but in order to avoid decreasing the strength, it is necessary to prevent the formation of coarsened cementite at the grain boundary. The second process was a refining process. This process is done for the purpose of refining the prior austenite grain size. The third process was a carbonitriding process. This process is done for the purpose of increasing hardness in the vicinity of the surface. Therefore, in this study, three processes— a CD carburizing process, a refining process, and a carbonitriding process— were undertaken, to see if CD carbonitriding with refined prior austenite grain size could be achieved.

The strength of vacuum CD carbonitrided specimen was evaluated using a ball-on-disk type rolling-contact-fatigue testing machine. Vacuum CD carbonitriding was found to have a lifetime six times that of conventional carburizing. Vacuum CD carbonitrided connecting rods have been used in single-cylinder ...

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[20139111 / 2013-32-9111]

### **Development of HPDC Alloy for Motorcycle Wheel Using Recycled Aluminum**

*Yukihide Fukuda, Masahiko Nakagawa, Toshimitsu Suzuki (Honda R&D Co., Ltd.)*

The new die cast (HPDC) wheel alloy has been developed using recycled aluminum to attain considerable reduction of energy at the time of material production to make large contribution to the reduction of CO2 emissions.

The material for motorcycle body parts, especially for wheels, requires a sufficient elongation property. However, when recycled aluminum, which contains large amount of impurities, is used as main raw material, the intermetallic compounds crystalize out and the elongation property is deteriorated.

Accordingly, we firstly made the investigations on the elements contained in a recycled aluminum and it was clarified that the elongation property was correlated to the shape of crystallized iron-based intermetallic compounds. Next, it also clarified that addition of manganese (Mn) improved the elongation property by changing the shape of crystallized iron-based intermetallic compounds from the plate form to the clumped form, followed by determination of the optimum content of Mn to prevent coarsening of the compounds. Additionally, it was clarified that the shape and size of crystalized iron-based intermetallic compounds significantly influenced by the solidification rate when casting products.

To analyze the solidification process, we developed a simulation method to estimate the size of metal ...

Wednesday, October 9, 10:30-12:00 at Room 201B

#### Engine Components II

Chair: Toshimi Kobayashi (Kawasaki Heavy Industries, Ltd.), Co-Chair: Fabio Auriemma (Tallinn University of Technology)

[20139102 / 2013-32-9102]

#### Improvement of Powder Metallurgy Gears for Engines and Transmissions

*Paul Skoglund, Ola Litström (Höganäs China Ltd), Dr. Anders Flodin (Höganäs AB)*

This paper presents the progress in Powder Metallurgy (PM) Gears, including examples of how to combine the disciplines of materials-, design- and process technology to push the limits towards increased performance, reduced weight, energy consumption and total manufacturing cost. Advancements in materials and manufacturing technology for PM gears will be presented as well as the result from simulations and reverse engineering work on existing automotive transmissions. The results from this work show that the amount and type of load on the individual gears in auto transmissions are very different and this gives room for optimized selection of material and manufacturing process. PM gears do not have the same geometrical design limits as conventional gears machined from wrought steel, and in this paper it is exemplified how modifications of macro- and micro gear geometries of PM gears can reduce weight, inertia and stress levels and in such a way contribute to improved transmissions for cars and motorcycles.

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[20139163 / 2013-32-9163]

#### Idle Air Control Valve for the Small Engine Market

*Hong Dian, Chen Kun, Cheng Tao (Continental Automotive Wuhu China), Craig Weldon P.Eng (Continental Tire Canada), Alois Christiaens, Ren Jie (Continental Automotive Belgium N.V)*

Developing countries, facing greater challenges related to air pollution, are enacting more stringent emission rules for small engines. Idle Air Control Valve [IACV] along with Electronic Fuel Injection [EFI] is widely used for emission control in the large engine automotive market. This combination is also considered as one of the best solutions to aid in reducing the tailpipe emissions from small engines. One regulatory board for small engine use in USA is the California Air Resource Board [CARB]. CARB has a separate small engine emission category for nonautomotive Small Off-Road Engine [SORE] consisting of off-road spark-ignition engines below 25 horsepower, including all small off-road engines such as lawn mowers, weed trimmers, garden and other maintenance utility equipment **[1]**. SORE emission regulations for the handheld equipment were initially implemented in 1995 with most recently Tier II reductions of exhaust emissions in 2010.

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[20139068 / 2013-32-9068]

#### Development of Advanced Propeller Damper (Shift Dampener System)

*Yohei Kuroki, Hiroyuki Tsunekawa, Shunsuke Yukawa (Yamaha Motor Co., Ltd.)*

Generally, the gearshift mechanism for outboard motors shifts into forward or reverse gear without using the synchromesh arrangement (dog clutch engagement) (See Fig.1). This type of shift mechanism has advantages in simple structure and in saving space and cost, but at the same time, this is often the source of problem due to the abrasion caused by the hitting of gear against the dog clutch before the engagement, as well as large gearshift shock and noise. In addition, the outboard motor horsepower is getting bigger in recent years. As they are equipped with bigger and heavier engines and propellers, the shifting shock and noise tend to become more severe. For this reason, the improvement in this aspect is required.

We looked into the way to reduce the shock and noise by means of propellers, because the propeller can be mounted and replaced easily, which allows the effective improvement to be spread to the outboard motors already in the market. Consequently, the advanced propeller damper for reducing the gearshift shock and noise has been developed. This report presents the development process of the advanced propeller damper.

**Wednesday, October 9, 10:30-12:00 at Room 201C**

**Engine Controls I**

Chair: Masayoshi Uno (Kawasaki Heavy Industries, Ltd.), Co-Chair: Thorsten Raatz (Robert Bosch LLC)

[20139041 / 2013-32-9041]

**Reduced-order Modeling of Intake Air Dynamics in Single-cylinder Four-stroke Engine**

*Shun-ichi Akama, Yasunori Murayama, and Shigeho Sakoda (Yamaha Motor Co., Ltd.)*

This study deals with reduced-order modeling of intake air dynamics in single-cylinder four-stroke naturally-aspirated spark-ignited engines without surge tanks. It provides an approximate calculation method for embedded micro computers to estimate intake manifold pressures in real time. The calculation method is also applicable to multi-cylinder engines with individual throttle bodies since the engines can be equated with parallelization of the single-cylinder engines. In this paper, we illustrate the intake air dynamics, describe a method to estimate the intake manifold pressures, and show experimental results of the method.

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[20139061 / 2013-32-9061]

**Estimation of Intake Manifold Absolute Pressure Using Kalman Filter**

*Bo-Chiuan Chen, Yuh-Yih Wu, Hsien-Chi Tsai (National Taipei University of Technology)*

For vehicles with intake manifold absolute pressure (MAP) sensor, the intake air mass is obtained using speed-density method. Since the analog MAP signal will contain high frequency noise with uncertain amplitude, the MAP value obtained in the engine management system using angle based sampling will result in MAP value variation even for engine steady-state operation. In order to properly obtain a MAP value under nonlinear time-varying characteristics, a MAP estimation method based on a closed-loop model is proposed. First, an adaptive two-input single-output intake manifold model is constructed. The Recursive Least Square technique is utilized to on-line identify the intake manifold model with throttle opening angle and engine speed as inputs. The identified intake manifold model is then employed to estimate the MAP using the Kalman Filter. Simulation results show that the proposed method can bring smaller standard deviation of air fuel ratio than that of using conventional methods for noise rejection under open-loop fuel control and system parameters drift. When a high frequency noise with higher amplitude is caught while sampling a MAP value, the proposed method can also reduce the noise effect and preserve the open-loop control performance on air fuel ratio. The proposed method is also investigated if the engine output torque is fluctuated.

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[20139037 / 2013-32-9037]

**Online engine speed based adaptation of air charge for two-wheelers**

*Christian Steinbrecher, Bastian Reineke, Jürgen Berkemer, Henning Heikes, Wolfgang Fischer (Robert Bosch GmbH)*

Regarding the strongly growing two-wheeler market fuel economy, price and emission legislations are in focus of current development work. Fuel economy as well as emissions can be improved by introduction of engine management systems (EMS). In order to provide the benefits of an EMS for low cost motorcycles, efforts are being made at BOSCH to reduce the costs of a port fuel injection (PFI) system.

The present paper describes a method of how to reduce the number of sensors of a PFI system by the use of sophisticated software functions based on high-resolution engine speed evaluation. In order to improve the performance of a system working without a MAP-sensor (manifold air pressure sensor) an air charge feature (ACFn) based on engine speed is introduced. It is shown by an experiment that ACFn allows to detect and adapt changes in manifold air pressure. Cross-influences on ACFn are analyzed by simulations and engine test bench measurements. Whereas the air-fuel ratio can be neglected, the temperature influence has to be considered. Finally, additional applications of engine speed based features for small engine control are discussed. Algorithms for ignition angle optimization and air-fuel ratio adaptation are part of the current development work at Bosch.



**Wednesday, October 9, 10:30-12:00 at Room 201D**

**Hybrids, Electric Drives & Fuel Cells II**

Chair: Jung-Ho Chen, (National Taiwan University), Co-Chair: Glenn Bower (University of Wisconsin-Madison)

[20139132 / 2013-32-9132]

**Single Cylinder 25kW Range Extender as Alternative to a Rotary Engine Maintaining High Compactness and NVH Performance**

*Christian Hubmann, Frank Beste, Hubert Friedl, Wolfgang Schoffmann (AVL List GmbH)*

Due to the restricted capacity of today's battery systems and therefore limited operating range of electric vehicles (EV), several solutions for recharging the energy storage during driving already have been published and still are matter of extensive development programs. One example is the Range Extender (RE), which is a combination of an internal combustion engine (ICE) with a generator-unit, which serves the purpose of a power back-up in case of a battery with low state of charge (SOC) without any direct connection to drivetrain.

For such kind of RE-application different boundary conditions are getting of major importance. Especially in EVs topics like packaging space and NVH behavior do play a main role. To fulfill these important characteristics, AVL has developed a 25kW Wankel-RE unit in which the generator is driven directly from the excenter-shaft of the rotary-piston ICE. With such an arrangement and the correct balancing of the power unit directly on the rotor of the generator, a very small packaging size in combination with a smooth and silent running can be achieved and fulfills the most important characteristics for an electric vehicle. Besides of these outstanding attributes, even RE rotary engine concepts have proven excellent fuel efficiency even under stringent emission challenges, the main drawback of rotary engines can be seen in non-availability of large scale manufacturing devices for specific rotary engine components. Therefore, the industry would prefer and ...

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[20139071 / 2013-32-9071]

**Development of Belt-Driven Starter-Generator Control Strategy for Hybrid Electric Vehicle**

*Qing-Lin Chen, Jieng-jang Liu, Pai-Hsiu Lu (China Engine Corporation, Taiwan)*

A Hybrid electric vehicle saves fuel by four aspects, i.e. engine idle-stop, regenerative braking, engine downsizing, and engine load change. Saving fuel by 5-10% is achievable with optimized fuel cut-off strategy. However, emission and drivability trade-off must be carefully treated. The conventional automatic transmission requires a mechanical pump driven by the engine crankshaft offers hydraulic function, lubrication, and cooling. To stop the engine during vehicle idling, transmission fluid pressure will not be sufficiently maintained for the launch clutch in engaged status. Once the engine restarts, the engine speed profile can cause the transmission fluid pressure uncontrollable, which creates bump during vehicle take-off. In most vehicles equipped with a conventional automatic transmission (AT) as well as start-stop function, an electric oil pump is usually installed to maintain fluid pressure.

However, cost and complexity increase, and the electric pump is redundant to the mechanical pump during normal driving. This paper presents a method for smoothing the change of automatic transmission fluid (ATF) pressure by utilizing the belt-driven starter-generator (BSG) using field oriented control (FOC) method and the correlation curve between AT fluid pressure and rotational speed of BSG.

The proposed system reduced the numbers of changes and incremental cost due to additional ...

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[20139072 / 2013-32-9072]

**Development of the idle-stop starter with pre- and post-engage pinion gear**

*Chih-Wei Hu, Shih-Lin Lin, Heng-Chih Tang, Ting-Chi Kao, Andrew P.H. Lu (China Engine Corporation)*

Reducing the fuel consumption of conventional ICE vehicles are usually achieved from reducing vehicle running resistance, improving engine efficiency, save the idle energy, and recycling the waste energy. About 5-10% of fuel consumption can be saved by engine idle-stop, which strongly depends on fuel cut-off schedule before the vehicle completely stop.

However, engine shut-off during vehicle coasting-down always exist strong concerns of safety and drivability issues. Fuel cut-off before vehicle completely stop creates the risk that the driver might change-of-mind (CoM). The driver could request the engine restart during engine running down period, when engine speed between 200-500rpm.

With convention starter, the pinion gear is actuated simultaneously with the starter motor energizing. There will be no chance to engage the pinion gear with crankshaft gear when the engine is not still. That realizes idle-stop function activated before vehicle completely stop is unachievable by using conventional starter.

**Wednesday, October 9, 10:30-12:00 at Room 201E**

**Advanced Combustion I**

Chair: Koji Yoshida (Nihon University), Co-Chair: Ken Fosaaen (Fosaaen Technologies, LLC.)

[20139002 / 2013-32-9002]

**Effects of Intake System with Swirl and Tumble Valve on the Combustion in a Small Four Stroke Engine**

*Hui-Ting Chang, Chih-Wei Huang, Kuan-Hsu Lin, Wen-Cheng Hu (SANYANG INDUSTRY CO., LTD.)*

It is well known that better fuel economy, good drivability, lower cost are essential for motorcycle market in Asia. To meet these demands in the meantime is a challenge for engineers. Gas motion in cylinder has significant effects on engine combustion efficiency and stability. A simple gas motion control valve may be a solution to meet these demands. This paper examines the turbulence characteristics, combustion and fuel consumption between swirl valve and tumble valve on an air cooled 150cc four valves scooter engine. Finally, the swirl valve and tumble valve respectively improve the fuel consumption about 12% and 17% in the partial load 4500rpm, 2bar BMEP engine operating condition.

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[20139030 / 2013-32-9030]

**A Study of the Effects of Varying the Supercharging Pressure and Fuel Octane Number on Spark Ignition Engine Knocking using Spectroscopic Measurement and In-cylinder Visualization**

*Takashi Ishino, Norikuni Hayakawa, Tomomi Miyasaka, Akira Iijima, Koji Yoshida, Hideo Shoji (Nihon University)*

Engine downsizing with a turbocharger / supercharger has attracted attention as a way of improving the fuel economy of automotive gasoline engines, but this approach can be frustrated by the occurrence of abnormal combustion. In this study, the factors causing abnormal combustion were investigated using a supercharged, downsized engine that was built by adding a mechanical supercharger. Combustion experiments were conducted in which the fuel octane number and supercharging pressure were varied while keeping the engine speed, equivalence ratio and intake air temperature constant. In the experiments, a visualization technique was applied to photograph combustion in the combustion chamber, absorption spectroscopy was used to investigate the intermediate products of combustion, and the cylinder pressure was measured. The experimental data obtained simultaneously were then analyzed to examine the effects on combustion. The results showed that increasing fuel octane number had effect of moderating combustion by lengthening period from development of a cool flame to occurrence of autoignition. Additionally, increasing the supercharging pressure retarded the onset of the cool flame reactions and advanced the occurrence of autoignition.

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[20139144 / 2013-32-9144]

**Influence of High Frequency Ignition on the Combustion and Emission Behaviour of Small Two-Stroke Spark Ignition Engines**

*Clemens Hampe, Markus Bertsch, Kai W. Beck, Ulrich Spicher (MOT GmbH), Steffen Bohne, Georg Rixecker (BorgWarner Beru Systems)*

The two-stroke SI engine is the predominant driving unit in applications that require a high power-to-weight ratio, such as handheld power tools. Regarding the latest regulations in emission limits the main development area is clearly a further reduction of the exhaust emissions. The emissions are directly linked to the combustion processes and the scavenging losses. The optimization of the combustion processes, which represents one of the most challenging fields of research, is still one of the most important keys to enhance the thermal efficiency and reduce exhaust emissions. Regarding future emission regulations for small two-stroke SI engines it is inevitable that the emissions of gases causing the greenhouse effect, like carbon dioxide, need to be reduced. As most small SI engines are carburetted and operate open loop, the mixture formation and the amount of residual gas differs from cycle to cycle [1]. When using conventional ignition systems, the size of the plasma is restricted to the small dimensions of the spark plug gap. In combination with the high flow velocities of small two-stroke SI engines and the variations of the mixture, the cycle-to-cycle variations are very high. Misfiring and delayed combustion lead to high emissions and poor running smoothness, especially at idle speed. Therefore an alternative ignition system was used to enhance the inflammation behavior with a more stable and faster combustion compared to a conventional ignition. At rated power there were improvements in the engine power and also in the engine efficiency due to a better combustion. At idle the most important improvement was the lean misfire limit which could help the fuel efficiency and the reduction of emissions a lot dependent on the field of application of the engine.

Wednesday, October 9, 13:30-15:00 at Room 201A

#### Emissions I

Chair: Hiromi Deguchi (SUZUKI MOTOR CORPORATION), Co-Chair: Kai W. Beck (MOT GmbH)

[20139058 / 2013-32-9058]

#### Misfire Diagnostic Strategy for Motorcycles

*Hsien-Chi Tsai, Bo-Yu Gao, Ming-Hao Chiang, Bo-Chiuan Chen, Yuh-Yih Wu (National Taipei University of Technology)*

The on-board diagnostic (OBD) technologies for automobiles have been well-developed; however, it could not be carried out on motorcycles directly since the operation conditions are quite different between automobiles and motorcycles. In this research, we propose a misfire detection strategy for motorcycles based on the characteristics of crankshaft rotational dynamics. At first, experiments were done on a 125cc motorcycle to investigate the variation of instantaneous crankshaft rotational speed in power stroke while the misfire events are injected at different engine operation conditions. In order to generate misfire events for the engine, a misfire generator is established for providing specific misfire rates. If a misfire takes place at higher engine speed, the instantaneous rotational speed will decline continuously during power stroke due to higher friction losses...

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[20139050 / 2013-32-9050]

#### Exhaust Emissions Characteristics of Scooters on the Real World in Taiwan

*Su, Kao-Chun, Chuang, Chih-Wei (Automotive Research & Testing Center) Chen, Hsin-Yi, Pei-Chang Wen, Chen, Hsueh-Heng (Chung-Hua Institution for Economic Research)*

Scooter is the most popular personal vehicle in Taiwan; however, it also causes serious air pollution, especially in big crowded cities. In traditional method, vehicle exhaust emissions are measured with specific driving cycle in laboratory, but the test results hardly reflect the authentic exhaust emission for real world driving and road conditions. In the recently, OBS (On-Board Emission Measurement System) is a technology which can be installed on vehicles to collect exhaust emissions instantaneously on different road condition and time. This paper uses OBS (developed by ARTC, Automotive Research & Testing Center) installed on testing scooters to collect instantaneous exhaust emissions on typical roads and time periods. The test results can be used to analyze the scooter running characteristics of emissions.

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[20139052 / 2013-32-9052]

#### Feasibility Study of Emission Improvement through Transient Emission Characteristics Analysis for Idle-Stop Motorcycles

*Chao-Lung Chen, Zong-Da Lin (Industrial Technology Research Institute)*

In order to improve the fuel economy and CO<sub>2</sub> emission for motorcycles, manufacturers have developed and commercialized motorcycles equipped with idle-stop (also known as stop-start) systems. Some test data have shown that such motorcycles may cause 55% more exhaust emissions over the test driving cycle when idle-stop function is on, and fail to meet the functionality expectations of reducing emissions from such motorcycles. Two market sold idle-stop motorcycle types were tested on chassis dynamometer to investigate their transient exhaust emissions over six different driving cycles with idle-stop function on and off separately. Further more, the feasibility of emissions improvement by adjusting ECU calibration was also evaluated. The results...

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[20139055 / 2013-32-9055]

#### Feasibility of Using Half Useful Life Mileage Accumulation for Motorcycle Certification Durability Tests in Taiwan

*Shin-Hui Lin, Chao-Lung Chen (Industrial Technology Research Institute)*

Since the exhaust emissions of an in-use motorcycle usually increases along its age, the Taiwan Environmental Protection Administration (TEPA) started to adopt useful life and deterioration factors requirements for the emission type approval certification in 1991. Considering the actual travel mileages for most motorcycles in Taiwan, it is necessary to extend the useful life period and mileage requirements for the future emission standards. This change of requirement will increase certification time and costs of new models for manufacturers. To evaluate the feasibility of shortening the accumulated useful life mileage for the regulatory durability test requirement; this study surveyed 105 sets of durability test results to explore the effects of deterioration factors on durability test result calculations. The analysis showed no significant difference....

Wednesday, October 9, 13:30-15:00 at Room 201B

#### HCCI I

Chair: Yasuo Moriyoshi (Chiba University), Co-Chair: Markus Bertsch (MOT GmbH)

20139031 / 2013-32-9031

##### **A Study of the Effects Varying Compression Ratio and Fuel Octane Number on HCCI Engine Combustion using Spectroscopic Octane Number on HCCI Engine Combustion using Spectroscopic Measurement**

*Akira Terashima, Naoya Ito, Tomoya Tojo, Akira Iijima, Koji Yoshida, Hideo Shoji (Nihon University)*

A Homogeneous Charge Compression Ignition (HCCI) engine was operated under a continuous firing condition in this study to visualize combustion in order to obtain fundamental knowledge for suppressing the rapidity of combustion in HCCI engines. Experiments were conducted with a two-stroke engine fitted with a quartz observation window that allowed the entire bore area to be visualized. The effect of varying the compression ratio and fuel octane number on HCCI combustion was investigated. In-cylinder spectroscopic measurements were made at compression ratios of 11:1 and 15:1 using primary reference fuel blends having different octane numbers of 0 RON and 50 RON. The results showed that varying the compression ratio and fuel octane number presumably has little effect on the rapidity of HCCI combustion at the same ignition timing when ...

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[20139054 / 2013-32-9054]

##### **Influence of Fuel Properties on Operational Range and Thermal Efficiency of Premixed Diesel Combustion**

*Qian Xiong, Kazuki Inaba, Hideyuki Ogawa, Gen Shibata (Hokkaido University)*

The influence of fuel properties on the operational range and the thermal efficiency of premixed diesel combustion was evaluated with an ordinary diesel fuel, a primary reference fuel for cetane numbers, three primary reference fuels for octane numbers, and two normal heptane-toluene blend fuels in a single-cylinder DI diesel engine. The fuel injection timing was set at 25°CA BTDC and the maximum rate of pressure rise was maintained below 1.0 MPa/°CA when lowering the intake oxygen concentration by cooled EGR. With increasing octane numbers, the higher intake oxygen concentration can be used, resulting in higher indicated thermal efficiency due to a higher combustion efficiency. The best thermal efficiency at the optimum intake oxygen concentration with the ordinary diesel fuel is lower than with the primary reference fuels with the similar ...

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[20139098 / 2013-32-9098]

##### **A Study of Controlled Auto-Ignition in Small Natural Gas Engines**

*Hibiki Koga, Toshiro Kiura (Honda R&D Co., Ltd.)*

Research has been conducted on Controlled Auto-Ignition (CAI) engine with natural gas. CAI engine has the potential to be highly efficient and to produce low emissions. CAI engine is potentially applicable to automobile engine. However due to narrow operating range, CAI engine for automobile engine which require various speed and load in real world operation is still remaining at research level. In comparison some natural gas engines for electricity generation only require continuous operation at constant load. There is possibility of efficiency enhancement by CAI combustion which is running same speed at constant load.

Since natural gas is primary consisting of methane (CH<sub>4</sub>), high auto-ignition temperature is required to occur stable auto-ignition. Usually additional intake heat required to keep stable auto-ignition. To keep high

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[20139166 / 2013-32-9166]

##### **Visualization and Spectroscopic Measurement of Knocking Combustion Accompanied by Cylinder Pressure Oscillations in an HCCI Engine**

*Akira Iijima, Mitsuaki Tanabe, Koji Yoshida, Hideo Shoji, Naoya Itoh, Akira Terashima, Tomoya Tojo (Nihon University)*

Combustion experiments were conducted with an optically accessible engine that allowed the entire bore area to be visualized for the purpose of making clear the characteristics that induce extremely rapid HCCI combustion and knocking accompanied by cylinder pressure oscillations. The HCCI combustion regime was investigated in detail by high-speed in-cylinder visualization of autoignition and combustion and emission spectroscopic measurements. The results revealed that increasing the equivalence ratio and advancing the ignition timing caused the maximum pressure rise rate and knocking intensity to increase. In moderate HCCI combustion, the autoignited flame was initially dispersed temporally and spatially in the cylinder and then gradually spread throughout the entire cylinder. In contrast to that behavior, in extremely rapid HCCI combustion...

Wednesday, October 9, 13:30-15:00 at Room 201C

#### Engine Controls II

Chair: Masayoshi Uno (Kawasaki Heavy Industries, Ltd.), Co-Chair: Thorsten Raatz (Robert Bosch LLC)

[20139062 / 2013-32-9062]

#### Development of Torque-Based Engine Management System for Range Extender Engine

*Yao-Chung Liang, Hsien-Chi Tsai, Yuh-Wen Peng, Yuh-Yih Wu (National Taipei University of Technology)*

Range extender (RE), combined by an engine and a generator, charges the battery on the electric vehicle. Power management strategy of a range extended electric vehicle (REEV) will determine the required charging power according to battery state of charge (SOC) and driver demands. The charging power demand will be further converted into required operation torque and rotational speed demands from engine. Torque-based engine management system (EMS) is, therefore, required to receive the torque command from power management strategy for controlling the engine at required torque. This research develops a torque-based EMS for a RE engine which is a 125cc four-stroke semi-direct injection engine and fueled by liquefied petroleum gas (LPG).

[20139042 / 2013-32-9042]

#### Torque Control of Rear Wheel by Using Inverse Dynamics of Rubber/Aramid Belt Continuous Variable Transmission

*Shun-ichi Akama, Yasunori Murayama, and Shigeho Sakoda (Yamaha Motor Co., Ltd.)*

This paper concerns a torque control of a rear wheel of a motorcycle equipped with a rubber/aramid belt electronically-controlled continuous variable transmission where a primary sheave position is controlled by an electric motor. In particular, the paper discusses a method to calculate a required engine torque and a required primary sheave position, given reference values of a rear-wheel torque and an engine rotational velocity. The method forms a foundation of a hierarchized traction control where a higher control layer decides an optimal motorcycle motion (rear-wheel torque and engine rotational velocity) and a lower control layer realizes the motion by actuators (engine torque and primary sheave position). Difficulties of the control are due to large mechanical compliance of the rubber/aramid belt, which leads to an inevitable lag from the primary sheave position to a speed...

[20139040 / 2013-32-9040]

#### Construction of Data-setting Configuration Using Prescribed Template and Profile for Competition Motorcycles

*Takashi Suda, Koichi Tsunokawa, Satoru Kanno and Xi Sun (Keihin Corporation), Yue Zhou (Keihin R&D China Co., Ltd.)*

In racing world regardless of two-wheeled vehicle (motorcycle) or four-wheeled vehicle, vehicle setting is performed in accordance with various race conditions. From the age of carburetor till even now ECU is used, vehicle setting executes as well and plays an important role. Changeover to electronic control makes vehicle control more precise; meanwhile, vehicle control technique to become complicated is occurring every day. Therefore, whenever a new competition vehicle is developed, tool required for vehicle setting is also necessary to be updated according to vehicle control technique implemented. Setting-method till now is that, all information required for vehicle setting is packaged in tool, thereby tool and vehicle have always been a combination of 1-to-1. Consequently, in manufacturer's vehicle development, tool development / update becomes a burden and..

[20139066 / 2013-32-9066]

#### Providing Calibration Tools for Cost Sensitive Electronic Control Systems

*Garrard, M.R. (Freescale Semiconductors UK), Tobin, P. (EFI Analytics), Grippo, A. (B.G.Soflex)*

The move to electronics in order to meet Stage IV emissions standards brings with it the requirement to understand and use calibration and programming tools. Previously calibration was a mechanical optimization task, and some smaller manufacturers may not have electronic or software capability on the design team. To reduce the barriers to entry, Freescale has worked with EFI Analytics to develop a cost effective calibration solution. This permits more than one engineer to own the tool, and to calibrate using a simple to understand interface on the PC, rather than developing 'c' coding expertise. The tool includes a single text based customization file to allow the user to create application specific features appropriate to the system being calibrated, such as Electronic Fuel Injection (EFI), Capacitor Discharge Ignition (CDI), or even non-powertrain..

**Wednesday, October 9, 13:30-15:00 at Room 201D**

**Hybrids, Electric Drives & Fuel Cells III**

Chair: Yasuyuki Muramatsu (Yamaha Motor Co., Ltd.), Co-Chair: Glenn Bower (University of Wisconsin-Madison)

[20139119 / 2013-32-9119]

**The Development of Non-contact Torque and Angle Sensor for Intelligent Power Assist System**

*Chau-Chih Yu, Jin-Yan Hsu, Tsung-Hua Hsu (Automotive Research & Testing Center)*

In recent years, many attentions have been paid on global environmental protection and energy saving; more people, therefore, have chosen bikes for commuting to work or school. For longer distance transportation and less effort, electric power assist bikes have re-entered the market. Due to regulation of some countries, electric bikes that must be pedaled were developed. These machines utilize the pedals as the dominant form of propulsion, with the motor used only to give extra assistance when needed for hills or long journeys. The ratio of electric power to human power may affect the riding feel. As a result, a torque sensor, which detects the pedaling force, is crucial in this application. This paper proposes a new design of torque sensor by way of twist angle measurement. It is composed of ...

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[20139045 / 2013-32-9045]

**Development of Torque Sensor with Nickel-iron Alloy Plating for Pedal-equipped Electric Vehicles**

*Kentaro Ikegami (Honda R&D Co., Ltd.)*

This paper describes the development of non-contacting detection type torque sensor that realizes a small lost motion with light weight and low cost.

Pedal-equipped electric vehicles are becoming popular in recent years. In those vehicles, torque sensors are usually necessary for measuring the pedaling force to determine the motor torque.

We applied an integrated sensing structure and a non-contacting scheme utilizing inverse-magnetostrictive material to minimize the lost motions. As for the sensing material, nickel-iron alloy plating was used to obtain a wide dynamic range. In the tests using the actual structure, the output linearity deterioration occurred because of the strain distribution dispersion produced by the ratchet drive structure. Therefore, the effect of this ...

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[20139120 / 2013-32-9120]

**Study of Different Arrangement of Magnets for the Purpose of Reducing Magnet Usage in Designing an Integrated Starter/Generator for Hybrid Vehicles**

*Kai-Fan Hsueh, Jung-Ho Cheng (National Taiwan University), Yi-Shen Chen, Andrew Lu (CEC Engine Co. Ltd)*

Due to the fluctuating price of rare earth raw material in recent years, the manufacturing cost for high performance motors used in electric or hybrid vehicles becomes very difficult to control. Therefore, the automotive industries have been actively performing research and development to reduce the dependence of the rare earth magnet. The purpose of this paper is to investigate the effects of magnet arrangements at the same time to improve the magnetic circuit by increasing the reluctance torque while lowering the alignment torque in a permanent magnet synchronous motor. As a result, the amount of expensive NdFeB magnet is substantially reduced by adopting a V-shape arrangement.

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[20139087 / 2013-32-9087]

**Two-speed Automatic Transmissions of Electric Scooters**

*Kuo-ching Chen, Keng-tso Chuang, Han-hsueh Liu, Ching-ya Chen (CHINA MOTOR CORPORATION)*

To effectively reduce the greenhouse gas emission, electric scooters have been developed and become a booming green transportation around the world. Most of these electric scooters possess a fixed reduction ratio in the powertrain, which makes them far from satisfactory--you can't have low cost, high performance and efficiency at the same time. However, as a silver bullet, one kind of two-speed transmission is developed.

The two-speed transmission will shift automatically according to speed and throttle. An exquisite design with of a one-way clutch as well as a synchronizer effectively reduces the inevitable shocks while shifting. The electric scooter with such two-speed transmission will be launched on the market in 2013. This product ...

Wednesday, October 9, 13:30-15:00 at Room 201E

**Advanced Combustion II**

Chair: Koji Yoshida (Nihon University), Co-Chair: Ken Fosaaen (Fosaaen Technologies, LLC.)

[20139116 / 2013-32-9116]

**Small Kerosene Droplet Evaporation Near Butane Diffusion Flame**

*Hiroshi Enomoto, Shogo Kunioka, Lukas Kano Mangalla, Noboru Hieda (Kanazawa University)*

An experimental study has been conducted at small kerosene droplet behavior near well-defined butane diffusion flame for the critical need on high efficient and cleaner energy technology. High temperature of background gas was generated using butane flame. Microflame from butane can reach the maximum temperature around 1200K at tip of outer glass. Single droplet of kerosene was injected by a small injector tube (30  $\mu\text{m}$ -diameter) in to hot environment. Droplet of kerosene was released by attachment of piezo actuator on wall injector. Once the droplet is exposed to the hot atmosphere of micro flame, the temporal regression of the droplet surface was recorded. Droplet diameter was observed by CCD camera with strobe light flash at 180ns. The images captured in this experiment were analyzed by post-processing software to determine the vaporization of droplet. Temperature of background gas was measured by K-type thermocouple and speed of droplet released from injector was also measured to investigate the effect of relative velocity between droplet and background gas. The result shows that the linear changing point of droplet diameter is started at different droplet temperature and different initial velocity. For further movement to high temperatures environment the vaporization rate of droplet is almost linear with time.

[20139117 / 2013-32-9117]

**Observation of Kerosene Droplet Evaporation under High Pressure and High Temperature Environment**

*Hiroshi Enomoto, Shunsuke Sawasaki, Kosuke Nishioka, Lukas Kano Mangalla (Kanazawa University)*

In this study, the background gas of the droplet vaporization was concerned and simulated numerically using ANSYS fluent code. The new type, engine-like, condition of high pressure chamber and high temperature environment was considered to conduct experiment on kerosene droplet evaporation. 2D geometry of domain simulation was discretized in the very fine quadrilateral meshes. The numerical approach was solved using implicit scheme of compressible gas solver (density based). Temperature dependent properties of air are expressed for gas material properties. As the study concerning on high pressure condition the equation state of Peng-Robinson was expressed in simulation. Governing equations of mass, momentum and energy were solved by the second order upwind for flow, turbulent kinetic energy and turbulent dissipation rate. Standard  $k-\epsilon$  model was used to solve turbulence flow in the spatial discretization. The effects of the non-ideal gas phase behavior were found to be important for prediction background gas of droplet vaporization especially in high pressure environment. It can be concluded that we can predict the environment of high temperature and high pressure condition, however the quantitative measurement of droplet evaporation is still facing problem on physical devices. The environmental conditions has significant effect on droplet behavior inside the chamber.

[20139123 / 2013-32-9123]

**Behavior of Small Fuel Droplet near Butane Diffusion Flame**

*Hiroshi Enomoto, Shogo Kunioka, Noboru Hieda (Kanazawa University)*

In this paper, droplet behavior near diffusion flame was observed. Single droplet was created by thin glass tube and piezo device which pushes the side of glass tube. Dispersions of droplets location near diffusive flame were compared to droplets with no flame condition. CCD camera, strobe light with 180nsec flash time and lens of ten magnification were used for observation. Droplet pictures were taken with resolution of 0.46 $\mu\text{m}/\text{pix}$ . As a result, droplets near diffusive flame tend to increase its dispersion of location as approaching tip of the flame. Stefan flow caused by evaporation and turbulence outer flow can be thought as causes.

Thursday, October 10, 08:30-10:00 at Room 201A

## Emission II

Chair: Hiromi Deguchi (SUZUKI MOTOR CORPORATION), Co-Chair: Kai W. Beck (MOT GmbH)

[20139057 / 2013-32-9057]

### **New VM R750 engine family: a different approach to reach the emission limit**

*Emilio Bertoni, Alessandro Mazza, Carlo Ricci (VM Motori), Lorenzo Pace, Manuel Presti (Emitec G.m.b.H.)*

Emission legislation for Off Road Engines is forcing the industry to review the engine design, introducing state of the art technology for many components and tailored exhaust gas after treatment architectures. Particulate matter reduction is a crucial issue to be addressed having an influence on overall engine performance and cost. At the present stage there is not a unilateral solution in the industry, as some manufacturers use a combination of very high fuel injection pressure and very efficient DOC, while others rely on the automotive derived DPF technology with active regeneration or SCR-only technology to reach EU Stage IV and US Tier4f. Considering the pros and cons of each solution, VM Motori decided to adopt an innovative solution consisting in a DOC followed by a partial-flow filter PM-Metalit® for the R750 Engine family. The advantages of this solution will be discussed in this paper along with the application work that has been carried over to reach the emission limit. A short overview of the PMMetalit technology will be given together with a comprehensive explanation of the physical mechanisms that allow a constant and maintenance-free PM reduction. Moreover, tests results to simulate real life conditions will be discussed.

[20139053 / 2013-32-9053]

### **Durable Catalyst Formulations For Four-stroke Small Engines**

*W. Boll, M. Bonifer, R. Kiemel, U. Endruschat (Heraeus Precious Metals GmbH & Co. KG)*

In this paper the development of durable Palladium containing catalytic coatings suitable for the application in a carbureted four-stroke multipurpose small engine is presented. The catalyst activity is evaluated with regard to the overall washcoat architecture in terms of i.e. implementation of oxygen storage material. The basic parameters of all investigated fresh and thermally aged catalyst formulations are evaluated by light-off experiments using a synthetic gas test bench. In addition, engine test bench experiments are conducted to prove the catalyst activity in real application conditions. Finally a set of promising formulations are successfully submitted to a 25 hours durability test run with regard to the EPA III class I regulation.

[20139064 / 2013-32-9064]

### **Drive Cycle Fuel Economy and Engine-Out Emissions Evaluation Using an Opposed-Piston Sleeve-Valve Engine with Lean Operation and Ignition Delay for NOx Control**

*Michael A. Willcox, James M. Cleeves (Pinnacle Engines)*

In small vehicle applications in which carburetion and oxidation catalysts are used, a fuel efficient means of engine-out NOx reduction is necessary to avoid the cost of implementing a 3-way catalyst and closed-loop-controlled fuel injection system. Pinnacle Engines' single-cylinder 110cc lean-burn opposed-piston 4-stroke architecture has been tested to gather steady-state fuel consumption, emissions, and combustion stability data over a matrix of speed, load, mixture ratio, and combustion phasing. Contributions to total vehicle fuel usage and emissions production are evaluated using steady-state flow data weighted by time spent at a respective load and speed from a tested WMTC drive cycle. Cumulative emissions and fuel economy impacts are presented for multiple NOx-reducing engine control strategies using control variables of mixture ratio and combustion phasing. Pre-catalyst HC and CO levels are affected by operating strategy and are reported for catalyst load. The extent of combustion instability (COV of IMEP) required to achieve various emissions criteria is swept to evaluate what emissions regulation can be achieved with the current hardware set without NOx after treatment. Results show that operation at best efficiency mixture ratio and combustion phasing is likely sufficient to meet current emissions regulations depending on HC levels. Deviations from best efficiency mapping by a combination of leaner mixture and delayed ignition targeting minimum NOx at 6% COV of IMEP can offer Euro 4 NOx levels without after treatment. This method offers greater than 60% reduction of NOx with respect to best efficiency but is associated with less than a 1.5% fuel economy reduction.



**Thursday, October 10, 09:00-10:00 at Room 201B**

**HCCI II**

Chair: Tomoo Shiozaki (Honda R&D Co., Ltd.), Co-Chair: Roberto Gentili (University of Pisa)

[20139070 / 2013-32-9070]

**A Study of Fuel and EGR Stratification to Reduce Pressure-Rise Rates in a HCCI Engine**

*Kyohei Ozaki, Dong-Won Jung, Norimasa Iida (Keio University)*

Problem of HCCI combustion is knocking due to a steep heat release by the ignition that is occurred in each local area at the same time. It is considered that dispersion of auto-ignition timing at each local area in the combustion chamber is necessary to prevent this problem. One of technique of this solution is to make thermal stratification. It could be made by using two-stage ignition fuel, which has large heat release at low temperature reaction. Dispersion of fuel concentration leads to difference of temperature histories while combustion phasing is dispersed at each local area. Also, EGR gas stratification could make difference of temperature histories at each local area because of that of the characteristics. This study examines the effect of mixing stratification by stratifying the charge of fuel and CO<sub>2</sub>. A single-cylinder engine equipped with optical access was used in experiments, and numerical analysis was executed. This study shows that stratified mixtures of the fuel and EGR gas make differences of the temperature histories at each local area, which results in difference of the combustion phasing at each local area in combustion chamber and reduction of PRR.

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[20139083 / 2013-32-9083]

**Potential of Stratification Charge for Reducing Pressure-Rise Rate in HCCI Engines Based on Multi-Zone Modeling and Experiments by using RCM**

*Shota Ito, Hiroki Ikeda, Dong-Won Jung, Norimasa Iida (Keio University)*

The charge stratification has been thought as one of the ways to reduce the sharp pressure rises of HCCI combustion. The objective of this study is to evaluate the potential of equivalence ratio, initial temperature, and EGR gas stratifications for reducing pressure-rise rate of HCCI combustion. Using rapid compression machine, the stratified pre-mixture is charged, and compressed to analyze the change of in-cylinder gas pressure and temperature traces during compression process. Based on the experiment results, numerical calculations by CHEMKIN are conducted to more specifically analyze the potential of equivalence ratio, initial temperature, and EGR gas stratifications on the reduction of pressure rise rate. Multi-zone model is used to simulate the thermal stratification, fuel stratification and EGR gas stratification of in-cylinder charge as like real engine. Then, the results from multi-zone model are compared with that from single-zone model to clearly verify the effects of three stratifications on pressure-rise rate. The results from comparison between single-zone model and multi-zone model show that EGR gas stratification was the most effective to disperse ignition timing compared to the thermal stratification and fuel stratification when setting the same time differences of ignition timing shown in singlezone model. Among the three stratifications of in-cylinder charge, fuel stratification was the worst to disperse of ignition timing.

**Thursday, October 10, 09:00-10:00 at Room 201C**

**Engine Controls III**

Chair: Takashi Mitome (SUZUKI MOTOR CORPORATION), Co-Chair: Thorsten Raatz (Robert Bosch LLC)

[20139065 / 2013-32-9065]

**Detecting the Misfire of Motorcycle Engine with Wide Band Oxygen Sensor**

*Yameogo Amadou, Chang-Tai Wu, Yu-Cheng Jiang, and Jau-Huai Lu (National Chung Hsing University)*

Use of catalyst in engines has entailed a radical increase in the importance of misfire detection. When a misfire occurs, hydrocarbon emissions will increase and the unburned fuel can damage the catalyst by overheating. On-Board Diagnostics II (OBDII) regulations are still not applied to motorcycle or moped yet. However its application is under discussion in European Union. In Taiwan, OBD is scheduled to be implemented soon. Many strategies of misfire detection have been developed, including variation in engine shaft angular speed, spark plug voltage, cylinder pressure, oxygen sensor signal, knowledge based expert system, and neural networks. WE propose a new method to use the real time signals of a wide band oxygen sensor to detect misfire where, misfire was induced on purpose with a misfire generator. The sensor and the misfire trigger signals were recorded simultaneously. It was found that when a misfire occurs, a spike of sensor signal would follow due to instantaneous variation of the oxygen content in the exhaust flow. This signal was then processed to detect the occurrence of misfire. Results of test show that differentiated signals have good correlation with the misfire trigger. Misfire is detected by monitoring the amplitude of differentiated signals. The scheme has been shown to detect the misfiring condition reliably up to 5000rpm.

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[20139003 / 2013-32-9003]

**FlexFuel Strategy for 2-wheeler**

*Erika Xavier, Ariel Bepu, Martin Leder, Walter Arens (Robert Bosch Ltda)*

Brazilian energetic matrix is based on two fuels: gasoline (E22: 78% pure gasoline + 22% anhydrous ethanol) and ethanol (E100: 93% anhydrous ethanol + 7% water).

A Flex Fuel 2-wheeler (motorcycle) engine management software strategy was developed in order to meet Brazilian market demand based on the energetic matrix mentioned above and a worldwide market forecast growth in the corresponding small engines segment.

As 2-wheeler engine configuration and electric architecture is simpler than passenger cars, a premise was established: to develop a completely new Flex Fuel system for the 2-wheeler segment with functionalities simpler and easier to calibrate than actual concept used for Flex Fuel passenger cars.

This paper presents the result of this study: a Flex Fuel system able to operate with gasoline (E22), ethanol (E100) or any mixture of both fuels with similar behavior in an easy-to-calibrate system.

Thursday, October 10, 09:00-10:00 at Room 201D

**Vehicle Dynamics & Safety I**

Chair: Masayuki Baba (Honda R&D Co., Ltd.), Co-Chair: Brent Dohner (Lubrizol UK)

[20139026 / 2013-32-9026]

**Effects of the Compensated Control of Gradient for the Haptic Throttle Grip**

*Manabu Fujito, Yasunobu Harazono and Kouji Sakai (Yamaha Motor Co., Ltd.)*

Recently, there have been many reports about developing control systems that actuate engines and brakes based on friction circle. We are researching the control system for motorcycles, which adds the return torque of throttle grip based on it for informing the limit of tire grip on the driving wheel. This throttle grip is a haptic display, offers haptic signals by controlling the motor connected to the throttle grip as a HMI. From the results of riding tests, the system was found helpful for riders to control the throttle grip as well as feeling easy about knowing the limit of tire grip. But it is known that the friction circle of a driving wheel depends on the normal force which changes by the gradient of road, acceleration and so on. The compensated control for changing the normal force by gradient was made to improve the throttle grip control system. The results of riding tests with the compensated system, we found that this system is important for the controls based on friction circle and it makes the haptic signals come close to the timing that riders want.

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[20139106 / 2013-32-9106]

**Development of New Concept Two-Wheel Steering System for Motorcycles**

*Tetsuya Kimura, Yusuke Ando, Eiichiro Tsujii (Yamaha Motor Co., Ltd.)*

This paper describes the development of a new concept two-wheel steering system for realizing motorcycle motion control. By considering the whole of the main frame as the rear-wheel steering axis, it was possible to move the rearwheel steering system from the conventional installation position at the rear arm to the head pipe. As a result, the developed two-wheel steering system is both lightweight and compact. This two-wheel steering system was installed in a motorcycle, and starting and stopping tests were carried out with two people riding on the motorcycle. The test results confirmed that the two-wheel steering system is capable of changing the motion characteristics of the motorcycle in actual riding. Furthermore, by calculating the equivalent wheel alignment of this system, this paper also theoretically demonstrates that these changes in motion characteristics are caused by changes in caster and trail.

**Thursday, October 10, 10:30-12:00 at Room 201A**

**Emission III**

Chair: Hiromi Deguchi (SUZUKI MOTOR CORPORATION), Co-Chair: Kai W. Beck (MOT GmbH)

[20139091 / 2013-32-9091]

**1-D Modeling and Experimental Evaluation of Secondary Air Injection system for a Small SI Engine**

*Pratap C Kavekar (TVS Motor CO Ltd)*

In order to comply with the existing emission norms of BSIII in India or EURO III and beyond that also, it is not sufficient to use the catalytic converter technology alone over the wide range of engine operating maps. Different studies across the world have proved that the cost, drivability, operating range against AFR, heat dissipation rate characteristics of catalytic converter limit their use in startup and idling conditions. One common way to tackle this condition is to use the Secondary Air Injection (SAI) system. In this system, small amount of air is injected after the exhaust port to initiate the thermal oxidation of gases. The right amount of air injected at the right time and at right location will reduce the emission by 37-90%. In the following study, SI engine vehicle with single cylinder, 160 cc and having carburetor is used as a test vehicle to evaluate the performance of SAI. The SAI system is modeled in AVL BOOST software and validated against the experimental data. The experimental data is collected at transient condition of IDC (Indian Driving Cycle). SAI system of the same vehicle is modified for different parameters like reed stopper height, SAI outlet pipe length and angle of secondary air injection. In order to avoid the complexity in experiments, DOE technique is used. The optimum parameters of SAI are determined for maximum CO conversion efficiency with uncoated CAT. The combination giving best conversion efficiency is then tested with coated CAT for emission cycle. Model results and the experimental results are compared on the basis of mass flow rate.

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[20139130 / 2013-32-9130]

**A demonstration of emissions' behaviour of various handheld engines including investigations on particulate matter**

*Cécile Favre, John May, Dirk Bosteels (Association for Emissions Control by Catalyst (AECC) AISBL ), Jürgen Tromayer, Gerd Neumann (Graz University of Technology)*

To get an overview of the emission situation in the field of small non-road mobile machinery powered by various types of SI engines, the Association for Emissions Control by Catalyst (AECC), together with the Institute for Internal Combustion Engines and Thermodynamics (IVT) of Graz University of Technology, conducted a customized test program. The main goal for this campaign was to derive information regarding the emissions of regulated gaseous components (following European Directive 97/68/EC) as well as particulate matter. With regard to the big variety of different engines that are available on the European and North-American market, the most representative ones had to be chosen. This resulted in a pool of test devices to cover different engine working principles (2-Stroke and 4-Stroke), technological standards (low-cost and professional tools) and different emissions control strategies (advanced combustion and exhaust gas aftertreatment). The test results illustrate a wide range of emissions' behaviour depending on engine technologies and testing conditions and can serve as a database of in-field emissions of small handheld applications. Particulate matter emissions were also measured in terms of mass and number and their chemical composition was evaluated via Thermo-Gravimetric Analysis of the PM deposit.

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[20139150 / 2013-32-9150]

**Physical Characterization of Biodiesel Particle Emission by Electron Microscopy**

*Preechar Karin, Yutthana Songsaengchan (King Mongkut's Institute of Technology Ladkrabang), Songtam Laosuwan, Chinda Charoenphonphanich (King Mongkut's Institute of Technology Ladkrabang), Nuwong Chollacoop (National Science and Technology Development Agency), Katsunori Hanamura (Tokyo Institute of Technology)*

Nanostructures of diesel and biodiesel engine particulate matters (PMs) were investigated by using a Transmission Electron Microscopy (TEM). The average single particle sizes of biodiesel and diesel PMs are approximately 30-40 nm and 50-60 nm, respectively. Image processing process was used to estimate each carbon platelet length by using TEM image. The average carbon platelet length of biodiesel and diesel PMs are in the range of 0.1-7.0 nm. Moreover, carbon atoms per cubic volume of PMs are approximately 500-900. The result shows that engine load and fuel property are strongly impact on the size of single particle and carbon atom density of particle. This is one of interesting behaviors need to be investigated for better understanding. The results of this research would be used as basic information for design and develop removing process of PM emitted from engine combustion which using in diesel and biodiesel fuels.

Thursday, October 10, 10:30-12:00 at Room 201B

### HCCI III

Chair: Tomoo Shiozaki (Honda R&D Co., Ltd.), Co-Chair: Brian Callahan (Achates Power & Basco)

[20139069 / 2013-32-9069]

#### **Closed-Loop Combustion Control of a HCCI Engine with Re-breathing EGR System**

*Yusuke Nakamura, Dong-Won Jung, Norimasa Iida (Keio University)*

This study experimentally investigates the control system and the algorithm after constructing a HCCI combustion control system for the development of a small HCCI engine fuelled with Dimethyl Ether (DME). This system can control four throttles for the mixing ratio of three gases of in-cylinder (stoichiometric pre-mixture, hot EGR gas and cold EGR gas). At first, the combustion behavior for combustion phasing retarded operation with cold and hot EGR was examined. Then, the potential of model-based and feed back control for HCCI combustion with change of the demand of IMEP was investigated. In the end, the limit of combustion-phasing retard for IMEP and PRR was explored. Results shows that to get high IMEP with acceptable PRR and low coefficient of variation of IMEP, crank angle of 50% heat release (CA50) should be controlled at constant phasing in the expansion stroke. CA50 can be controlled by changing the ratio of pre-mixture, hot EGR gas and cold EGR gas with throttles. Due to the cycle-to-cycle variation, the change of total mass of fuel in cylinder has a big effect on IMEP. After misfire, unburned fuel and intermediates remain in exhaust gas, which is re-breathed as hot EGR gas, and unburned fuel and intermediates are supplied to next cycle. This leads to the total mass of fuel...

[20139171 / 2013-32-9171]

#### **A Study of Supercharged HCCI Combustion using In-cylinder Spectroscopic Techniques and Chemical Kinetic Calculation**

*Yasuhide Abe, Yuma Ishizawa, Go Emori, Mitsuo Asanuma, Akira Iijima, Hideo Shoji (Nihon University), Kazuhito Misawa, Yusuke Kiguti, Hiraku Kojima, Shunichi Mori, Kenjiro Nakama (SUZUKI MOTOR CORPORATION)*

A great deal of interest is focused on Homogeneous Charge Compression Ignition (HCCI) combustion today as a combustion system enabling internal combustion engines to attain higher efficiency and cleaner exhaust emissions. Because the air-fuel mixture is compression-ignited in an HCCI engine, control of the ignition timing is a key issue. Additionally, because the mixture ignites simultaneously at multiple locations in the combustion chamber, it is necessary to control the resultant rapid combustion, especially in the high-load region. Supercharging can be cited as one approach that is effective in facilitating high-load operation of HCCI engines. Supercharging increases the intake air quantity to increase the heat capacity of the working gas, thereby lowering the combustion temperature for injection of the same quantity of fuel. In this study, experiments were conducted to investigate the effects of supercharging on combustion characteristics in an HCCI engine. Light emission and absorption spectroscopic measurement techniques were used to investigate the combustion behavior in detail. Chemical kinetic simulations were also conducted to analyze the reaction characteristics in detail. The results made clear that the raising the intake air pressure under a condition of a constant quantity...

[20139172 / 2013-32-9172]

#### **Evaluation of the Performance of a Boosted HCCI Gasoline Engine with Blowdown Supercharge System**

*Shunsuke Gotoh, Tatsuya Kuboyama, Yasuo Moriyoshi (Chiba University), Koichi Hatamura (Hatamura Engine Research Office), Toshio Yamada (IDAJ Co., LTD.), Junichi Takanashi, Yasuhiro Urata (Honda R&D Co., LTD.)*

HCCI combustion can realize low NO<sub>x</sub> and particulate emissions and high thermal efficiency. Therefore, HCCI combustion has a possibility of many kinds of applications, such as an automotive powertrain, general-purpose engine, motorcycle engine and electric generator. However, the operational range using HCCI combustion in terms of speed and load is restricted because the onset of ignition and the heat release rate cannot be controlled directly. For the extension of the operational range using either an external supercharger or a turbocharger is promising. The objective of this research is to investigate the effect of the intake pressure on the HCCI high load limit and HCCI combustion characteristics with blowdown supercharging (BDSC) system. The intake pressure ( $P_{in}$ ) and temperature ( $T_{in}$ ) were varied as experimental parameters. The intake pressure was swept from 100 kPa (naturally aspirated) to 200 kPa using an external mechanical supercharger. The experimental results showed that the maximum load successfully increased with increasing the intake pressure. The highest load in this study was 935kPa in IMEP<sub>g</sub> at the condition of 200 kPa in  $P_{in}$  and 32 °C in  $T_{in}$ . The maximum load of boosted BDSC-HCCI engine can be achieved comparable to the full load of naturally aspirated SI engine. In addition, for conditions with above 200 kPa in  $T_{in}$ , A/F and G/F could be almost the same. The comparison of heat release rate between with and without BDSC showed that the peak value of heat release rate decreased...

**Thursday, October 10, 10:30-12:00 at Room 201C**

#### **Engine Controls IV**

Chair: Bo-Chiuan Chen (National Taipei University of Technology), Co-Chair: Thorsten Raatz (Robert Bosch LLC)

[20139007 / 2013-32-9007]

#### **A 5cm square gasoline Engine Controller based upon an advanced System in Package semiconductor device**

*Garrard M. (Freescale Semiconductors UK), Edwards, W (Freescale Semiconductors Inc.)*

Affordability is key when it comes to applying fuel injection to small engines. Existing designs from Freescale are quite sophisticated: a more affordable approach was needed to hit the price point required for the automotive applications in India and China, and the tools market.

Work has been undertaken to reduce the entry cost to fuel injection. The system content has been analysed and optimised, along with the semiconductor content required to drive the engine. A new Engine Control Unit reference design has been developed, cost comparable to a d.c. Capacitor Discharge Ignition module. It has been verified on a leaf blower motor and 160cc motorcycle.

This paper describes the system and semiconductor content of the ECU. A dual die System in Package (SiP) semiconductor device was developed and the rationale is described concerning cost, reliability, and test. The board design is described including layout, track placement, and grounding required to package the 370V 10A spark output next to a 5V microcontroller with 1mV sensitivity on the analog inputs. Design choices and rules to reduce board cost and increase manufacturing yield are covered. The result is a cost effective 5cm square microcontroller based fuel injection ECU reference design.

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[20139020 / 2013-32-9020]

#### **Thermal Optimization Process for Small Engine Control Units**

*Christian Schweikert, Marco Nicolò, Dirk Schweitzer (Infineon Technology AG, Germany), David Witt (Infineon Technologies, North America)*

The Engine Control Unit (ECU) for small engines is facing challenges with regard to performance, size and cost. In many instances, the customer requirements often contradict each other. Examples include higher performance at lower cost or smaller size, both of which can cause thermal challenges. In order to meet varying performance requirements in a platform approach, the ECU must provide a wide range of functionality. Providing a solution that can meet these flexible requirements will result in an increased component count and larger ECU size. An optimized feature set in the right package can help alleviate these issues. The ECU must be impervious to a wide range of environmental conditions, such as temperature, humidity and vibration. Restricted air flow must also be considered when designing an ECU. Existing approaches often apply the use of large aluminum housings to provide a strong mechanical support with good thermal performance. As the market pushes for lower cost solutions, housing materials are being evaluated as cheaper alternatives become available. Alternative housing materials will drive the electronics design to either reduce the power dissipation or improve thermal performance.

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[20139094 / 2013-32-9094]

#### **Implementation of Software and Hardware solutions for battery-less systems**

*Marco Cortecchia, Claudio Gonella (Mectronik s.r.l.)*

The modern market of small engines requires low-cost solutions compatible with anti-pollution regulations. On applications without electric starter it is possible to remove the battery, but hardware and software aspects must be investigated and special solutions implemented. The main problems occur during engine fire-up (engine start), because using kick-start, only a little bit more than one engine cycle is possible for a single kick. The second aspect is that no energy is available before the crank shaft is moving, and the generator is able to supply energy to the electrical systems. Our target is to implement solutions able to start-up the ECU very quickly, ensure low consumption, and be ready to recognize engine position in the shortest possible time.

Thursday, October 10, 10:30-12:00 at Room 201D

**Vehicle Dynamics & Safety II**

Chair: Masayuki Baba (Honda R&D Co., Ltd.), Co-Chair: Robert Kee (Queen's University Belfast)

[20139165 / 2013-32-9165]

**Development of Technology for Measuring Dynamic Deformation of Motorcycle Bodies**

*Yasushi Nakamura, Kazuhiro Ichikawa, Takumi Kawasaki, Yasuhisa Okabe, Hiroshi Ishii, Akiyuki Yamasaki (Kawasaki Heavy Industries, Ltd.)*

In this study, a technology for measuring dynamic deformation of motorcycle bodies in running is developed. The deformation has significant association with the maneuverability and stability of motorcycles. The developed system by combining the numerical simulation and the measurement of strains enable application of the measurement of dynamic deformation of motorcycles. This paper reports technical details of the system and measurement results of dynamic deformation of motorcycle bodies.

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[20139173 / 2013-32-9173]

**Evaluation of Injury Risks and Benefits of a Crush Protection Device (CPD) for All-Terrain Vehicles (ATVs)**

*John W. Zellner, Scott A. Kebschull, R. Michael Van Auken (Dynamic Research, Inc.)*

An updated evaluation of the effects on predicted injuries of an example crush protective device (CPD) proposed for application to All-Terrain Vehicles (ATVs) is described. As in previous evaluations, this involved extending and applying the test and analysis methods defined in ISO 13232 (2005) for motorcycle impacts, to evaluate the effects of the example CPD in a sample of simulated ATV overturn events. Updated modeling refinements included lowering the energy levels of the simulated overturn events; accounting for potential mechanical/ traumatic (compressive) asphyxia mechanisms; refining and calibrating the force-deflection characteristics of helmet, head, legs and soil so as to reduce potential over-prediction of head and leg injuries; and calibrating the simulation against aggregated injury distributions from actual accidents. Approximately 3,080 computer simulations were run, and the results indicated that, for the simulation sample and in comparison to the helmeted baseline ATV, addition of...

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[20139175 / 2013-32-9175]

**Testing of ABS Systems for 2-Wheelers via Hardware-in-the-Loop Technology**

*Steven Shenker, Rosana Yamasaki, Tobias Kreuzinger (ETAS K.K., Japan)*

In recent years, driving safety systems such as Anti-Lock Brake Systems (ABS) can be found more and more as standard components in 2-wheeler applications. As these safety critical systems are produced in large numbers, it is of highest interest to keep production and development cost at a minimum on one hand and provide best reliability of the system on the other. In order to attain these cost and quality objectives, hardware-in-the-loop (HIL) technology provides excellent opportunities for test and validation. This paper presents a HIL testing framework for 2-wheeler ABS systems which is optimized in terms of cost and usability for test engineers. The setup comprises an ABS Electronic Control Unit (ECU) for 2-wheelers, a single PC ETAS LABCAR system with hardware I/O boards and LABCAR Operator as software package for real time configuration and control of the entire system. Finally, a simulated vehicle model was ...

**Thursday, October 10, 10:30-12:00 at Room 201E**

**NVH Technology**

Chair: Tadao Okazaki (LEMA / Kubota Corporation), Co-Chair: Roland Kirchberger (Graz University of Technology)

[20139001 / 2013-32-9001]

**Application of Novel Micro-Grooved Elements to Small Engine Silencer**

*Fabio Auriemma, Hans Rämmal, Jüri Lavrentjev (Tallinn University of Technology)*

Micro-grooved elements (MGEs) represent a novel technology developed for noise control in automotive, aerospace and room acoustics. The key concept of the MGEs is based on the use of micro-grooved layers forming micro-paths where the energy dissipation of the acoustic waves is primarily originated by viscous friction.

Composed of a multi-layer fiber-less material, the MGEs represent a potential alternative to the traditional fibrous material based solutions as well as to the increasingly popular micro-perforated elements (MPEs). MGEs are designed as cost effective elements, found to be suitable for substitution of fibrous materials, typically present in silencer units. In this paper, a design procedure for a fiber-less small engine silencer based on MGEs is presented and experimentally validated. Hereby, the acoustical performance of the MGEs has been modeled by adapting the theoretical models provided by Allard and Maa for rectangular and circular ducts. The simulated impedance and absorption coefficient of a MGE have been compared to the experimentally determined data by following the classical twoport approach. The absorption coefficients of micro-grooved sample and micro-perforated element have also been analyzed in comparison. As the first practical noise control implementation of the MGEs the novel acoustic panels have been utilized in a Formula SAE racecar silencer. In this silencer the MGEs are designed to acoustically behave as locally reacting surfaces. The use of the MGEs is believed to provide the reduction in soot contamination that typically occurs in silencers with micro-perforated internal ducts. This paper also provides an overview of several silencer configurations equipped with MGEs, tested, together with the results in terms of transmission loss (TL), absorption and reflection coefficients.

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[20139148 / 2013-32-9148]

**The trial to quantify the feeling of sound & vibration ("Kodo-kan") for the Motorcycle**

*Kenta Suzuki, Hitoshi Uchida, Shogo Kida, Tsutomu Sonehara, Keisuke Namekawa (SUZUKI MOTOR CORPORATION)*

It has become clear that a motorcycle rider regards the sound and vibration which occurs from a motorcycle as a feeling of a "Kodo-kan" which is not unpleasant and becomes a part of comfortable nature. In this paper, the physical quantity relevant to a feeling of a beat was extracted from the sound and oscillating measurement data of an idling state for the purpose of quantification of the feeling evaluation of a "Kodo-kan" of the motorcycle, and the feeling evaluation score prediction of a beat was tried from the physical quantity.

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[20139164 / 2013-32-9164]

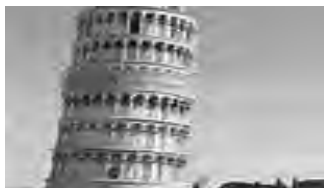
**Development of Intake Sound Control Technique for Sports-Type Motorcycles**

*Kenta Matsubara, Noritaka Nakamura, Yota Katsukawa, Kenichi Furuhashi (Kawasaki Heavy Industries, Ltd.)*

Engine sound is one of the most important factors when selecting a motorcycle from various models. Therefore, it is necessary to create an appealing sound in the rider's ears in addition to complying with noise regulations. In this paper, how we control intake sound is described through the study of a sports-type motorcycle with an inline 4 cylinder engine. To control intake sound, both intake pressure pulsations generated by the engine and acoustic transfer characteristics of the intake system are important. It is shown by unsteady-state one-dimensional computational fluid dynamics analysis that specifications of the exhaust system affect intake pressure pulsations across the valve overlap period. Therefore, to emphasize high order components of the engine revolutions in the intake sound, for example, modifying the layout of the exhaust muffler is effective. Next, acoustic transfer characteristics from the air cleaner box to the rider's ears of the motorcycle are investigated by acoustic tests based on the reciprocity principle. We try tuning these acoustic transfer characteristics by controlling resonance in the air cleaner box by means of finite element analysis. And, it is illustrated experimentally that the sound in the rider's ears is created as intended by modifying the air cleaner box. As a result, it is shown that intake sound can be designed effectively by the proposed method.



# SETC2014 CALL FOR PAPERS



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- HCCI
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- Vehicle Dynamics & Safety
- Vehicle Components

Papers/presentations should be applications oriented, contribute to state-of-the-art technology with conclusions supported by technical data, and be devoid of commercialism. Authors should prepare their papers in hard metric (SI) units. No paper is accepted without a presentation.

Prospective authors are asked to submit electronic abstracts of 300-500 words for consideration including a tentative paper title, author(s) name(s), mailing address, e-mail address, telephone and fax numbers. In addition, each abstract should:

- State the main conclusions of the proposed paper.
- Summarize the process by which the conclusions were reached.
- State the significance of the work to the progress of relevant engineering areas.
- Indicate whether the paper has ever been presented before.

Abstracts are to be submitted on-line via the SAE website: [www.sae.org/setc](http://www.sae.org/setc) . Upon submission, you will receive an automatic reply with your paper offer number.

Important deadline dates:

- Abstracts – March 3, 2014
- Draft Manuscripts – May 1, 2014
- Final Papers - September 2, 2014

For more information, please contact:

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Program Developer  
724-772-8517  
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# TAIPEI INFORMATION

## INTRODUCTION

The city is situated in a basin in northern Taiwan that was inhabited by aboriginal people until settlers from China moved into the area about 300 years ago. Eastern Taipei was largely underused fields until the nineteen-seventies, when the city began to develop the area as a financial and commercial district. Here, the modern face of Taipei shines through, with its glass and steel skyscrapers, wide boulevards, and the world's tallest building, Taipei 101.

Taipei also boasts dozens of world-class performance venues, where you can enjoy world-class theater and concert events. The city also offers a wide range of other diversions -- shopping malls, nightclubs, live-music bars, quality hotels, and exotic restaurants.

## PUBLIC TRANSPORTATION

### Taipei Mass Rapid Transit System (MRT)

The system operates according to a spoke-hub distribution paradigm, with most rail lines running radically outward from central Taipei.

- Operation Hour: Daily from 6AM to midnight; extended services during special events.
- Frequency: 1.5 to 15 minutes intervals depending on the line and time of day.
- Fare:
  - ◎ "Single-journey Ticket for Cyclists" costs NT\$80 valid for one person with a single bicycle.
  - ◎ "One-day Pass" costs NT\$150 with unlimited travel within one day; can be purchased from a service booth.

*See page 72 for Taipei Metro Map.*

### City Bus

Taipei City Bus operates daily from 6AM to midnight with extended services during special events.

Learn more about Taipei Bus routes and schedules at <http://www.taipeibus.taipei.gov.tw/TPBUS.aspx?lang=eng>

## Sightseeing in Taipei



### SHILIN NIGHT MARKET

is the one of the largest night markets in Taipei. Shilin Market is famous for various snacks and eatery. Many visitors have come to Shilin Night Market to enjoy the delicious foods, such as large pancake enfolding small pancake, hot pot on stone or Shilin sausage. Shilin Night Market has become a renowned place for great foods.

**Address:** Between end of Wenlin Rd., Jihe Rd. and Zhongshan N. Rd.

**MRT:** Take the MRT and exist at the Jiantan Stop.



### GUANGHUA MARKET

is the place to go in Taipei for computer equipment and other electronic gadgets, with over a hundred shops selling the high-tech items. In addition to computers and other electronic peripherals, the market also sells branded sportswear and athletic gear, DVDs and CDs, posters, PC and console games, books, stereo equipment, mobile phones and more. The market is known for its wide variety, low prices and convenient comparison shopping, making it a magnet for budget-minded student shoppers.

**Address:** No.77, Jinshan N. Rd., Jhongjheng District, Taipei City

**MRT:** Take the MRT and exist at Zhongxiao Xinseng Station (Exit 1) then walk about 5 minute towards Civic Blvd.



### THE NATIONAL PALACE MUSEUM

houses the world's largest collection of priceless Chinese art treasures, one which spans China's nearly 5,000-year history. Most of the museum's 620,000 art objects were part of the Chinese imperial collection, which began over 1,000 years ago in the early Song dynasty.

**Address:** No.221, Sec. 2, Zhishan Rd., Shilin District, Taipei City

**MRT:** Take the MRT to the Shilin Station and take bus R30 (Red 30) to the National Palace Museum.



### CHIANG KAI-SHEK MEMORIAL HALL

is located in the heart of Taipei City. The area is 250,000 square meters and it is the attraction most visited by foreign tourists. Outside the gate of Chiang Kai-shek Memorial Hall, there are poles carrying the sign of true rightness. The architecture of Chiang Kai-shek Memorial Hall is inspired by Tientam in Beijing. The four sides of the structure are similar to those of the pyramids in Egypt.

**Address:** No.21, Zhongshan S. Rd., Zhongzheng District, Taipei City

**MRT:** Take the MRT and exist at CKS Memorial Hall (Exit 5).



### LONGSHAN TEMPLE

is a famous old temple in Taiwan for worshipping Guanshiyin Buddha and other divine spirits. Its architecture is a three-section design in shape built in Qianlong 5th year in Qing Dynasty. On each 1st and 15th day each month of lunar year, regular visitors will come to the temple for worship ceremony. Longshan Temple is not only a temple, a sightseeing attraction, but also a second-degree historical site.

**Address:** No. 211, Guangzhou St., Wanhua District, Taipei City

**MRT:** Take the MRT and exist at Longshan Temple Station.



### TAIPEI 101

, with a mass of shops on the lower floors, incorporating many top brands under the LVMH group, such as Louis Vuitton, Dior, Celine, etc. The fourth floor houses the Page One bookstore from Singapore, with the highest-roofed coffee house in Taipei and many fine restaurants.

**Address:** 89F, No. 7, Sec. 5, Xinyi Rd., Xinyi District, Taipei City

**MRT:** Take the MRT and exist at Taipei City Hall Station then walk about 5 minute towards Xinyi Shopping District.



### MAOKONG GONDOLA

is located in the southern tip of Taipei City, and the system began operation in July 2007. Since then it has evolved into a favorite tourist destination for locals and visitors. It is Taipei City's first high-altitude gondola. This French POMA-made system makes a circuit of four stations: Taipei Zoo Station, Taipei Zoo South Station, Zhinan Temple Station, and Maokong Station.

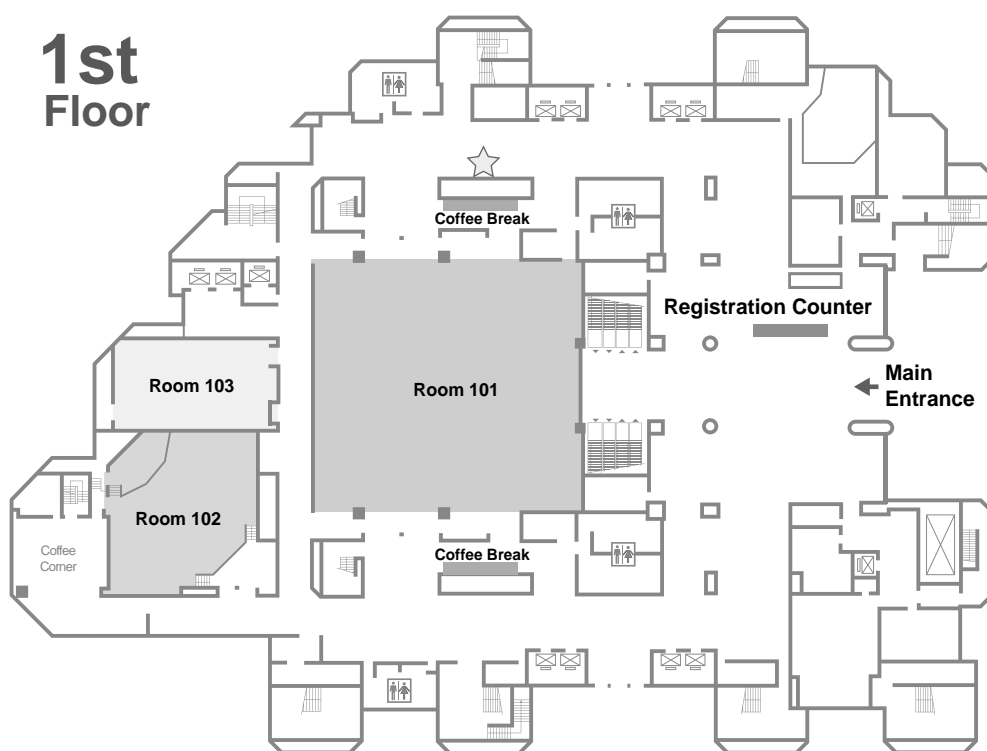
**Address:** Sec. 2, Xinguang Rd., Wenshan District, Taipei City

**MRT:** Take the MRT and exist at Taipei Zoo.

## TAIPEI METRO MAP



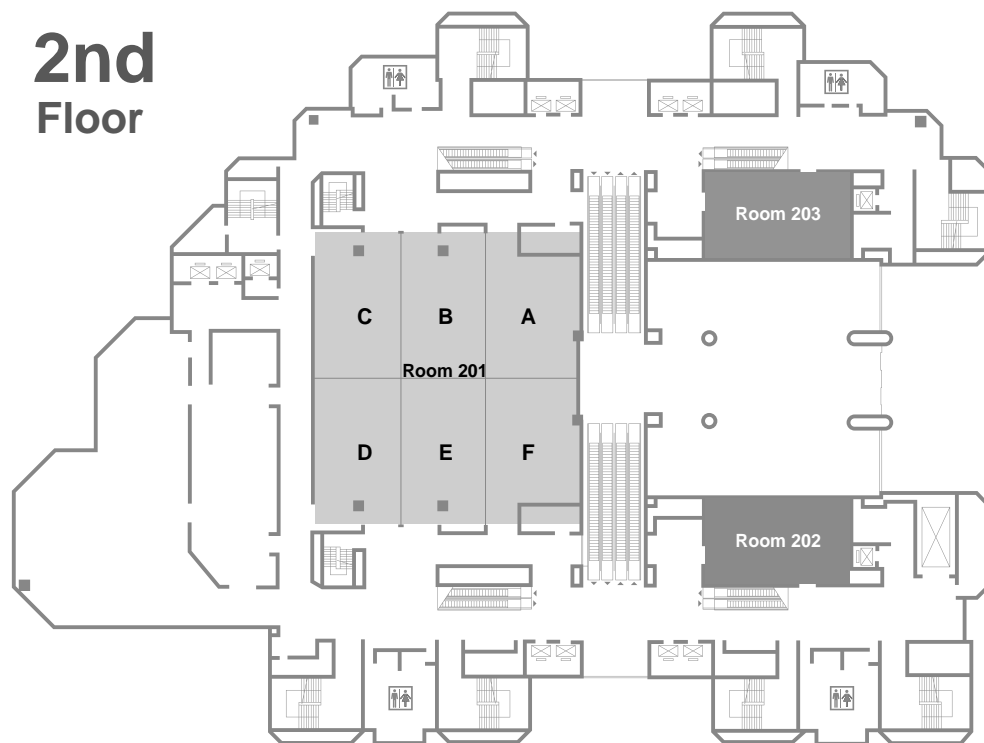
# FLOOR PLAN



- **Room 101** Exhibition
- **Room 102** Plenary Session / Technical Session
- **Room 103** Technical Session

☆ Poster Session

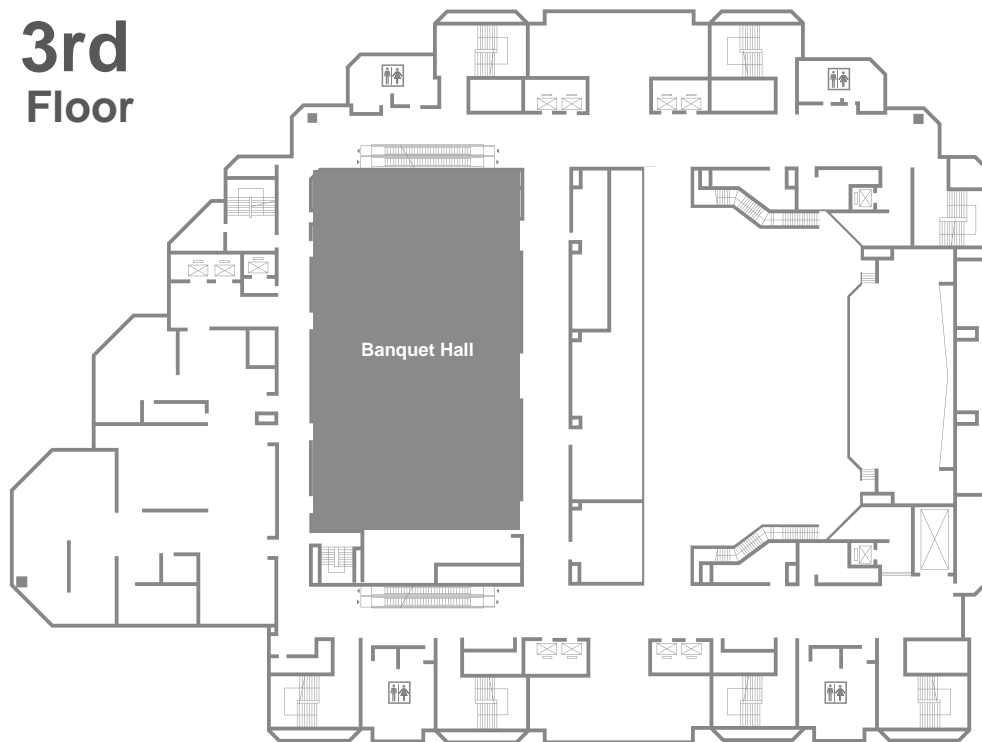
## 2nd Floor



- **Room 201** Opening Ceremony & Keynote Speech(BCDE)/ Technical Sessions
- **Room 202** Secretariat Room
- **Room 203** Preview Room/ Internet Room



## 3rd Floor

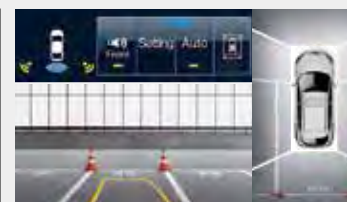


- **Banquet Hall** Banquet / Lunch / Closing Ceremony



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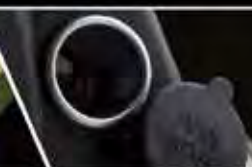
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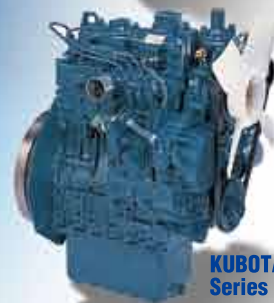
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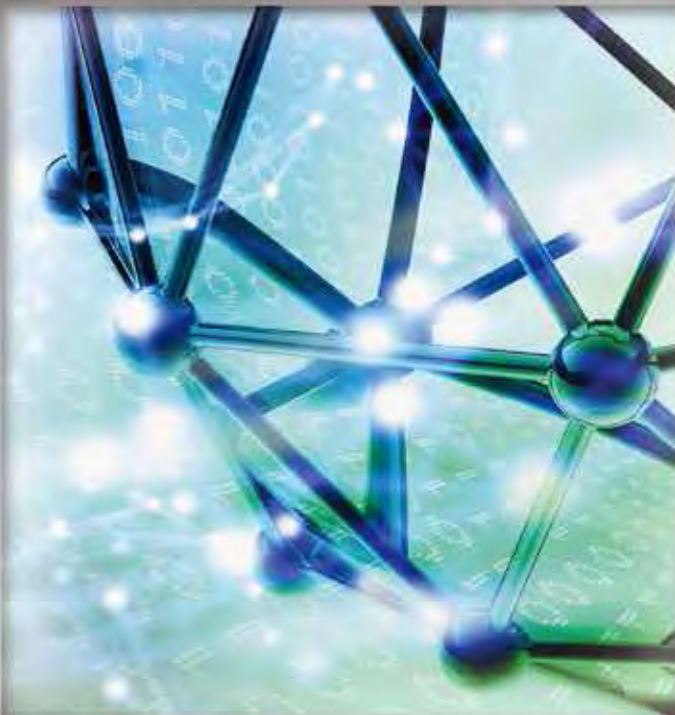
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# SCSK

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