

Abstracts of Technical Sessions

1. Date Tuesday, November 17
 2. Room. 1005
 3. Time 11 : 00 - 12 : 00
 4. Session Lubricants
 5. Chair (Affiliation), Tohru Nakazono (LEMA / YANMAR Co., Ltd.)
 Co-chair (Affiliation) Brent Dohner (The Lubrizol Corporation)

6. Paper No.(JSAE/SAE)	20159708 / 2015-32-0708
7. Paper title	Unique Needs of Motorcycle and Scooter Lubricants and Proposed Solutions for More Effective Performance Evaluation
8. Authors (Affiliation)	Michael J Marcella (The Lubrizol Corporation)

9. Abstract

The operating conditions of a typical motorcycle are considerably different than those of a typical passenger car and thus require an oil capable of handling the unique demands. One primary difference, wet clutch lubrication, is already addressed by the current JASO four-stroke motorcycle engine oil specification (JASO T 903 : 2011). Another challenge for the oil is gear box lubrication, which will be addressed in part with the addition of a gear protection test in the proposed 2016 revision to the JASO specification. A third major difference between a motorcycle oil and passenger car oil is the more severe conditions an oil is subjected to within a motorcycle engine, due to higher temperatures, engine speeds and power densities.

Scooters, utilizing a transmission not lubricated by the crankcase oil, also place higher demands on an engine oil, once again due to higher temperatures, engine speeds and power densities. However, because scooter oils do not need to lubricate a wet clutch or protect gears, scooter oils can provide more fuel economy benefits than motorcycle oils, when properly formulated.

This study compares the piston deposit performance of motorcycle oils and passenger car oils in the API Sequence III Test and in a fired-engine motorcycle piston deposit evaluation. While the API Sequence III Test is certainly an effective tool for ensuring passenger car motor oil piston deposit performance, the results show that some oils formulated to meet the needs of the Sequence III test do not match the performance of motorcycle-specific oils in a motorcycle piston deposit evaluation....

6. Paper No.(JSAE/SAE)	20159764 / 2015-32-0764
7. Paper title	Additive Technology for Superior and Unique Motorcycle Oil (SUMO)
8. Authors (Affiliation)	Pei Yi Lim (Infinium Singapore Pte Ltd.)

9. Abstract

In a market survey conducted in 2010 on major South East Asian cities, motorcycle users identified some of the most valued oil features being clutch friction, durability and engine cleanliness. In the fast growing motorcycle markets of Asia where motorcycles are used mainly for daily transportation needs, there are enormous opportunities for motorcycle oils delivering differentiated attributes that provide superior reliability to the end users. It was with this market perspective that this new additive technology was developed.

The additive technology was developed based on a unique set of components and formulation approach to meet the lubrication challenges of motorcycles, particularly its high shear and temperature conditions. In a forward-looking standpoint, the development was aligned to the current energy conservation and environmental trends in the personal mobility oil segment. Hence, the technology was formulated in SAE 5W-30 with an opportunity for fuel economy credits from the lower viscometrics. The additive was also developed in the lower phosphorous range of the JASO specification to be positioned as a lower SAPS catalyst compatible additive. With the lower phosphorous and viscosity grade, durability trade off was a concern. However, the additive technology demonstrated excellent durability performance, as shown from results in the modified FZG Pitting Test, extended JASO T903 Friction Test, API SN demonstration program (with extended Sequence IVA) and a field test in Thailand. In addition to durability, the additive technology also showed excellent engine cleanliness and sludge control performance. The results of this extensive performance evaluation activity will be presented in detail in this paper....



Abstracts of Technical Sessions

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| 1. Date | Tuesday, November 17 |
| 2. Room. | 1006 |
| 3. Time | 11 : 00 - 12 : 00 |
| 4. Session | Engine Controls I |
| 5. Chair (Affiliation), | Yutaka Nitta (SUZUKI MOTOR CORPORATION) |
| Co-chair (Affiliation) | Roland Kirchberger (Graz University of Technology) |

6. Paper No.(JSAE/SAE)	20159788 / 2015-32-0788
7. Paper title	Application of Adaptive Idle Speed Control on V2 Engine
8. Authors (Affiliation)	Jie Yin, Yong Fu Syu, Bo Chiuan Chen, Yuh Yih Wu (National Taipei University of Technology), Yao Chung Liang, Hsien-Chi Tsai (Hua-Chuang Automobile Information Technical Center)

9. Abstract

This paper develops an adaptive idle speed control strategy for a V2, 1000 cc four-stroke, water-cooled, port injection SI engine. In order to verify the proposed strategy, the non-dimensional engine model including charging and torque dynamics is established in Matlab/Simulink software based on previously experimental verification. The integration of dynamics above will be a multi-input-single-output (MISO) system, which inputs are throttle angle and spark advance angle, and the output is engine speed. The proposed adaptive controller is developed on the model-based structure. The system parameters are updated by recursive least square (RLS) method so the system is able to represent the actual operation. The updated system parameters adjust control gain by derivation of closed-loop gain and pole placement. This research also applies RLS method in torque load identification, and uses feedforward control module to calculate the desired throttle opening for the corresponding engine torque. The feedforward throttle control makes controller less angle of spark advance, therefore, the tracking time could be reduced. In order to verify the proposed adaptive idle speed controller performance, the conventional proportional integral derivative (PID) idle speed controller is established. The results show the proposed feedforward adaptive controller can obviously improve about 40% of tracking time with ramps load. In addition, when the water pump load is added, the proposed strategy can also improve about 20%. Finally, the results of the proposed strategy are also improved comparing to the conventional PID control as deposits happen.

6. Paper No.(JSAE/SAE)	20159749 / 2015-32-0749
7. Paper title	Online Engine Speed Based Adaptation of Combustion Phasing and Air-Fuel Ratio : Evaluation of Feature Quality
8. Authors (Affiliation)	Henning Heikes, Geetesh Gadkari, Christian Steinbrecher, Christian Linder, Martin Loehning, Wolfgang Fischer (Robert Bosch GmbH)

9. Abstract

In the Indian two-wheeler market, legislation and customers demand for a reduction of emissions and an increase of fuel efficiency. For two-wheelers with engine management systems, a cost-efficient approach for this trend exploits that the periodical fluctuation of the engine speed of single cylinder engines contains useful information about its operating conditions. The present article focuses on the quality of the estimation of combustion phasing and air-fuel ratio of a 125 cc single cylinder motorcycle engine, obtained from the evaluation of these fluctuations.

The robustness of an oxygen sensor-less port fuel injection system can be increased by using the estimated air-fuel ratio to adapt the parameters of the fuel injection algorithm. The investigations have been carried out only on one bike so far, and have indicated the following accuracies : with the implemented resource optimized algorithm the combustion phasing can be estimated up to $\pm 5^\circ$ ca accurate with a good reproducibility even after long term operation on a chassis dynamometer. The observed influence of engine temperature was insignificant. The air-fuel ratio feature showed an accuracy of about $\pm 3\%$ in a wide operating range for lambda values smaller than 1.05.

Furthermore it is shown that reaching Indian emission legislation Bharat Stage 4 with a PFI system relying only on feed forward control of the air-fuel ratio is possible.



Abstracts of Technical Sessions

1. Date	Tuesday, November 17
2. Room.	1007
3. Time	11 : 00 - 12 : 00
4. Session	Two Stroke Engine I
5. Chair (Affiliation),	Yuh Motoyama (Yamaha Motor Co., Ltd.)
Co-chair (Affiliation)	Pierre Duret (IFP Energies Nouvelles)

6. Paper No.(JSAE/SAE)	20159702 / 2015-32-0702
7. Paper title	CFD Modelling of a Two Stroke Engine to Predict and Reduce Short Circuit Losses
8. Authors (Affiliation)	Manish Garg, Davinder Kumar, Madani Syed (TVS Motor Company), Siva Nageswara (CD-adapco)

9. Abstract

One of the major reason for lower efficiency and higher unburned hydrocarbon and carbon monoxide emission for two stroke engine is short circuit losses during the scavenging process. An attempt has been made in this study to understand and improve this phenomenon. A three dimensional transient CFD model is developed for a loop scavenged, Schnuller type, 70 cc two stroke engine. Three major processes, namely, blow down (expansion); scavenging and compression have been modelled. The model is validated with PIV measurement done in motoring mode. Model is also validated with experimental data for trapping efficiency with Watson method and for in-cylinder pressure during expansion, blow down and intake events. A good correlation is observed between experimental and simulation results. CFD model is used to quantify various parameters, such as, delivery ratio, trapping efficiency, scavenging efficiency, and amount of fresh mass short circuit at different load and speed points. Around 20 to 25% short circuit losses are observed at all the load cases analyzed. The mechanism for this short circuit loss is understood with the help of a passive scalars based visualization method. Two major root causes identified are, port design and exhaust pressure wave dynamics. Three different designs of ports are analyzed. With the best design, the short circuit loss is reduced by 12%. Same design has been tested on a chassis dynamo-meter, that resulted into a reduction of 10% in HC (hydro-carbon) emission in a mass emission test on a drive cycle and 10% to 25% improvement in WOT (wide open throttle) wheel force in mid and higher speed operating points.

6. Paper No.(JSAE/SAE)	20159716 / 2015-32-0716
7. Paper title	Quantification of Short-Circuiting and Trapping Efficiency in a Small Internal Combustion Engine by GC-MS and GC-TCD
8. Authors (Affiliation)	Joseph Karl Ausserer, Kevin P. Horn, Marc D. Polanka (Air Force Institute of Technology), Paul J. Litke (Air Force Research Laboratory), Keith D. Grinstead Jr. (Innovative Scientific Solution Incorporated)

9. Abstract

Loss mechanisms in 1-10 kW spark-ignition, two-stroke engines may be grouped into five categories : thermal losses, frictional losses, sensible enthalpy in the exhaust gases, incomplete combustion, and short-circuiting of fresh fuel and air mixture. These loss mechanisms cause small two-stroke engines to have fuel conversion efficiencies 50%-70% lower than similar larger engines. Previous studies of loss scaling in small engines have estimated the short-circuiting using heuristics derived for larger engines or grouped it with other combustion losses to complete the energy balance. This work describes and compares two methods for measuring short-circuiting on a commercially available, two-stroke, naturally aspirated, spark ignition engine with 55 cm³ displacement. One method used oxygen as an analyte (the Watson method), nitrogen as an internal standard, and gas chromatography with a thermal conductivity detector for quantification. While the Watson method is historically proven, it only works under globally rich combustion conditions. The other method, selected for its potential to work under lean combustion conditions, used iso-octane as an analyte, argon as an internal standard, and gas chromatography for separation with mass spectrometry for identification and quantification. The iso-octane method yielded results within 4% of the Watson method, a difference that is statistically indistinguishable at the 95% confidence level. Therefore, despite the larger uncertainty of the iso-octane method (10%-15% versus 3%-5% for Watson's method), the iso-octane method offers a valid method for determining short-circuiting under lean combustion conditions.



Abstracts of Technical Sessions

1. Date Tuesday, November 17
 2. Room. 1008
 3. Time 11 : 00 - 12 : 00
 4. Session Fuel Supply Systems I
 5. Chair (Affiliation), Hideyuki Okumura (JMIA/Yamaha Motor Co., Ltd.)
 Co-chair (Affiliation) Tony Szczotka (Robert Bosch LLC)

6. Paper No.(JSAE/SAE)	20159755 / 2015-32-0755
7. Paper title	CFD Simulation and Experimental Validation of a Throttle Body Design without Bypass for Fuel Injected Motorcycles
8. Authors (Affiliation)	Pradeep Ramachandra, Mohankumar Nagalapura (Bosch Limited)

9. Abstract

Increased penetration of gasoline EFI (Electronic Fuel Injection) in the Indian two wheeler commuter segment, demands simplified, but robust solutions. Freedom for the end user to adjust the idle speed with carbureted engines is considered as reference behavior. Control of idle air flow in the traditional throttle body designs is through a bypass path with either an idle speed actuator or a mechanical screw. Due to the quality of air and vented blow-by in the air path, field issues observed on most throttle body designs include a) carbon deposition influencing the air flow characteristics b) consequent effects included instability of idle speed, jamming of throttle valve or clogging of idle air control valve. One of the design measures suggested [1] was to introduce an idle screw on the throttle flap to retain the user experience based on the incumbent carburettor and address the carbon deposition based on the knowledge of ETB (Electronic Throttle Body).

The primary objective of this investigation was to validate this assumption through CFD (Computational Fluid Dynamics) analysis backed by vehicle trials. In CFD, carbon deposition can be characterized as a function of velocity and pressure. This phenomenon was used to simulate air flow in the throttle body with and without bypass path and compared against the experimental results. Further, these configurations were subjected to real world driving conditions to evaluate the effect on carbon deposition phenomenon.

The simulation showed a channeled air flow with the maximum velocity of 353 m/s (which is greater than sonic velocity) for throttle body without bypass path. The simulation and experimental results for air mass flow had close agreement with <8% deviation over the entire range of throttle opening. The results from vehicle trials indicated reduced rate of carbon deposition when observed at frequent intervals during the trials. Learning from the iterative steps, vehicle validation results and combination of smart software algorithm enabled a robust throttle body design.

6. Paper No.(JSAE/SAE)	20159842 / 2015-32-0842
7. Paper title	Downsizing of Fuel Injection Components for Small Motorcycles
8. Authors (Affiliation)	Naoto Miyauchi, Takeshi Enomoto, Yukinori Kato, Satoshi Miura (Aisan Industry Co., Ltd.)

9. Abstract

In recent years, more and more small motorcycles, such as scooters, are introducing Fuel Injection System (FI system) worldwide. As motorcycles have limited component spaces, it is not easy to put the fuel supply system products such as Fuel Pump Module (FPM) and Fuel Injector intended for four-wheel vehicles. Therefore, downsizing of these components are being required. In addition, weight reduction is also an important design factor in terms of improvement in fuel efficiency and driving performance. To meet these needs, we focused on motorcycles to optimize the design. We have been standardizing these components and starting mass-production in order since 2002. This paper introduces FPM and Fuel Injector that were newly developed for motorcycles.



Abstracts of Technical Sessions

1. Date Tuesday, November 17
 2. Room. 1004
 3. Time 13 : 30 - 15 : 00
 4. Session Diesel Engine I
 5. Chair (Affiliation), Keiya Nishida (University of Hiroshima)
 Co-chair (Affiliation) Giovanni Vichi (University of Florence)

6. Paper No.(JSAE/SAE)	201597010/ 2015-32-0710
7. Paper title	Engine Performance, Emission and Combustion of Common Rail Turbocharged Diesel Engine from <i>Jatropha Curcas</i> Using Artificial Neural Network
8. Authors (Affiliation)	Arridina Susan Silitonga, H.H.Masjuki, Hwai Chyuan Ong, H.G. How (University of Malaya) F. Kusumo (Universiti Kebangsaan Malaysia) Y.H. Teoh (Universiti Sains Malaysia) T.M.I. Mahlia (Universiti Tenaga Nasional)

9. Abstract

This paper investigates the performance, emission and combustion of a four cylinder common-rail turbocharged diesel engine using *jatropha curcas* biodiesel blends (JCB). The test was performed with various ratios of *jatropha curcas* methyl ester (JCME) in the blends (JCB10, JCB20, JCB30, and JCB50). An artificial neural networks (ANN) model based on standard back-propagation algorithm was used to predict combustion, performance and emissions characteristics of the engine using MATLAB. To acquire data for training and testing of the proposed ANN, the different engine speeds (1500-3500 rpm) was selected as the input parameter, whereas combustion, performance and emissions were chosen as the output parameters for ANN modeling of a common-rail turbocharged diesel engine. The performance, emissions and combustion of the ANN were validated by comparing the prediction dataset with the experimental results.

6. Paper No.(JSAE/SAE)	20159715/ 2015-32-0715
7. Paper title	Detailed Diesel Combustion and Soot Formation Analysis with Improved Wall Model Using Large Eddy Simulation
8. Authors (Affiliation)	Beini Zhou, Masahiro Horikoshi, Akira Kikusato, Jin Kusaka, Yasuhiro Daisho (Waseda University) Kiyotaka Sato, Hidefumi Fujimoto (Mazda Motor Corporation)

9. Abstract

A mixed time-scale subgrid large eddy simulation was used to simulate mixture formation, combustion and soot formation under the influence of turbulence during diesel engine combustion. To account for the effects of engine wall heat transfer on combustion, the KIVA code's standard wall model was replaced to accommodate more realistic boundary conditions. This were carried out by implementing the non-isothermal wall model of Angelberger et al. with modifications and incorporating the log law from Pope's method to account for the wall surface roughness. Soot and NOx emissions predicted with the new model are compared to experimental data acquired under various EGR conditions.

6. Paper No.(JSAE/SAE)	20159754 / 2015-32-0754
7. Paper title	Low temperature premixed diesel combustion with blends of ordinary diesel fuel and normal heptane
8. Authors (Affiliation)	Hideyuki Ogawa, Yuhei Sakane, Tatsunori Obe, Tatsuaki Arisawa, Gen Shibata (Hokkaido University)

9. Abstract

Premixed diesel combustion blending high volatility fuels into diesel fuel were investigated in a modern diesel engine. First, various fractions of normal heptane and diesel fuel were examined to determine the influence of the blending of a highly ignitable and volatile fuel into diesel fuel. The indicated thermal efficiency improves almost linearly with increasing normal heptane fraction, particularly at advanced injection timings when the fuel is not injected directly into the piston cavity. This improvement is mainly due to decreases in the other losses, The decreases in the other losses with normal heptane blends are due to a reduction in the unburned fuel which does not reach the gas analyzer.



Abstracts of Technical Sessions

1. Date Tuesday, November 17
 2. Room. 1005
 3. Time 13 : 30 - 15 : 00
 4. Session Vehicle Dynamics & Safety I
 5. Chair (Affiliation), Shigeru Fujii (Yamaha Motor Co., Ltd.)
 Co-chair (Affiliation) Thomas Lagö (QirraSound Technologies Europe AB)

6. Paper No.(JSAE/SAE)	20159705 / 2015-32-0705
7. Paper title	Simulation and Optimization Analysis of Small Vehicle Deceleration to Reduce Occupant Injury at Frontal Collision
8. Authors (Affiliation)	Takanobu Fujimura (SUZUKI MOTOR CORPORATION)

9. Abstract

Due to environmental problems, number of small vehicles with fuel efficiency increases. Since the small vehicles have small deformation space, it is difficult for them to achieve good crashworthiness at a frontal impact accident. Small deformation space usually yields high vehicle deceleration to absorb kinetic energy of the vehicle. The high vehicle deceleration may produce high occupant deceleration and lead to high occupant injury value. For example, North America, Japan and Europe specify head and chest injury value at vehicle's frontal collision. Those injury values tend to be improved if vehicle deceleration decreases. Deceleration of small vehicle with a little deformation space must be adjusted in order to prevent increase of the occupant injury value.

6. Paper No.(JSAE/SAE)	20159813 / 2015-32-0813
7. Paper title	Study on Airbag Concept for Motorcycles Using Opposing Vehicle as Reaction Structure
8. Authors (Affiliation)	Yutaka Aikyo, Yuki Kobayashi, Takashi Sato, Tomohiko Akashi and Makoto Ishiwatari (Honda R&D Co., Ltd.)

9. Abstract

An airbag system for motorcycle applications was developed and commercially released in 2006 based on many research results on that system. In the airbag system, the bag should be supported during the period in a collision. The previously developed system employed a configuration in which the airbag was supported by the structures of the motorcycle, such as the instrument panel and the surrounding structures. These structures receive the reaction force to hold the airbag during a crash to properly absorb the rider's kinetic energy. Meanwhile, the previous system requires a larger area for these reaction structures and is applicable only to the motorcycles that can provide the area. To overcome this limitation, we propose an airbag system employing another concept. In this concept, the airbag does not use its vehicle structures as reaction structures but uses the structures of an opposing vehicle, such as doors and/or pillars. For evaluations of the proposed system, full scale motorcycle-to-car crash tests using 125 cm³ scooter-type models with and without the airbag were conducted in the seven impact configurations specified in ISO13232. Through the crash tests, benefits of protective effects of the airbag system were confirmed in particular impact configurations, and no significant risk for the rider due to the airbag was observed in the all tested impact configurations. It was concluded that the proposed airbag system is feasible for reducing rider's severity of injuries in a collision of a motorcycle not having sufficient reaction structures.

6. Paper No.(JSAE/SAE)	20159839 / 2015-32-0839
7. Paper title	Development of a Motorcycle Frame with Low Stiffness in the Side Direction for Racing
8. Authors (Affiliation)	Koichiro Kawata (SUZUKI MOTOR CORPORATION)

9. Abstract

In motorcycle race represented by MotoGP, the motorcycle bank angle in turning state reaches approximately 60 degrees. In such a large bank angle, it is important that response of the motorcycle for the road surface displacement input is relaxed by designing the frame with low stiffness in the side direction to secure the speed on cornering. On the other hand, strong frame stiffness of longitudinal direction is required with a proper frame displacement to resist large force by the rapid deceleration. As seen above, regarding stiffness of longitudinal and side direction of the frame of motorcycle, one should be high, and the other should be low. However, in general, the ratio estimated by stiffness of side direction per that of longitudinal direction is approximately constant with existing frame. This means that if the frame stiffness of side direction is lowered, that of the longitudinal would also be lowered accordingly. Thus, it is difficult to design the frame of which stiffness of longitudinal direction is strengthened while that of side direction is kept lowered. An object of this study is the development of the frame with different longitudinal and side stiffness ratio unlike the current longitudinal and side stiffness ratio. The frame developed from this study is adopted in our MotoGP machine and contributes to secure high speed on cornering.



Abstracts of Technical Sessions

1. Date Tuesday, November 17
2. Room. 1006
3. Time 13 : 30 - 15 : 00
4. Session Engine Controls II
5. Chair (Affiliation), Yutaka Nitta (SUZUKI MOTOR CORPORATION)
Co-chair (Affiliation) Roland Kirchberger (Graz University of Technology)

6. Paper No.(JSAE/SAE)	20159752 / 2015-32-0752
7. Paper title	Application of OSC Estimation Technology of the Catalyst to the Air-Fuel Ratio Control of the Motorcycle
8. Authors (Affiliation)	Daisuke Yanase, Shinichi Kuratani, Takashi Abe, Hiroyuki Koga (Kawasaki Heavy Industries, Ltd.)

9. Abstract

The regulation for emission gas of the motorcycle is rapidly being strengthened as the concern about global environment grows around the world, and manufacturers are facing the problem to reduce the toxic materials in the emission gas more. As the technology to reduce the toxic materials, it is common to install a three way catalyst (TWC) on an exhaust system and optimize the oxygen concentration at the inlet of TWC by maintaining air fuel ratio (A/F) on stoichiometric A/F with the control of fuel injection quantity. Furthermore, TWC itself is designed to maintain proper oxygen concentration by the addition of a substance with oxygen storage capacity (OSC), which is able to suppress the variation of the oxygen concentration. However, TWC losses OSC during transient operation with the effect of a large disturbance of A/F and the conversion efficiency of TWC is not able to recover right after the disturbance even though maintaining the A/F near the stoichiometric A/F, which is regarded as a future problem. Therefore the authors focused on maintaining OSC properly with A/F control in order to solve the above ...

6. Paper No.(JSAE/SAE)	20159819 / 2015-32-0819
7. Paper title	Impact of Alcohol-Gasoline Fuel Blends in Long-Tailed Boat Application
8. Authors (Affiliation)	Kittichart Tumaiam, Kraiwut Kujirapan, Chinda Charoenphonphanich, Chaiwat Nuthong (King Mongkut's Institute of Technology Ladkrabang), Teera Phatrapornnant (National Science and Technology Development Agency), Masaki Yamakita (Tokyo Institute of Technology)

9. Abstract

Nowadays, human realize to the environment pollution cause from old engine and use the engine misapply. These engines will cause the problem such as air pollution and cannot use the engine to work at the maximum efficiency and fuel consumption. The new of control technologies can solve problems from misuse engine by an electronic control unit work with many sensors. Optimization of electronic control unit (ECU) makes an engine to work in maximum efficiency and decrease the environment pollution. In this research, Port-fuel injection spark ignition engine (PFI Engine) fuelled with gasoline is use as the boat engine. To use car engine as boat engine, the control system has to be modify and tune up for proper condition. For the method, the parameters that used to control and optimization are the boat's running condition to tune up injection timing, injection duration, ignition timing, and also the engine special function. And this paper aim to investigate and improve performance, efficiency and emission of misapply engine. After that we plan to do research on each part of the system that makes the engine run with alternative energy such as gasohol (E10 to E85) to reduce ...

6. Paper No.(JSAE/SAE)	20159843 / 2015-32-0843
7. Paper title	Patented Software Solution to Prevent Rotation of the Tool upon Machine Start at Idle
8. Authors (Affiliation)	Marek Lajda, Sebastian Hook, Nikolai Reimgen (PRUFREX)

9. Abstract

During the start-up phase of machines it can happen that tools are inadvertently rotating, which is caused by the half-throttle setting. Due to the starting throttle locking mechanism, the engine's rotational speed is above the engagement speed of the tool (for example the chain of a chain saw).

This article describes the software algorithms developed by PRUFREX that are able to prevent rotation of the tool upon machine start at idle. The patented software solution is able to differentiate between start behavior with and without a starting throttle locking mechanism based on the machine's speed and time information and, as a result, can identify or estimate the position of the throttle valve. The effect of the algorithms is the switch-over between different ignition curves that are stored in the microcontroller-operated ignition modules. This includes a provision in the start ignition curve that prevents the tool from rotating. Toggling between different ignition curves is already part of today's technology. The underlying patent defines the conditions for switch-over that is solely controlled by software. The article explains the various machine states and their identification in detail. The possible program sequence is featured.



Abstracts of Technical Sessions

1. Date	Tuesday, November 17
2. Room.	1007
3. Time	13 : 30 - 15 : 00
4. Session	Two Stroke Engine II
5. Chair (Affiliation), Co-chair (Affiliation)	Yuh Motoyama (Yamaha Motor Co., Ltd.) Pierre Duret (IFP Energies Nouvelles)

6. Paper No.(JSAE/SAE)	20159760 / 2015-32-0760
7. Paper title	CFD Analysis of the Effect of the Injection Pressure on a Small 2S LPDI Engine
8. Authors (Affiliation)	Francesco Balduzzi, Giovanni Vichi, Luca Romani, Giovanni Ferrara (University of Florence)

9. Abstract

The paper investigates the influence of the fuel injection pressure on a small two-stroke engine with low pressure direct injection (LPDI). The authors in previous studies showed the benefits of the LPDI system in reducing the fuel short circuit, both from an experimental and numerical point of view. As a direct consequence, both the specific fuel consumption and the pollutant emissions were notably reduced, reaching the typical performance of a standard fourstroke engine of comparable size.

The main drawback of the system is the limited time at disposal for delivering the fuel with difficulties in achieving a satisfactory air-fuel mixing and homogenization as well as fuel vaporization.

In order to overcome the aforementioned issues, a detailed numerical analysis is carried out by performing a wide set of CFD simulations to properly investigate and understand the many complex phenomena occurring during the interaction between the injected fuel and the fresh scavenging air. Starting from the reference configuration working...

6. Paper No.(JSAE/SAE)	20159762 / 2015-32-0762
7. Paper title	An experimental methodology for the evaluation of the trapped air-fuel ratio of a small 2S LPDI engine
8. Authors (Affiliation)	Luca Romani, Francesco Balduzzi, Giovanni Vichi, Giovanni Ferrara (University of Florence)

9. Abstract

A typical issue of the two-stroke engine in monitoring the combustion process is to measure the actual burning mixture with a conventional O₂-sensor placed in the exhaust duct. In fact, the short circuit of fresh charge affects the correct acquisition of the residual oxygen associated to the completeness of the combustion process, leading to the overestimation of the trapped air-fuel ratio.

In a conventional homogenously scavenged two-stroke engine, a possible solution to the aforementioned issue is the direct measurement of the mass flow rate of both the intake fresh air and the fuel delivered by the fuel supply system. This methodology cannot be applied to 2S direct injection engine because air and fuel are not premixed.

The paper shows the application of a methodology for the evaluation of the trapped air-fuel ratio of the mixture inside the combustion chamber in a small two-stroke low pressure direct injection (LPDI) engine. More in detail, the air short circuit is estimated by coupling the measurement of intake airflow and O₂ raw emissions, while the fuel...

6. Paper No.(JSAE/SAE)	20159832 / 2015-32-0832
7. Paper title	Layout and development of a 300 cm ³ high performance 2S-LPDI engine
8. Authors (Affiliation)	Franz Winkler, Roland Oswald, Oliver Schögl, Andrea Abis, Stefan Krimplstätter, Roland Kirchberger (Graz University of Technology)

9. Abstract

In consideration of the fact that in extreme Enduro competitions two-stroke motorcycles are still dominating, the Institute of Internal Combustion Engines and Thermodynamics, Graz University of Technology, with a long tradition in two-stroke technology, has developed a new 300 cm³ two-stroke motorcycle engine.

The 2-stroke LPDI (Low Pressure Direct Injection) technology was originally developed for the 50 cm³ Scooter and moped market in Europe. In 50 cm³ applications the LPDI technology fulfils the EURO 4 emission standard (2017) [1]. In a next step the LPDI technology was applied to a 250 cm³ Enduro engine demonstrator vehicle. Based on the results of the demonstrator, a complete new high performance 300 cm³ engine was developed. The development of this new engine will be described in this publication.

Some interesting aspects of the layout with 3D-CFD methods and also 1D-CFD simulation to optimize the exhaust system by DoE methods are discussed in the paper.

For the first prototype (prototype 1) some carry over parts had to be used – crankshaft, connecting rod, clutch,...



Abstracts of Technical Sessions

1. Date Tuesday, November 17
 2. Room. 1008
 3. Time 13 : 30 - 14 : 30
 4. Session Fuel Supply Systems II
 5. Chair (Affiliation), Hideyuki Okumura (JMIA/Yamaha Motor Co., Ltd.)
 Co-chair (Affiliation) Tony Szczotka (Robert Bosch LLC)

6. Paper No.(JSAE/SAE)	20159767 / 2015-32-0767
7. Paper title	Analysis of Mixture Formation Process in a PFI Motorcycle Engine
8. Authors (Affiliation)	Yasuo Moriyoshi, Tatsuya Kuboyama (Chiba University) Hisashi Goto, Minoru Iida (Yamaha Motor Co.)

9. Abstract

PFI (Port Fuel Injection) gasoline engines for motorcycles have some problems such as slow transient response because of wall wet of fuel caused by the injector's layout. Hence, it is important to understand the characteristics of fuel sprays such as droplet size and distribution of fuel concentration. Considering the spray formation in a port, there are three kinds of the essential elements : breakup, evaporation and wall impingement. However, it is difficult to observe three of them at the same time. Therefore, the authors have made research step by step.

In the authors' previous study, the authors focused on the wall collision, droplet sizes, droplet speeds and the space distribution of the droplets. In this study, the authors focused on evaporation. A direct sampling method using FID (Flame Ionization Detector) for evaporating fuel was established and the concentration distribution of evaporating fuel in the port was measured and analyzed. As a result, it was found that higher velocity in the port increases fuel concentration with enhanced atomization and that evaporating fuel is easier to be affected by the flow and fuel distillation characteristics.

6. Paper No.(JSAE/SAE)	20159773 / 2015-32-0773
7. Paper title	A Novel Concept for Mixture Preparation in Port Fuel Injected Engines
8. Authors (Affiliation)	Saransh Jain, Anand T.N.C. (Indian Institute of Technology Madras)

9. Abstract

Every year, large numbers of two wheelers are sold in India and other Asian countries. A majority of these engines still tend to be carbureted due to cost and fuel quality issues. As an alternative to the carburetor, port fuel injectors (PFI) have started being introduced in the last few years for small two wheeler vehicles. Although PFI systems offer better metering of fuel and better transient response compared to carbureted systems, they are more expensive and require more power to pressurize the fuel. More importantly, wall film formation is observed in both the technologies, which reduces the effectiveness of the PFI system. Hence, a new technology is proposed which includes a PFI system along with an ultrasonic atomizer. The purpose of the proposed system is to improve the transient response and hence improve the fuel economy of gasoline engines and lower the emissions especially under cold conditions.

The proposed concept was tested standalone on a laboratory setup. A transparent duct of square section was fabricated and fuel was injected in it. High speed schlieren imaging was done to qualitatively visualize the vapor concentration in the proposed system compared to a conventional port fuel injection system. Mass measurement of the fuel atomized was done to quantitatively characterize the proposed system. The proposed system was found to be better than the existing conventional PFI system. It has metering capability like PFI with potentially better transient response at a similar cost.



Abstracts of Technical Sessions

1. Date	Tuesday, November 17
2. Room.	1004
3. Time	16 : 00 - 18 : 00
4. Session	Diesel Engine II
5. Chair (Affiliation),	Yoshimitsu Kobashi (Kanazawa Institute of Technology)
Co-chair (Affiliation)	Giovanni Vichi (University of Florence)

6. Paper No.(JSAE/SAE)	20159724 / 2015-32-0724
7. Paper title	Droplets Behavior and Evaporation of Diesel Spray Affected by Ambient Density after Pilot Injection
8. Authors (Affiliation)	Mohd Al-Hafiz Mohd Nawi, Naoya Uwa, Yuki Ueda, Yuzuru Nada, Yoshiyuki Kidoguchi (Tokushima University)

9. Abstract

A fundamental study on spray behavior for small quantity injection under high boosting and high temperature conditions was carried out by applying dual nano-spark shadowgraph photography method to constant volume spray chamber filled with inert gas. The study showed macro-scale and micro-scale spray structures and dynamic changes of diesel spray affected by ambient density and temperature right after the pilot injection. Detailed observation and analysis of the images showed that high density surrounding....

6. Paper No.(JSAE/SAE)	20159761 / 2015-32-0761
7. Paper title	Detection of Cylinder-to-Cylinder Injection Variation in a Four-Stroke Diesel Engine by Monitoring the Turbocharger Speed
8. Authors (Affiliation)	Giovanni Vichi, Isacco Stiaccini, Michele Becciani, Giovanni Ferrara (University of Florence) Lorenzo Ferrari (Italian National Research Council - CNR – ICCOM) Alessandro Bellissima (Yanmar R&D Europe) Ryouta Minamino (Yanmar Co. Ltd.)

9. Abstract

A condition monitoring activity consists in the analysis of several information from the engine and the subsequent data elaboration to assess its operating condition. By means of a continuous supervision of the operating conditions, the performance of an internal combustion engine can be maintained at design-level in the long term. The growing use of turbocharger (TC) in ICE for automotive and industrial applications suggests to use the TC speed as a possible feedback of engine operating condition. Indeed, the turbocharger behavior is connected to the thermo-dynamic and fluid-dynamic conditions at the engine cylinder exit....

6. Paper No.(JSAE/SAE)	20159816/ 2015-32-0816
7. Paper title	Study on the Effects of EGR Supply Configuration on Cylinder-to-Cylinder Dispersion and Engine Performance Using 1D-3D Co-simulation
8. Authors (Affiliation)	Pavlos Dimitriou, Richard Burke, Colin Copeland, Sam Akehurst (University of Bath)

9. Abstract

Exhaust Gas Recirculation (EGR) is widely used in IC combustion engines for diluting air intake charge and controlling NOx emission. The rate of EGR required by an engine varies by the speed and load and control of the right amount entering the cylinders is crucial to ensure good engine performance and low NOx emission. However, controlling the amount of EGR entering the intake manifold does not ensure that EGR rate will be evenly distributed among the engine's cylinders. This can many times lead to cylinders....

6. Paper No.(JSAE/SAE)	20159825/ 2015-32-0825
7. Paper title	Combustion Characteristics of Diesel Spray with Temporally-Splitting High-Pressure Injection
8. Authors (Affiliation)	Yusuke Nishioka, Heizo Tomoda, Keiya Nishida, Youichi Ogata (University of Hiroshima) Baolu Shi (Beijing Institute of Technology) Gnanasekaran Kishorkumar (University of Hiroshima)

9. Abstract

Effects of temporally-splitting and high-pressure injection on the Diesel spray and combustion processes were investigated by using the high-speed video camera and the two-color pyrometry. The images were analyzed to obtain the tip penetration/spray angle/air entrainment of the spray and the soot concentration/temperature distributions in the flame. It was found that the optimal combination of the temporally-splitting and the high-pressure injection could simultaneously reduce the soot concentration and the temperature of the spray flame.



Abstracts of Technical Sessions

2. Room.	1005
3. Time	16 : 00 - 18 : 00
4. Session	Vehicle Dynamics & Safety II
5. Chair (Affiliation),	Masayuki Baba (Honda R&D Co., Ltd.)
Co-chair (Affiliation)	Thomas Lagö (QirraSound Technologies Europe AB)

6. Paper No.(JSAE/SAE)	20159723 / 2015-32-0723
7. Paper title	Chassis Development for the Motorcycle With High Power Output Supercharged Engine
8. Authors (Affiliation)	Hiroshi Ishii, Daisuke Saeki, Tomo Yamamoto, Manabu Morikawa, Eiji Sakurada, Kazuhiro Ichikawa, Seiichi Sonoda, Taku Nagata, Toshiyuki Kimura (Kawasaki Heavy Industries, Ltd.)

9. Abstract

In motorcycles, the size and output performance of the engine itself has a major effect on the maneuverability of the motorcycle. In particular for cases where a high output engine is mounted on a lightweight frame, these effects are even more of a concern. In the case of developing a racing motorcycle with a high power engine, the behavior of the motorcycle differs depending on the output range used and there are a lot of cases where changes to the basic dimensions of the motorcycle as well as the main components are required. Here, there are a lot of cases where the rider and drive-able courses are limited to compatibility with distinct specifications and when considering use as ...

6. Paper No.(JSAE/SAE)	20159810 / 2015-32-0810
7. Paper title	Development of High Performance Motorcycle Wheel using Numerical Shape Optimization
8. Authors (Affiliation)	Hisato Tokunaga, Kazuhiro Ichikawa, Takumi Kawasaki, Masato Kogirima, Eiji Sakurada, Tomo Yamamoto (Kawasaki Heavy Industries, Ltd.)

9. Abstract

High performance motorcycles require dynamic performance that encompasses superior handling, wherein the wheels are one of the key components that determine the dynamic performance of the motorcycle. In this paper, we will clarify the dynamic parameters for the wheels that have an impact on the handling while also constructing a design technique in which numerical shape optimization is applied.

6. Paper No.(JSAE/SAE)	20159834 / 2015-32-0834
7. Paper title	Motorcycle Stability Control – The next generation of motorcycle safety and riding dynamics
8. Authors (Affiliation)	Thomas Lich (Robert Bosch GmbH), Wilko Gordon Block, Prashanth S N (Robert Bosch Corporation Japan), Brad Heiler (Robert Bosch LLC)

9. Abstract

Anti-lock Braking Systems (ABS) for motorcycles have already contributed significantly to the safety of powered two wheelers on public roads by improving bike stability and controllability in emergency braking situations. In order to address further riding situations, another step forward has been achieved with Motorcycle Stability Control (MSC) system. By combining ABS, electronically combined braking system (eCBS), traction control and inertial sensors even in situations like braking and accelerating in corners the rider's safety can be improved...

6. Paper No.(JSAE/SAE)	20159709 / 2015-32-0709
7. Paper title	Novel Low Cost Experimental Procedures to Estimate the Longitudinal Force Characteristics of a Tire
8. Authors (Affiliation)	Barath Mohan, Venkata Mangaraju Karanam (TVS Motor Company) Chandramouli Padmanabhan (IIT Madras)

9. Abstract

The aim of the present study is to develop feasible test methods to measure tire parameters that can be used in two wheeler industry for tire development. In this work, test methods are developed to measure the longitudinal friction coefficient and stiffness characteristics of motorcycle tires. Using the measured longitudinal forces from the testing procedure, a fairly accurate tire model has been developed. Based on this tire model the braking performance of the motorcycle is estimated using an analytical model of the vehicle. These are validated with experimental data. It is found that there is a good match between the results. The test is conducted for various bias ply tires used in motorcycles and the results are presented. The test methods proposed are shown...



Abstracts of Technical Sessions

1. Date Tuesday, November 17
2. Room. 1006
3. Time 16 : 00 - 18 : 00
4. Session Alternative Fuels I
5. Chair (Affiliation), Koji Yoshida (Nihon University)
- Co-chair (Affiliation) Brent Dohner (The Lubrizol Corporation)

6. Paper No.(JSAE/SAE)	20159712 / 2015-32-0712
7. Paper title	SI Engine with Direct Injection of Methanol Reforming Products –First Experimental Results
8. Authors (Affiliation)	L. Tartakovsky, R. Amiel, V. Baibikov, R. Fleischman, M. Gutman, A. Poran, M. Veinblat (Technion – Israel Institute of Technology)

9. Abstract

In this paper we describe conversion of the gen-set gasolinefed carburetor single-cylinder SI engine to the directinjection version operating with the gaseous hydrogen-rich methanol reforming products, and present the first experimental results. It was found that engine feeding by methanol steam reforming products has a great potential of pollutant emissions mitigation as compared with gasoline. NO_x concentrations in the exhaust gas were reduced by a factor of 7 as a result of the lean combustion and lowering incylinder temperatures. Particle mass emissions were mitigated to zero-impact levels. Harmful emissions of the target pollutants THC, CO and the GHG gas CO₂ were reduced by a factor of 6, 25 and 1.5, respectively...

6. Paper No.(JSAE/SAE)	20159784 / 2015-32-0784
7. Paper title	An Experimental Investigation of Butanol-Gasoline Blend Fuel with Different Fuel Injection Pressure
8. Authors (Affiliation)	Yung-Hsiang Hsu, Huang-Min Lin, Chia-Hong Chung, Yuh-Yih Wu (Nation Taipei University of Technology)

9. Abstract

Butanol is deemed as the potential alternative fuel for future development, and the previous researches show poor injection spray atomization when high butanol concentration blended fuel applying on stock small scooter engines. In this research, a platform is built to observe the spray atomization phenomena with 2.5 kg/cm² (2.452 bar), 3.5 kg/cm² (3.433bar) injection pressures and various n-butanol volume percent concentration blended fuels, B60, B80 and B100. After that, engine experiments are undergone with above conditions under wide open throttle (WOT) with stoichiometric air fuel ratio (AFR) at 4000 rpm. The experiment results are analyzed and discussed from different aspects eventually....

6. Paper No.(JSAE/SAE)	20159795 / 2015-32-0795
7. Paper title	Effect of Ignition timing on Small SI Engine Torque at WOT condition with syngas from wood biomass gasifier
8. Authors (Affiliation)	Hiroshi Enomoto, Kazuyuki Teraoka, Noboru Hieda, Masahiro Sasao and Yusuke Odani (College of Science & Technology, Kanazawa University)

9. Abstract

Recently, alternative power generation that does not use the oil has attracted attention. There is a power generation using a biomass in one of them. However, biomass power plants is fewer in Japan. Below are two reasons why biomass power plants is few. Firstly, biomass resources are widely and thinly. So, biomass resources is a high transportation cost. Secondly, Efficiency of small biomass plant is low. Therefore, we're working with high-efficiency small biomass gasifier to the development of the power generation method....

6. Paper No.(JSAE/SAE)	20159831 / 2015-32-0831
7. Paper title	A study of Stoichiometric Bio-mass Gas Engine
8. Authors (Affiliation)	Toru Nakazono, Yuta Watanabe (Yanmar company.,co.ltd)

9. Abstract

Bio-mass fuel gas is very important because bio-mass gas is renewable and carbon free. Especially, woody chips are very popular and are not used efficiently. Gasifier makes the producer gas from woody chips. Conventionally, dual fuel engines are used to generate electricity by producer gas and light oil. As the dual fuel engine can run under the low heating value gas, dual fuel engine is very useful. As light oil is fossil oil, it is not carbon free. If bio-mass gas engine can run only by producer gas, this power unit is carbon free. As the heat value of producer gas is very low and fluctuates always, bio-mass gas engine should be controlled A/F precisely....



Abstracts of Technical Sessions

1. Date Tuesday, November 17
 2. Room. 1007
 3. Time 16 : 00 - 18 : 00
 4. Session Collegiate Events
 5. Chair (Affiliation), Takashi Mitome (SUZUKI MOTOR CORPORATION)
 Co-chair (Affiliation) Robert Kee (Queen's University Belfast)

6. Paper No.(JSAE/SAE)	20159742 / 2015-32-0742
7. Paper title	Optimizing the Opening Period and the Timing of Intake and Exhaust Valves to Improve Engine Performance in a Supermilage Vehicle
8. Authors (Affiliation)	Kenta Goto, Shinji Noda, Kohei Nakashima, Yoshio Murakami (Meijo University)

9. Abstract

To improve engine torque and specific fuel consumption in a supermilage vehicle, we experimentally adjusted the valve lift and opening period in rocker arms, testing various follower configurations and adjust screws. Using the follower configuration in a commercially-available rocker arm, we compared 4 different levels of valve lift and opening period in the intake, and 4 different levels in the exhaust, making 16 combinations. Then, utilizing 5 kinds of modified follower configurations of the rocker arms in the intake, and 3 in the exhaust, we also compared 24 combinations (including the commercially-available follower configurations). We tested our experimental supermilage engine under full-load at 2000 to 4500 rpm, simulating powering a supermilage vehicle...

6. Paper No.(JSAE/SAE)	20159823 / 2015-32-0823
7. Paper title	Adaptation of turbocharger to small displacement single cylinder SI engine
8. Authors (Affiliation)	Duan Chaoran, Yujiro Fujita, Mitsuhsa Ichiyanagi, Takashi Suzuki (Sophia University)

9. Abstract

This paper represents the adaptation of turbo charger to single cylinder 450 cc SI engine which is used for the student formula competition. The experiment and 1D engine simulation called as GT-Power were performed to confirm the effect of valve profile, compression ratio and air fuel ratio on the engine performance under the naturally aspirated condition. The maximum valve lift of the intake valves increased 27% and that of the exhaust valves increased 15% as compared with the low profile cam. The compression ratio was increased from 12.3 to 13.5 by changing the piston top land length in order to improve the thermal efficiency. It was confirmed that the torque peak was moved from 6000 rpm to 8000 rpm by changing the valve profile...

6. Paper No.(JSAE/SAE)	20159838 / 2015-32-0838
7. Paper title	Tuning for FSAE Engine with a Supercharger
8. Authors (Affiliation)	Fukuoka Tadamasu, Shinji Kajiwaru (Kinki University)

9. Abstract

Kinki University formula project has been participating in the student Formula SAE of Japan (JSAE) every year for the Competition since the second time.
 The engine uses ZX-6R made by Kawasaki Heavy Industries for the Competition from the eighth time.
 "Improvement of limited performance" is inserted in the concept through the development of a power train.
 Supercharger loading, engine dry sump and engine cooling management were improved.
 (80.0 PS) / 9000 rpm of maximum output 59.6 kW and (7.2 kgfm) / 8000 rpm of maximum torque 70.6 Nm were achieved by the supercharger loading. We succeeded in getting 90% of torque band (4000-9000 rpm) by 50% of the number of rotations in regular use (2000-12000 rpm)...

6. Paper No.(JSAE/SAE)	20159829 / 2015-32-0829
7. Paper title	A Study on the Design and Manufacturing for Student Formula Japan Vehicle
8. Authors (Affiliation)	Toshiki Yamashita, Naohiro Nojima (Graduate School of Kokushikan University), Tomoaki Kodama, Yuji Mizutani (Kokushikan University), Yasuhiro Honda (Kokushikan University, School of Science and Engineering)

9. Abstract

Higher running performance of a manufactured vehicle is one of the most important themes that should be studied in Student Formula Japan Competition (SFJ Competition). In the purpose of this study, the chassis must be required light weighting and high stiffness. The former can reduce the centrifugal force and the inertial force in the turning and the latter can contribute to demonstrate the suspension performance according to design. The SFJ competition has Skid Pad event to compete for steering responsiveness and high suspension performance on turning. The balance of the highly performed engine and chassis requires to keep high running performance of competition vehicle...



Abstracts of Technical Sessions

1. Date Tuesday, November 17
 2. Room. 1008
 3. Time 16 : 00 - 18 : 00
 4. Session Engine Technology I
 5. Chair (Affiliation), Satoshi Inoue (Honda R&D Co., Ltd.)
 Co-chair (Affiliation) Patrik Pertl (Graz University of Technology)

6. Paper No.(JSAE/SAE)	20159701 / 2015-32-0701
7. Paper title	Compressed Air as a Quality and Pollution Free Fuel Substitute in Reciprocating Engines - an Effect of the Valve Size on the Engine Performance
8. Authors (Affiliation)	Takayuki Sugita (Hiroshima Prefectural Miyajima Technical High School)

9. Abstract

An existing 4 stroke-cycle gasoline engine has been partially modified without dynamically changing its mechanism for the purpose to utilize the compressed air as an alternative energy source. The principle is to mechanically control the compressed air flow through the intake and exhaust valve every revolution of a crankshaft by modifying the camshaft cam's lobes, which changes the engine operation from 4 strokes to 2 strokes cycle mode. In the previous investigation the principle was verified with a current 50 cc....

6. Paper No.(JSAE/SAE)	20159713 / 2015-32-0713
7. Paper title	Miller/Atkinson Valve Timing as Full Load Concept for a Naturally Aspirated Cogeneration Engine
8. Authors (Affiliation)	Denis Neher, Fino Scholl, Matthias Deinert, Maurice Kettner (Karlsruhe University of Applied Sciences), Danny Schwarz, Markus Klaissle (SenerTec Kraft-Wärme-Energiesysteme GmbH), Blanca Giménez Olavarria (University of Valladolid)

9. Abstract

Lean burn operation allows small cogeneration engines to achieve high efficiency and low NOx emissions. While further mixture dilution enables future emission standards to be met, it leads to retarded combustion phasing and losses in indicated engine efficiency. IMEP drops due to lower fuel fraction, in particular, for naturally aspirated engines, reducing mechanical efficiency significantly. In this work, an alternative engine configuration was investigated that improves the trade-off between engine efficiency....

6. Paper No.(JSAE/SAE)	20159809 / 2015-32-0809
7. Paper title	Expansion to Higher Efficiency – Experimental Investigations of the Atkinson Cycle in Small Combustion Engines
8. Authors (Affiliation)	Patrick Pertl, Alexander Trattner, Reinhard Stelzl, Michael Lang, Stephan Schmidt, Roland Kirchberger (Graz University of Technology)

9. Abstract

The enhancement of efficiency will play a more and more important role in the development of future (small) internal combustion engines. In recent years, the Atkinson cycle, realized over the crank drive, has attracted increasing attention. Several OEMs have been doing investigations on this efficiency-increasing principle with in the whole range from small engines up to automotive ones. In previous publications, the authors stated that an indicated efficiency of up to 48% could be reached with an Atkinson cycle-based engine...

6. Paper No.(JSAE/SAE)	20159808 / 2015-32-0808
7. Paper title	Development of two types of industrial SI engines, to meet diverseness of regional demands and emissions requirements
8. Authors (Affiliation)	Takeshi Kawasaki, Yuichiro Yamada, Toshihiro Tsujioka, Kentaro Shiraishi, Shinji Kishi (Kubota Corporation)

9. Abstract

Due to the changes in the environment surrounding the industrial engine market, such as strengthening of exhaust emissions regulations of diesel engines and production increase of shale gas, the needs of the gasoline, LPG or natural gas fueled engines are growing. In the North American market, exhaust emissions regulations of industrial SI engines are getting strict. On the other hand, European market and developing countrys' market have no exhaust emissions regulations for SI engines. Therefore it is necessary to develop the engines which meet the needs of each region. Based on the existing diesel engine, we developed the two types of SI engine WG2503....



Abstracts of Technical Sessions

1. Date Wednesday, November 18
 2. Room. 1004
 3. Time 8 : 30 - 10 : 00
 4. Session NVH Technology
 5. Chair (Affiliation), Hiroshi Yano (Kawasaki Heavy Industries, Ltd.)
 Co-chair (Affiliation) Thomas Lagö (QirraSound Technologies Europe AB)

6. Paper No.(JSAE/SAE)	20159747 / 2015-32-0747
7. Paper title	Placement Technique of Measurement Points for Inverse Acoustic Analysis
8. Authors (Affiliation)	Hiroko Oshima, Hilmi Bin Hela Ladin, Akihito Ito, Nobutaka Tsujiuchi, Takayuki Koizumi (Doshisha University)

9. Abstract

This paper describes a measurement points' placement technique for the sound source identification using inverse acoustic analysis. In order to reduce noise in NVH problem for various kinds of machines including small size engine, it is necessary to identify the sound source. The inverse acoustic analysis is a technique that is effective for the sound source identification. The inverse acoustic analysis identifies a surface vibration of an object by measuring the radiated sound and solving the inverse problem. Nakano et al. researched about the location of sound pressure measurement points for accurate improvement. They clarified that the sound pressure measurement points on the concentric circle gave more accurate surface vibration than the measurement points on the square lattice. In this paper, we proposed a measurement points' placement technique based on the space filling design. The placement of the measurement points with the space filling design has the following merits; (1) Enables to decide a number of measurement points according to the experiment. This characteristic is superior to location on the square lattice. (2) Enables to predict the surface vibration of a rectangular object....

6. Paper No.(JSAE/SAE)	20159774 / 2015-32-0774
7. Paper title	Comparison Method of Input Powers and Contribution Rates Between Statistical Energy Analysis and Transfer Path Analysis for Small Power Generator's Enclosure
8. Authors (Affiliation)	Hilmi Bin Hela Ladin, Nobutaka Tsujiuchi, Katsuhiko Kuroda, Akihito Ito (Doshisha University)

9. Abstract

This paper describes the comparison method of input powers and contribution rates from vibration sources to a small power generator's enclosure represented by a thinwalled plane structure determined by Statistical Energy Analysis (SEA) and Transfer Path Analysis (TPA). In the pursuit of efficient ways to analyze the design dynamics of small machines such as a small power generator, it is important to identify information and dynamics of input power sources during machine operation. SEA and TPA are two of the most efficient methods in identifying the dynamics of a structure during machine operation. SEA is used for systems with many resonant modes, and predicted results are based on space averages. On the other hand, TPA is based on estimation of a frequency response function between an excitation point and a response point. In this study, we proposed a method to compare SEA evaluated by power injection method and TPA evaluated by matrix inversion method. The method is validated through numerical analyses, using a finite element method (FEM). We focused our research on the enclosure of a power generator and simplified it by constructing a partial enclosure model of a simple structure....

6. Paper No.(JSAE/SAE)	20159727 / 2015-32-0727
7. Paper title	Engine Mount System Achieving Reduced Vibration from an Inline 3 Cylinder Engine Installed in a Utility Vehicle
8. Authors (Affiliation)	Akiyuki Yamasaki, Teruaki Yamamoto, Kazumasa Hisada, Hiroshi Nakahara, Takumi Kawasaki (Kawasaki Heavy Industries, Ltd.)

9. Abstract

This paper describes an engine mount system that achieves reduced vibration on an industrial type utility vehicle. First the vibration level and direction of the inline three cylinder engine installed in the vehicle was analyzed and based on these results a mount layout that leads to a reduced level of vibration felt by the passengers was developed. Next, this was applied on an actual vehicle and spring characteristics were designed for each mount. The actual spring constants were set such that when considering the engine to be a rigid body, the resonance frequency thereof occurs at an engine speed lower than idle and in addition were set to ensure component strength relative to driving forces and inertial forces that act while the utility vehicle is being driven. Lastly, achievement of significant vibration reduction was confirmed on an actual vehicle showing that this engine mount system is effective at reducing vibration.



Abstracts of Technical Sessions

1. Date Wednesday, November 18
 2. Room. 1006
 3. Time 8 : 30 - 9 : 30
 4. Session Alternative Fuels II
 5. Chair (Affiliation), Tohru Nakazono (LEMA / YANMAR Co., Ltd.)
 Co-chair (Affiliation) Robert Kee (Queen's University Belfast)

6. Paper No.(JSAE/SAE)	20159733 / 2015-32-0733
7. Paper title	Influence of Supercharging on Biodiesel Combustion in a Small Single Cylinder DI Diesel Engine
8. Authors (Affiliation)	Yasufumi Yoshimoto (Niigata Institute of Technology)

9. Abstract

Biodiesel, a transesterified fuel made from vegetable oils, is a renewable, biodegradable, and nontoxic fuel. It offers potential reductions in carbon dioxide emissions, and a number of studies have been conducted for diesel engines with biodiesels as diesel fuel substitutes. From the viewpoint of environmental protection, it may be expected that biodiesels would give PM reductions at high load operation as well as there would be HC and CO emission reductions because of the oxygenated fuel characteristics.

It is well known that supercharging is a very effective technique to improve the characteristics of diesel combustion. The present study investigated the effect of boost pressure on the operation of a small single cylinder DI diesel engine equipped with a conventional jerk type injection system. The study employed a Roots blower type supercharger driven by a motor, and the boost pressures were varied from 100 kPa (nearly naturally aspirated condition) to 140 kPa. The experiments used three kinds of biodiesels : rapeseed oil methyl ester (RME), soybean oil methyl ester (SME), and coconut oil methyl ester (CME). Further, a blended fuel with 60% (mass) coconut oil and 40% 1-butanol (represented as CMEB) was also used. Here, butanol is a kind of biofuel that can be produced by various organic substances such as agricultural crop waste...

6. Paper No.(JSAE/SAE)	20159801 / 2015-32-0801
7. Paper title	An Application of Cellulosic Liquefaction Fuel for Diesel Engine
8. Authors (Affiliation)	Masayuki Yamazawa (Graduate school of Nihon university)

9. Abstract

In this study, wood was mixed with 20 wt.% of polypropylene and These was liquefied by using the mineral oil as a solvent. Diesel fraction CLF (Cellulose Liquefaction Fuel) and naphtha fraction CLF were distilled from this liquid. In case of diesel fraction CLF mixed diesel fuel, the ignition was delayed and a high smoke concentration was detected. In naphtha fraction CLF mixed diesel fuel, CO and THC concentrations were higher than those of diesel fuel. However, engine performance of these CLFs was almost equal to diesel fuel. Therefore, CLFs mixed diesel fuel can be used as diesel alternative fuel.



Abstracts of Technical Sessions

1. Date Wednesday, November 18
2. Room. 1007
3. Time 08 : 30 - 9 : 30
4. Session Measurement & Simulation I
5. Chair (Affiliation), Tadao Okazaki (LEMA / Kubota Corporation)
- Co-chair (Affiliation) Giovanni Ferrara (University of Florence)

6. Paper No.(JSAE/SAE)	20159717 / 2015-32-0717
7. Paper title	Effect of thickness ratio on fatigue and FEA life estimation criteria in welded structures
8. Authors (Affiliation)	Govardan Daggupati, Dora Karedla, Gagandeep Risam, N Kuppan (TVS Motor Company Limited)

9. Abstract

The welded structures have a broad applicability in automotive industry. The welding being an assembled process, presents both advantages and disadvantages for the two wheeler motor structure. A simple existing defect after welding can generate a catastrophic fracture. Recently all major fabricated structures in two wheelers are optimized by Computer Aided Engineering - Finite Element Analysis techniques to meet the constricted weight to strength and stiffness targets. Local reinforcements in the main structure with unequal member thickness are playing major role to meet these requirements. Various critical parameters which affect the weld structure life are not being modeled in FE analysis to minimize the modeling complexity and computation times. But in FEA-simulations acceptance stress values for a given base material are derived as a function of various parameters like the geometry, size, thickness, weld location, weld toe, flank angle, welding quality and cold working process etc. In this paper the effect of the base material thickness and weld location on fatigue life of welded structure and FEA simulation acceptance limit values are investigated for two wheeler scooter frame....

6. Paper No.(JSAE/SAE)	20159804 / 2015-32-0804
7. Paper title	Investigation of In-Cylinder Heat Flux in a Single Cylinder, 4 Stroke, Air Cooled, Spark Ignition Engine for Motorcycle Application
8. Authors (Affiliation)	Rajagopalan V.R, Anand S, Nagendra Kumar D, Karunaharan V and Lakshminarasimhan V (TVS Motor Company Ltd.)

9. Abstract

Heat flux measurements can provide much needed insight into the energy flow inside an IC engine, which is the key to optimizing its performance. This paper focuses on understanding the nature of heat flux curve and how it varies with varying load conditions, engine speed, Air fuel ratio and ignition timing in a single cylinder, 4 stroke, carbureted, air cooled, spark ignition engine for motorcycle application. Incylinder heat flux was monitored along with wall temperature and cylinder pressure for motored operation as well as fired conditions. The difference between the motoring mode and fired mode was analyzed to separate out the effects of combustion. In general, the magnitude of maximum heat flux was found to increase with engine rpm and load when all other engine parameters remained constant. The heat flux was found to increase when a mixture setting closer to the stoichiometric value was used. While studying the effect of ignition timing, it was observed that the peak cylinder pressure and cylinder head wall temperatures increased as the ignition timing was advanced. However, there exists a particular value of ignition timing for which the heat flux peaked for any set of operating conditions and advancing the timing any further resulted in a decrease in the magnitude of peak heat flux regardless of the fact that the cylinder pressure continued to rise well beyond this point.



Abstracts of Technical Sessions

1. Date Wednesday, November 18
 2. Room. 1008
 3. Time 8 : 30 - 10 : 00
 4. Session Engine Technology II
 5. Chair (Affiliation), Yuh-Yih Wu (National Taipei University of Technology.)
 Co-chair (Affiliation) Patrik Partl (Graz University of Technology)

6. Paper No.(JSAE/SAE)	20159729 / 2015-32-0729
7. Paper title	Development of a Supercharged Engine for Motorcycle with a Centrifugal Supercharger
8. Authors (Affiliation)	Hiroyuki Watanabe, Satoaki Ichi, Masahito Saito Kazuki Arima, Yasushi Ishibashi (Kawasaki Heavy Industries, Ltd.)

9. Abstract

In the development of motorcycle engines, a strong feeling of power, an element of being fun to ride has continued strong demand. However, demand to meet environmental performance, a conflicting element, has increased dramatically in recent years and a breakthrough technology that achieves both environmental performance and a feeling of power is in demand. Here, the newly developed engine has greatly enhanced feeling of power while clearing stringent environmental restrictions through use of a centrifugal type supercharger. However, there were several problems that had to be resolved with regards to application of a supercharger to a motorcycle engine. In applying a supercharger to a motorcycle, a major problem is the best way to keep the engine size from increasing in size. The engine, which is the heaviest parts on a motorcycle greatly affects motorcycle maneuverability so it must be compact and the mass concentrated. Another one of the problems was suppression of knocking to the extent possible. An intercooler for cooling intake air is generally used as a countermeasure for knocking in supercharged engines. However, increase in size and weight of the motorcycle through use of an intercooler was cause for a significant loss in the fun to ride aspect and thus was difficult to permit. For this model, by increasing the supercharging efficiency of the supercharger and matching it to the engine characteristics suppression of intake air temperature and thus knocking was achieved technologies used to resolve problems that arise when applying a centrifugal supercharger to a motorcycle engine.

6. Paper No.(JSAE/SAE)	20159768 / 2015-32-0768
7. Paper title	Free Piston Combustion Engine Design Analysis and Challenges
8. Authors (Affiliation)	Frank M. Washko, Rodeo A. Winchell (Saint Martin's University)

9. Abstract

There has been a recent resurgence in interest in "free piston" engine designs, particularly for small engine applications. This has been driven primarily by the demand for higher efficiency, flex-fuel capability, and also electrical demand in hybrid-electric applications. In free piston engines, expansion gasses are used to send energy directly to electrical or hydraulic power systems, rather than through a crankshaft. In many instances, the designs use opposed pistons to contribute the momentum of one piston to the upwards stroke of the opposing piston. This paper will review the details and benefits of the early free piston designs and some current designs, including our own hydraulic hybrid engine designs. The paper will then turn to a future free piston engine application that is in development.

6. Paper No.(JSAE/SAE)	20159757 / 2015-32-0757
7. Paper title	Fuelling a two-wheeler engine by ultrasonic atomization
8. Authors (Affiliation)	Balasubramanian N., Keerthi Ganesh and Anand T.N.C. (Indian Institute of Technology Madras, India)

9. Abstract

This paper presents work performed to improve an engine's fuel economy by introducing ultrasonic atomization as the method of fuelling. An ultrasonic atomizer was added to the air intake path of a four stroke spark-ignited two-wheeler engine, replacing the conventional carburetor. Test results indicate that the engine BSFC reduced by around 20% due to lower pumping losses and lean operation facilitated by better fuel atomization. Less throttling also reduced the pressure difference between the air filter and combustion chamber, especially at lower speeds and low loads. This reduced exhaust gas dilution into the intake manifold and hence a rich mixture was not required for stable operation even at idling conditions. HC emissions are seen to be high and will need to be addressed, but NO emissions reduced significantly.



Abstracts of Technical Sessions

1. Date Wednesday, November 18
 2. Room. 1004
 3. Time 10 : 30 - 11 : 30
 4. Session Advanced Combustion I
 5. Chair (Affiliation), Hiroya Ueda (Honda R&D Co., Ltd.)
 Co-chair (Affiliation) Francesco Balduzzi (University of Florence)

6. Paper No.(JSAE/SAE)	20159738 / 2015-32-0738
7. Paper title	Study on Flame Behavior Control by the Electric Field
8. Authors (Affiliation)	Shota Yanagisawa, Akira Iijima, Hideo Shoji, Koji Yoshida (Nihon University) Jun Osaka, Yoshihiko Matsui, Wakichi Kondo (DENSO CORPORATION)

9. Abstract

The purpose of this study is to elucidate flame propagation behavior of homogeneous propane-air mixture under application of non-uniform electric field. A needle-shaped electrode was attached to the ceiling and a plate electrode was set at bottom of combustion chamber, so that the electric field was applied in the direction of the chamber's vertical axis. A homogeneous propane-air mixture was supplied at equivalence ratio of 1.0 and was ignited by laser induced breakdown under atmospheric pressure and room temperature. It was found that the flame front and plate electrode were repelled each other and a thin air layer was formed between the flame and plate electrode when a relatively low positive DC non-uniform electric field was applied to the needle-shaped electrode. It might be thought that the induced current was generated in the flame front, so that the flame front and plate electrode repelled each other. However, when a high DC voltage which generated corona wind was applied, the flame front was deformed and the thin air layer was not formed. In case of a negative DC non-uniform electric field, the electrical breakdown was occurred through the flame. When the flame front approached the plate electrode and a positive single pulse high voltage was applied to the needle-shaped electrode (input voltage was 8 kV and pulse width was 2 ms), a thin air layer was effectively formed and the maximum combustion pressure was higher than that of conventional combustion due to reduction of heat loss by the thin air layer.

6. Paper No.(JSAE/SAE)	20159721 / 2015-32-0721
7. Paper title	Effects of Intake Pressure and Air-Fuel Ratio on Controlled Hot Surface Ignition Operating with Natural Gas
8. Authors (Affiliation)	Fino Scholl, Denis Neher, Maurice Kettner (Karlsruhe University of Applied Sciences), Andrés Melgar (BachillerUniversity of Valladolid), Markus Klaissle (SenerTec Kraft-Wärme-Energiesysteme GmbH)

9. Abstract

In an effort to reduce both maintenance costs and NOx emissions of small cogeneration engines operated with natural gas, an alternative ignition system that allows stable operation at very lean homogeneous air-fuel mixtures has been developed. Combustion is induced by an electrically heated ceramic glow plug, whose temperature is controlled by an ECU. Adjusting hot surface temperature allows shifting the inflammation timing of the mixture and, therefore, the phasing of combustion in the engine cycle.

The main aim of this work was to determine the effect of intake pressure and air-fuel ratio on the parameters of hot surface ignition (HSI) and understand which are the factors limiting stable HSI operation in terms of cycle-by-cycle variations. Furthermore, in order to explain abnormal combustion phenomena occurring at high surface temperatures, the process of mixture inflammation and combustion was examined through a combination of numerical simulation using the ECFM-3z combustion model and engine trials employing optical probes to record combustion radiation. The experiments showed that the energy consumption required to heat the surface and initiate combustion can be decreased substantially when raising intake pressure and/or advancing combustion phasing. On the other hand, when leaning the mixture or retarding combustion, the energy demand increases. It was found that the temperature control of the hot surface is most stable when heat released from combustion is relatively low and produces low combustion temperatures.



Abstracts of Technical Sessions

1. Date	Wednesday, November 18
2. Room.	1005
3. Time	10 : 30 – 11 : 30
4. Session	Materials I
5. Chair (Affiliation),	Hiroataka Kurita (Yamaha Motor Co., Ltd.)
Co-chair (Affiliation)	Brent Dohner (The Lubrizol Corporation)

6. Paper No.(JSAE/SAE)	20159743 / 2015-32-0743
7. Paper title	Development of Black Surface Treatment Applicable to Bolts for Motorcycles
8. Authors (Affiliation)	Hiroyuki Yoshida, Hiroshi Hirayama, Shinsuke Mochizuki (Honda R&D Co., Ltd.) Manabu Inoue, Yasuhiro Kato, Toshiki Inomata (Dipsol Chemicals Co., Ltd.)

9. Abstract

A black surface treatment without using hexavalent chromium and applicable to bolts of motorcycles has been developed. The surface treatment also satisfies the requirements of bolts for motorcycles such as fastening performance, corrosion resistance, weather resistance and appearance of outer finish.

There is a method of coating a black chemical conversion film using trivalent chromium on the zinc-plated surface as one of the surface treatments that do not use the hexavalent chromium. Such a black film, however, is thinner than the film using hexavalent chromium, and unable to ensure satisfactory black appearance. Meanwhile, although the dip-coating using a black paint can provide a sufficient black color, it is necessary to apply coating two times to eliminate an irregular color. As a result, thick paint films are formed on the roots of thread, making it difficult to fit into the internal thread. To simultaneously solve the above-mentioned two issues, two measures were executed. One was to apply the black film using trivalent chromium as an undercoat of dip-coating. The second was to develop paints that the amount of pigments in paints was adjusted on the assumption of the color of the undercoat. Thus a proper fit of thread was ensured when fastening in addition to a satisfactory black appearance even with the dip-coating only once. Also, the friction coefficient was controlled at an appropriate level by the selection of friction modifier. Moreover, the adhesion was improved by the enhancement of anchor effect of coating with the elimination of finishing process of the black chemical conversion film, and the requested corrosion resistance was achieved.

6. Paper No.(JSAE/SAE)	20159720 / 2015-32-0720
7. Paper title	Reduction in costs and environment Impact of The Composite Plating Solution
8. Authors (Affiliation)	Naoyuki Hirose (Kawasaki Heavy Industries, Ltd.)

9. Abstract

Our company adopts a cylinder-bore which is composite plated for weight saving and high output characteristics of the motorcycle engines.

The composite-plated-cylinder has good wear resistance in an efficient performance while there are some problems to control the composite plating solution since this solution contains particles which make filtration and electrolysis difficult.

Therefore we need to renew the solution within the stated periods, which brings about high cost and environment impact.

Thus we developed a recycle and reuse system by the used composite-plating-solution.

This method will cut costs by 60% approximately and reduce environment impact by reducing waste of plating solution.



Abstracts of Technical Sessions

1. Date Wednesday, November 18
 2. Room. 1006
 3. Time 10 : 30 - 11 : 30
 4. Session Alternative Fuels III
 5. Chair (Affiliation), Koji Yoshida (Nihon University)
 Co-chair (Affiliation) Robert Kee (Queen's University Belfast)

6. Paper No.(JSAE/SAE)	20159826 / 2015-32-0826
7. Paper title	Effects of Injection Timing and Injection Pressure on Combustion Characteristics and Emissions of Ethanol ED95 under Partially Premixed Combustion Condition
8. Authors (Affiliation)	Rachen Chumueang and Yossapong Laonual, (King Mongkut's University of Technology Thonburi (KMUTT), Thailand), Nuwong Chollacoop National (Metal and Materials Technology Center (MTEC), Thailand)

9. Abstract

The purpose of this study is to investigate the effects of injection timing and injection pressure on combustion characteristics and emissions of the direct injection single cylinder CI engine fueled with ethanol ED95 fuel (95% hydrous ethanol blended with 5% commercial additive by volume) under partially premixed combustion condition. The engine was modified to increase the compression ratio from 18 to 28. The experiment was tested at maximum engine load under a constant engine speed for all testing conditions.

The experimental results show a lower coefficient of variation (COV) for the indicated mean effective pressure (IMEP), which implies that higher combustion stability is achieved when the injection timing is advanced. However, the ignition delay significantly increases. In addition, when injection timing is advanced and the injection pressure is increased, THC and CO emissions increase due to lower combustion efficiency. Despite limitation of working operation at high load on ED95, it is remarkable to note that the indicated thermal efficiency of all ED95 experiments are achieved slightly higher compared to diesel.

6. Paper No.(JSAE/SAE)	20159797 / 2015-32-0797
7. Paper title	A Comparative Analysis of Combustion Process, Performance and Exhaust Emissions in Diesel Engine Fueled with Blends of Jatropha Oil-Diesel Fuel and Jatropha Oil-Kerosene
8. Authors (Affiliation)	Takaaki Yamaji (Kanazawa Institute of Technology)

9. Abstract

A comparative study was performed by use of blends of Jatropha oil/diesel fuel and Jatropha oil/kerosene in order to investigate the feasibility of direct utilization of Jatropha oil in DI diesel engine. The aim of mixing Jatropha oil into diesel fuel and kerosene was to mitigate the impacts of physical properties of Jatropha oil.

Mixing fraction of Jatropha oil was changed at low and partial loads in a diesel engine equipped with a common-rail fuel injection system, while other experimental conditions were fixed. Experimental result at low load demonstrated that mixing 60 vol.% of Jatropha oil gave no significant impact on indicated thermal efficiency whereas further increase of Jatropha oil deteriorated the thermal efficiency. Though, particulate matter (PM) increased with increase of Jatropha oil. At partial load where double injection was used, blends with 80 vol.% maintained indicated thermal efficiency and PM identical with diesel fuel. These observations were common for Jatropha oil/diesel fuel and Jatropha oil/kerosene blends, although there was a difference in PM amount at low load. To gain insight into the combustion process, ignition and combustion processes were visualized by use of an optically accessible engine. The high speed movies showed the influence of physical properties of Jatropha oil on timings and locations of ignition and combustion.



Abstracts of Technical Sessions

1. Date	Wednesday, November 18
2. Room.	1007
3. Time	10 : 30 - 12 : 00
4. Session	Measurement & Simulation II
5. Chair (Affiliation),	Hideyuki Ogawa (Hokkaido University)
Co-chair (Affiliation)	Giovanni Ferrara (University of Florence)

6. Paper No.(JSAE/SAE)	20159711 / 2015-32-0711
7. Paper title	Experiments and Simulations of a Lean -Boost Spark Ignition Engine for Thermal Efficiency Improvement
8. Authors (Affiliation)	Sok Ratnak, Jin Kusaka, and Yasuhiro Daisho (Waseda University) Kei Yoshimura, and Kenjiro Nakama (SUZUKI MOTOR CORPORATION)

9. Abstract

Primary work is to investigate premixed laminar flame propagation in a constant volume chamber of iso-octane/air combustion. Experimental and numerical results are investigated by comparing flame front displacements under lean to rich conditions. As the laminar flame depends on equivalence ratio, temperature, and pressure conditions, it is a main property for chemical reaction mechanism validation. Firstly, one-dimensional laminar flame burning velocities are predicted in order to validate a reduced chemical reaction mechanism. A set of laminar burning velocities with pressure, temperature, and mixture equivalence ratio dependences are used in a 3D-CFD calculation to compare the predicted flame front displacements with that of experiments. It is found that the reaction mechanism is well validated under 1D and 3D combustion flame calculations. Next, lean experiments are operated in a SI engine by boosting intake pressure to maintain high efficiency without output power penalty. The peak indicated thermal efficiency are finally achieved under $\lambda=1.3$ with intake manifold absolute pressure 150 kPa in experiment....

6. Paper No.(JSAE/SAE)	20159728 / 2015-32-0728
7. Paper title	Development of Measurement Technic on Propagating Flame by Densely Installed Ion-probes
8. Authors (Affiliation)	Tomoaki Yatsufusa, Shinsuke Miyata, Koji Ishibashi (Hiroshima Institute of Technology)

9. Abstract

A new technic to measure the propagating flame precisely by using densely installed multiple ion-probes has been developed. This system targets the high-intensity and pulsatile combustion, including knocking in gasoline engine, and oscillating combustion in burner or gas turbine combustor. In such environment, observation of details in the combustor by visualization is generally limited because of the strength of observation window. In contrast, ion-probe is physically and thermally strong enough to endure such environment. In the present study, characteristics of the combustion measurement were investigated using the different types of propagating flame with various LPG-oxygen-nitrogen mixtures. The composition of the mixture was stoichiometric LPG-oxygen diluted with nitrogen. Nitrogen dilution ratio was varied to control the flame propagation velocity. Minimum and maximum propagation velocity tested in the series of experiment was a few meters per second and about 2300m/s respectively. This range covers most type of combustions utilized in the industrial field. The result shows....

6. Paper No.(JSAE/SAE)	20159748 / 2015-32-0748
7. Paper title	Combustion Diagnostics Using Time-Series Analysis of Radical Emissions in a Practical Engine
8. Authors (Affiliation)	Nobuyuki Kawahara, Shota Hashimoto, Eiji Tomita (Okayama University)

9. Abstract

The objective of this study is to investigate the initial flame propagation characteristics of turbulent flame in an engine cylinder through time-series analysis of radical emissions. A spark plug with optical fiber was developed in this study. The plug sensor is M12 type that makes it possible to mount in practical engine. The spark plug sensor can detect radical emissions in time-resolved spectra through time-series spectroscopic measurement. In this spectra, some kinds of radical emissions such as OH*(306 nm), CH*(431 nm) and C₂*(517 nm) based on principle of chemiluminescence are observed. In this study, the spark plug sensor was applied to both compression-expansion machine (CEM) and practical engine. As a result of CEM with bottom viewed high-speed camera, three kinds of spectra could be detected. At first, after the spark, there were radical emissions of the CH* and C₂* in case that a spark plug sensor detected the flame front, and then the CO-O recombination emission was observed in the burned gas. As a result of practical engine, an hour durable experiment for spark plug sensor was implemented to confirm its durability by practical engine with high engine speed at wide-opened throttle....



Abstracts of Technical Sessions

1. Date Wednesday, November 18
2. Room. 1008
3. Time 10 : 30 – 12 : 00
4. Session Engine Technology III
5. Chair (Affiliation), Takahito Murase (Kawasaki Heavy Industries, Ltd.)
Co-chair (Affiliation) Patrick Pertl (Graz University of Technology)

6. Paper No.(JSAE/SAE)	20159805 / 2015-32-0805
7. Paper title	Study of Optimization of Reciprocating Parts for General-purpose Engine with Aluminum-alloy Connecting Rods
8. Authors (Affiliation)	Masami Okubo, Masato Suzuki (Honda R&D Co., Ltd.)

9. Abstract

The connecting rods employed in most of general-purpose engines with a power from 1.5 kW to 10 kW are manufactured from aluminum alloy in order to increase productivity and reduce weight, and therefore display lower material strength than steel connecting rods. In terms of operating conditions, general-purpose engines are frequently operated under high load while being held at a comparatively low engine speed, necessitating strength and durability in relation to combustion pressure. Realizing a balance between the rigidity of each part is an important factor in reconciling the achievement of weight reduction in the reciprocating parts while also keeping strength. The research discussed in this paper developed a structure optimization system to examine shape parameters for reciprocating parts targeting 4 kW class engines, and studied shapes that would balance the reduction of weight with the keeping of strength. These realizes design shapes of 4 kW class engines in which the stress generated on each part is equivalent to or lower than the stress generated on the mass-production shape, while reducing the mass of reciprocating parts by approximately 6% (compared to the initial shape). Investigation using reciprocating shapes of general-purpose engines with different power showed that shapes of reciprocating parts with the smallest weight had the same dimension pattern as discussed above irrespective of the cylinder bore size.

6. Paper No.(JSAE/SAE)	20159719 / 2015-32-0719
7. Paper title	Development of the XMv3 High Efficiency Cycloidal Engine
8. Authors (Affiliation)	D. Littera, M. Nickerson, A. Kopache, G. Machamada, C. Sun, A. Schramm, N. Medeiros, K. Becker, N. Shkolnik, A. Shkolnik (LiquidPiston, Inc.)

9. Abstract

The demand for lighter, smaller, more efficient, and more powerful engines calls for a rethinking of the traditional internal combustion engine (ICE). This paper describes development progress of LiquidPiston's small rotary engine, the XMv3, which operates on a Spark-Ignited (SI) variant of its patented High Efficiency Hybrid Cycle (HEHC). This thermodynamic cycle, which combines high compression ratio (CR), constant-volume combustion, and over-expansion, has a theoretical efficiency of up to 75% using air-standard assumptions and first-law analysis. XMv3 displaces 70 cc (23 cc per each of three working chambers) and is gasoline fueled. The engine is simple, having only two primary moving parts, which are balanced to prevent vibration. The 'X' engine geometry utilized by XMv3 can be considered an inverted 'Wankel', retaining the traditional Wankel' rotary advantages of high power density and smooth operation, while also overcoming some of Wankel's inherent performance limitations. These include inflexible combustion chamber shape, and lubrication and emissions challenges...

6. Paper No.(JSAE/SAE)	20159817 / 2015-32-0817
7. Paper title	Thermodynamic Limits of Efficiency Enhancement of Small Displacement Single-Cylinder Engines
8. Authors (Affiliation)	Alexander Trattner, Florian Kupelwieser, Patrick Pertl, Franz Winkler, Stephan Schmidt, Roland Kirchberger (Graz University of Technology)

9. Abstract

Millions of small displacement single-cylinder engines are used for the propulsion of scooters, motorcycles, small boats and others. These SI-engines represent the basis of an affordable mobility in many countries, but at the same time their efficiency is quite low. Today, the limited fossil fuel resources and the anthropogenic climate require a sustainable development of combustion engines, the reduction of fuel consumption being an important factor. A variety of different strategies (turbo-charging, cylinder deactivation, direct injection, etc.) are investigated here to increase the efficiency of multi-cylinder engines. In the case of small displacement single-cylinder engines, other strategies are required because of their special design and the high pressure on costs. In the context of this paper different layout parameters which have an influence on the working process are investigated, with the aim of increasing the efficiency of small displacement single-cylinder engines...



Abstracts of Technical Sessions

1. Date Wednesday, November 18
 2. Room. 1004
 3. Time 13 : 30 - 14 : 30
 4. Session Advanced Combustion II
 5. Chair (Affiliation), Hiroya Ueda (Honda R&D Co., Ltd.)
 Co-chair (Affiliation) Franz Winkler (Graz University of Technology)

6. Paper No.(JSAE/SAE)	20159771 / 2015-32-0771
7. Paper title	Influence of Ca-, Mg-and Na-based Engine Oil Additives on Abnormal Combustion in a Spark-ignition Engine
8. Author (Affiliation)	Kenta Miura, Kento Shimizu, Norikuni Hayakawa, Tomomi Miyasaka, Akira Iijima, Hideo Shoji (Nihon University) Toshimasa Utaka, Kazushi Tamura, Hideki Kamano (Idemitsu Kosan Co., Ltd.)

9. Abstract

One issue of downsized and supercharged engines is low-speed pre-ignition (LSPI) that occurs in the low-speed and high-load operating region. One proposed cause of LSPI is the influence of the engine oil and its additives. However, the effect of engine oil additives on pre-ignition and the mechanism involved are still not fully understood. This study investigated the influence of engine oil additives on abnormal combustion in a spark-ignition engine. A four-stroke air-cooled single-cylinder engine with a side valve arrangement was used in conducting combustion experiments. The research methods used were in-cylinder pressure analysis, in-cylinder visualization and absorption spectroscopic analysis. Engine oil additives were mixed individually at a fixed concentration into a primary reference fuel with an octane number of 50 and their effect on knocking was investigated.

6. Paper No.(JSAE/SAE)	20159796 / 2015-32-0796
7. Paper title	Effect of Xylene ratio on the secondary atomization with UV laser
8. Author (Affiliation)	Hiroshi Enomoto, Naoki Iwafune, Masaya Morii, Ryo Honda, Noboru Hieda, Yoshikazu Teraoka(Kanazawa University.)

9. Abstract

In our study, phenomena is observed that 30 μm droplet become breakup by UV laser irradiation. This phenomena change by composition of droplet. Then we focused on difference of absorbance, hexadecane and o-xylene are used as fuel. The former do not absorb UV enough and the latter do absorb UV enough. And authors examined the relation mixing ratio and breakup phenomena using blended fuel which consist of hexadecane and o-xylene. With regard to the UV laser we used, wavelength is 266 nm, flash of time is 10 nsec and laser intensity is 15 mJ. CCD camera, strobe light with 180 nsec flash time and lens of ten magnification were used for observation. As a result, we obtained the following; 1) A state of breakup phenomena depend on concentration of o-xylene. 2) The absorbance is not related with a state of breakup phenomena.



Abstracts of Technical Sessions

1. Date Wednesday, November 18
 2. Room 1005
 3. Time 13 : 30 - 14 : 30
 4. Session Materials II
 5. Chair (Affiliation) Hirotaka Kurita (Yamaha Motor Co., Ltd.)
 Co-chair (Affiliation) Brent Dohner (The Lubrizol Corporation)

6. Paper No.(JSAE/SAE)	20159830 / 2015-32-0830
7. Paper title	Development of Fracture-split Connecting Rods made of Titanium Alloy for Use on Supersport Motorcycles
8. Authors (Affiliation)	Tsuyoshi Kubota, Kosuke Doi, Takeshi Murakami, Yuuki Kojima, Tetsu Miura (Yamaha Motor Co., Ltd.)

9. Abstract

A connecting rod made of titanium alloy is effective for lower fuel consumption and higher power output comparing to a steel one because the titanium connecting rod enables to reduce the weight of both of reciprocating and rotating parts in an entire engine substantially. But up to now, it has been adopted only to expensive and small-lot production models because a material cost is high, a processing is difficult and a wear on a sliding area should be prevented. In order to adopt the titanium connecting rods into a more types of motorcycles, appropriate materials, processing methods and surface treatment were considered. Hot forging process was applied not only to reduce a machining volume but also to enhance a material strength and stiffness. And the fracture-splitting (FS) method for the big-end of the titanium connecting rod was put into a practical use. The brittle fractured surface of the big-end by FS method is useful for not only cost reduction but also ensuring the stiffness of the connecting rod compensating the low elastic modulus of titanium alloy comparing to that of ferrous alloys. In this study, the evaluation results of materials characteristics related to these processes and functional property of surface treatment is described. From these evaluations, the capabilities of FS titanium connecting rods were quantitatively shown. FS titanium connecting rods have been produced for the supersport motorcycle engines from November 2014.

6. Paper No.(JSAE/SAE)	20159850 / 2015-32-0850
7. Paper title	High Performance Powder-Forged Connecting Rods for Direct Injection Turbocharged Engines
8. Authors (Affiliation)	Edmond Ilia, Giorgio Lanni, Kevin Tutton, Doug Sinclair, and Michinari Suemasu (Metaldyne Performance Group)

9. Abstract

The introduction of direct injection turbocharged engines has increased the need for higher performance connecting rods, able to withstand higher compressive loads in operation. In this respect, new materials with high compressive yield strength and fatigue performance for powder-forged connecting rods, such as HS150, HS160, and HS170M, were developed and successfully introduced in production. Among them, HS170M, currently used to manufacture connecting rods for several high performance engines, not only has exceptional strength, but less variation in mechanical properties as a function of its chemical composition variation within the specified limits compared to other powder-forged materials. Furthermore, recent strength tests conducted at engine operating temperatures on specimens machined from connecting rods have shown some very interesting results : despite the fact that the mechanical properties of most steels decrease at higher temperatures, the strength of Cu-rich HS materials increases due to second phase strengthening provided by nano size Cu precipitates. For this reason, powder-forged connecting rods manufactured with HS170M are stronger than their dropforged counterparts manufactured with micro alloyed steels. Additionally, advancements in design and manufacturing, such as design optimization, post-delubrication shot peening, enhanced shot peening, etc., have resulted in higher performance powder-forged connecting rods and, as a result, in mass reductions, thus further contributing to fuel economy and reduced emissions.



Abstracts of Technical Sessions

1. Date Wednesday, November 18
 2. Room. 1007
 3. Time 13 : 30 - 14 : 30
 4. Session Measurement & Simulation III
 5. Chair (Affiliation), Shigeru Fujii (Yamaha Motor Co., Ltd.)
 Co-chair (Affiliation) Giovanni Ferrara (University of Florence)

6. Paper No.(JSAE/SAE)	20159731 / 2015-32-0731
7. Paper title	Acceleration Performance Analysis for Rubber V-belt CVT with Belt Tension Clutching
8. Authors (Affiliation)	Yusuke Okimura, Moriyuki Sakamoto, Seiji Ito, Akiyuki Yamasaki (Kawasaki Heavy Industries, Ltd.)

9. Abstract

The power train system for Utility Vehicles (UVs) or All-Terrain Vehicles (ATVs) mainly consists of a rubber V-belt CVT. The adjustment of the CVT specification requires many steps to realize the shifting operations of the CVT so as to satisfy the acceleration feeling of the driver.

In this paper, we report on the simulation technology that predicts the transient behavior during an acceleration of the vehicle equipped with a belt tension clutching CVT, which has both functions of the shift operation and the clutch action. By using the developed simulation technique, it has become possible to adjust the CVT specifications efficiently.

6. Paper No.(JSAE/SAE)	20159745 / 2015-32-0745
7. Paper title	Systematic Modeling Technique by using Function Power Graph on the Centrifugal Anti-lock Braking System Simulation
8. Authors (Affiliation)	Yu-fan Chen, Cheng-ping Yang, I-ming Chen, and Tyng Liu (Department of Mechanical Engineering, National Taiwan University)

9. Abstract

A systematic modeling methodology using Function Power Graph (FPG) to analyze mechanical systems is proposed in this paper, and the novel Centrifugal Anti-lock Braking System (C-ABS) is used as the example. In this paper, a systematic modeling process combined with the FPG method and SimulationX-based modeling has been demonstrated. First, schematic diagram and working principle of the C-ABS model has been developed and illustrated. Based on the FPG method, several symbols (power unit, clutch/brake unit, and connection unit) for the C-ABS have been introduced. Second, system mode, operation, and function inspection of the C-ABS have been analyzed. Then, each component model of the C-ABS (wheel, disc brake, gearbox, and centrifugal braking device) has been established, and then the schematic diagram of the C-ABS has been transferred into practical image of the system structure (or physical model) through SimulationX to identify the dynamic characteristics of the C-ABS. In addition, comparison between the C-ABS and conventional ABS has been made. Finally, an experimental platform of the C-ABS has been set up and the experiment measurements are in agreement with our SimulationX-based simulation results. According to this systematic modeling technique of the FPG method, the characteristics of any new system structure can be easily identified. Then, through CAE software, such as SimulationX, a physical model can be easily created to achieve better performance and development of system design and system analysis.



Abstracts of Technical Sessions

1. Date	Wednesday, November 18
2. Room.	1008
3. Time	13 : 30 - 14 : 30
4. Session	Hybrids, Electric Drives & Fuel Cells
5. Chair (Affiliation),	Yasuyuki Muramatsu (Yamaha Motor Co., Ltd.)
Co-chair (Affiliation)	Robert Kee (Queen's University Belfast)

6. Paper No.(JSAE/SAE)	20159740/2015-32-0740
7. Paper title	Single Cylinder 25 kW Range Extender : Development for Lowest Vibrations and Compact Design Based on Existing Production Parts
8. Authors (Affiliation)	Christian Hubmann, Hubert Friedl (AVL List-GmbH) Stefan Gruber, Nigel Foxhall (BRP-Powertrain GmbH & Co KG)

9. Abstract

The automotive trend towards increased levels of electrification is showing a clear direction for hybrid technologies. Nowadays Mild- and plug-in-hybrids open a very wide area of future developments whereas battery electric vehicles (BEV) are still evident but still perceived as niche products with limited production volumes. Nevertheless, major OEMs are working on these kinds of vehicles and have also brought such EV concepts into series production. All of these designs show a clear trend that, beside the topic of electric traction motor and energy storage systems, the internal combustion engine (ICE) is also coming into focus again. In many of these vehicles the range extender (RE) unit is foreseen as an emergency unit to recharge the batteries if the state of charge (SOC) is too low. One of the major advantages of a BEV over other designs is the very good acoustic behavior, so the NVH performance becomes the most challenging topic for RE development.

AVL has already investigated, published and partially also developed different types of RE units :

- single rotor Wankel [1]
- 2 cylinder inline [2]
- single cylinder [3]

Amongst others, a significant benefit of the single cylinder RE is the possible usage of parts from already existing powersports applications providing technology which typically is needed to fulfill the requirements of a BEV, such

6. Paper No.(JSAE/SAE)	20159753/2015-32-0753
7. Paper title	A Study of Function Control in the Electric Motorcycle
8. Authors (Affiliation)	Daisuke Kawai, Yoshimoto Matsuda, Takahito Murase (Kawasaki Heavy Industries, Ltd.)

9. Abstract

Generally, it is thought that control is simpler than an Internal Combustion Engine (ICE)-Motorcycle (MC) as for the Electric Vehicle (EV) type MC. However, there is few characteristic to the ICE-MC to the EV-MC and it cannot get good performance without control for EV-MC.

We study the methodology for design and evaluation an EV-MC. In this approach, we developed the prototype EV-MC having manual transmission. In our study, we think that EV-MC having manual transmission is feature in comparison with other general EV-MC. From this feature, we had to develop the function control in addition to standard EV-MC function control.

This paper provides a function control for EV-MC having manual transmission. In this paper, we arrange the problem points of EV-MC which put electric propulsion motor and manual transmission together at first. And report the result that studied a method to solve the problem points.



Abstracts of Technical Sessions

1. Date Thursday, November 19
 2. Room. 1005
 3. Time 8 : 30 - 10 : 00
 4. Session HCCI I
 5. Chair (Affiliation), Tatsuya Kuboyama (Chiba University)
 Co-chair (Affiliation) Giovanni Vichi (University of Florence)

6. Paper No.(JSAE/SAE)	20159706 / 2015-32-0706
7. Paper title	Experimental Investigation and Analysis of Homogeneous Charge Compression Ignition in a Two-Stroke Free-Piston Engine
8. Authors (Affiliation)	Stephan Schneider, Horst E. Friedrich (German Aerospace Center)

9. Abstract

The present paper deals with the experimental investigation of homogeneous charge compression ignition in a free-oscillating two-stroke free-piston engine. The Free Piston Linear Generator (FPLG), which is being developed at the German Aerospace Center (DLR), is an innovative internal combustion engine for the generation of electrical power. This concept can for example be used in hybrid electric vehicles, as an auxiliary power unit or in combined heat and power units. The FPLG consists of three main components. In the two-stroke combustion unit, heat is released by burning a fuel-air mixture and a piston is accelerated. This energy is then converted into electric energy in the second component, the linear generator. This subsystem consists of electromagnetic coils as a stator and permanent magnets as a mover. The mover is rigidly coupled to the combustion piston....

6. Paper No.(JSAE/SAE)	20159770 / 2015-32-0770
7. Paper title	Experimental and Numerical Study of HCCI Combustion using Cooled EGR
8. Authors (Affiliation)	Munehiro Matsuishi, Yuya Higuchi, Yasuhide Abe, Yuma Ishizawa, Akira Iijima, Hideo Shoji (Nihon University) Kazuhito Misawa, Hiraku Kojima, Kenjiro Nakama (SUZUKI MOTOR CORPORATION)

9. Abstract

Unresolved issues of Homogeneous Charge Compression Ignition (HCCI) combustion include an extremely rapid pressure rise on the high load side and resultant knocking. Studies conducted to date have examined ways of expanding the region of stable HCCI combustion on the high load side such as by applying supercharging or recirculating exhaust gas (EGR). However, the effect of applying EGR gas to supercharged HCCI combustion and the mechanisms involved are not fully understood.

In this study, the effect of EGR gas components on HCCI combustion was investigated by conducting experiments in which external EGR gas was applied to supercharged HCCI combustion and also experiments in which nitrogen (N₂) and carbon dioxide (CO₂) were individually injected into the intake air pipe to simulate EGR gas components. In addition, HCCI combustion reactions were analyzed by conducting chemical kinetic simulations under the same conditions as those of the experiments.

6. Paper No.(JSAE/SAE)	20159772 / 2015-32-0772
7. Paper title	A Study of Streamer-discharge-assisted Autoignition Combustion using an Optically Accessible Engine
8. Authors (Affiliation)	Masanori Yamada, Junki Sahara, Takashi Shimada, Yuki Yoshida, Chibin Rin, Akira Iijima, Tomohiko Asai, Mitsuaki Tanabe, Hideo Shoji (Nihon University)

9. Abstract

It is difficult to control the ignition timing of Homogeneous Charge Compression Ignition (HCCI) engines because they lack a physical means of igniting the mixture. Another issue of HCCI engines is their narrow operating range owing to the occurrence of misfiring at low loads and abnormal combustion at high loads. As a possible solution to these issues, this study focused on the generation of a streamer discharge using nonequilibrium plasma as a means of assisting HCCI combustion. A two-stroke engine that allowed visualization of the entire bore area was used in this study. A primary reference fuel blend (50 RON) was used as the test fuel. The streamer discharge was continuously generated in the end-gas region during a 360 deg. interval from the scavenging stroke to the exhaust stroke using a spark plug from which the ground electrode had been removed. Experiments were conducted in which the applied voltage of the streamer discharge was varied to investigate its effect on combustion. The results showed that the application of the streamer discharge to an HCCI engine has the effect of advancing the ignition timing and moderating the rapid rate of combustion. It was also observed that these characteristics can be varied depending on the applied voltage of the streamer discharge.



Abstracts of Technical Sessions

1. Date	Thursday, November 19
2. Room.	1006
3. Time	8 : 30 - 10 : 00
4. Session	Emissions I
5. Chair (Affiliation),	Hiroimi Deguchi (SUZUKI MOTOR CORPORATION)
Co-chair (Affiliation)	Leonid Tartakovsky (Technion - Israel Institute of Technology)

6. Paper No.(JSAE/SAE)	20159783 / 2015-32-0783
7. Paper title	Development of three-way catalytic converter diagnostic strategy
8. Authors (Affiliation)	Yong Fu Syu, Jia Siou Wu, Jhih Si Syu, Bo Chiuan Chen, Yuh Yih Wu (National Taipei University of Technology)

9. Abstract

In this paper, the off-line analysis method is applied to develop three-way catalytic converter (TWC) diagnostic strategy including oxygen sensor (O₂ sensor) diagnostic strategy with common narrow band oxygen sensor (EGO sensor) in Matlab/Simulink software. Moreover, Mototron ECU (Engine Control Unit) is used for monitoring catalyst deterioration. However, aged catalyst is difficult to possess so the different catalytic conversion efficiency (CCE) is simulated by using exhaust by-pass valve. The CEC (China Engine Corporation) 1L V2, four stroke, water-cooled engine is selected as target engine to conduct engine dynamometer test. After making sure O₂ sensor operates normally, the catalyst diagnostic strategy test is executed. The experimental result shows that the catalyst deterioration accurately can be detected when the failure phenomenon takes place. In order to make sure the robustness of proposed diagnostic strategy, the common diagnostic strategy, switching times and amplitude ratio, is established to compare accuracy of proposed strategy. Shown as result, when the CCE is closed to 50%, the proposed strategy can reduce possible misjudgment.

6. Paper No.(JSAE/SAE)	20159802 / 2015-32-0802
7. Paper title	Investigation of high achievable pollutant reduction on a “State of the Art” Indian 2 wheelers - Technology road map to a cleaner air
8. Authors (Affiliation)	Francois Jayat, Sven Seifert (Continental Emitec GmbH)

9. Abstract

Affordable, efficient and durable catalytic converters for the two and three wheeler industry in developing countries are required to reduce vehicle emissions and to participate in a cleaner and healthier environment. As a contribution Continental Emitec started a comprehensive testing program with a state of the art 180 cc Bharat Stage (BS) III Indian motorcycle. The program consists of testing the state of the art of Metallic substrates with structured foils with various catalyst sizes and positions (original or close coupled). The publication presents a short literature survey and the results of the investigation with a big catalyst volume mounted in underfloor position as well as in close coupled position, gained over the World-wide harmonized Motorcycle Test Cycle, considering the two possible vehicle classifications of this motorcycle, Sub-Class 2.1 and Sub-Class 2.2. This catalyst is based on metal turbulent structured catalyst substrate with longitudinal foil structures (LS-Design™). The results are showing that all pollutant emissions could be reduced to very low levels if an appropriated technology road map is applied.

6. Paper No.(JSAE/SAE)	20159821 / 2015-32-0821
7. Paper title	Characterization of Biodiesel Particle Emission in Trapping and Regeneration Processes on Cordierite Diesel Particulate Filter
8. Authors (Affiliation)	Komkla Siricholathum, Preechar Karin, Chinda Charoenphonphanich (King Mongkut's Institute of Technology Ladkrabang), Katsunori Hanamura (Tokyo Institute of Technology), Nuwong Chollacoop (National Science and Technology Development Agency)

9. Abstract

As well-known, the diesel engine has the highest thermal efficiency at the same load as compared with internal combustion engine but its disadvantage is particulate matter (PM) emitted to the atmosphere. The studies of this paper were divided into two parts. The first part studied the quantity of PM from the both diesel and biodiesel fuels at 80% load (2400 rpm) by the trapping process on diesel particulate filter (DPF) used in a partial flow dilution tunnel. The second part studied the regeneration process of PM under the flow rate of oxygen and nitrogen gas of 13.5 L/min with 10%, 15%, and 21% of oxygen gas. The result showed that amount of PM from biodiesel fuel was lower around two times than PM from diesel fuel. The duration in regeneration process of biodiesel's PM was shorter than diesel while increasing of oxygen percentage can reduce regeneration time.



Abstracts of Technical Sessions

1. Date Thursday, November 19
 2. Room. 1007
 3. Time 8 : 30 - 9 : 30
 4. Session Measurement & Simulation IV
 5. Chair (Affiliation), Shigeru Fujii (Yamaha Motor Co., Ltd.)
 Co-chair (Affiliation) Stephan Schmidt (Graz University of Technology)

6. Paper No.(JSAE/SAE)	20159811 / 2015-32-0811
7. Paper title	Development of Fatigue Durability Evaluation Technology for Motorcycle Frame
8. Authors (Affiliation)	Daichi Kano, Nagasaka Kazuya, Go Matsubara, Takumi Kawasaki, Akiyuki Yamasaki, Hiroyuki Kasugai, Hideaki Saito (Kawasaki Heavy Industries, Ltd.)

9. Abstract

In the development of a motorcycle frame, the balance between high performance and reliability and a short development period are important. In this study, a fatigue durability evaluation technique for a motorcycle frame was developed to enable highly accurate development within a short period of time. Furthermore, we developed a shaking table excitation system as a means to supplement the road test.

6. Paper No.(JSAE/SAE)	20159739 / 2015-32-0739
7. Paper title	Prediction of fatigue strength of motorcycle exhaust system considering vibrating and thermal stresses
8. Authors (Affiliation)	Hiroshi Kuribara, Hiroshi Horikawa, Takashi Teraguchi, Takanori Nagata, Daisuke Kitamura (Honda R&D Co., Ltd.)

9. Abstract

A method applicable in the design stage to predict fatigue strength of a motorcycle exhaust system was developed. In this prediction method, a vibrating stress, thermal stresses, stresses resulting from the assembling of the exhaust system components and a deterioration of fatigue strength of materials originated from high temperature were simultaneously taken into account. For the prediction of the vibrating stress, flexible multibody dynamics was applied to get modeling accuracy for vibration characteristics of the entire motorcycle and the exciting force delivered from engine vibrations. The thermal conduction analysis and the thermal deformation analysis based on finite element method (FEM) were applied for the prediction of thermal stresses in the exhaust system components. The temperature distribution on the surfaces of the exhaust system components is required for calculations of the thermal stresses. The heat transfer analysis, which was composed by combing a one-dimensional (1D) engine cycle simulation and an air flow simulation around the vehicle by 3D-CFD, was used for the estimation of temperature distributions. To validate the developed method, the correlations between the simulations and the actual measurements were analyzed for the vibrating stress, the temperature distribution, the thermal stresses and the fatigue safety factor....



Abstracts of Technical Sessions

1. Date Thursday, November 19
 2. Room. 1004
 3. Time 11 : 00 - 12 : 30
 4. Session Functional Safety
 5. Chair (Affiliation), Takashi Mitome (SUZUKI MOTOR CORPORATION)
 Co-chair (Affiliation) Tony Szczotka (Robert Bosch LLC)

6. Paper No.(JSAE/SAE)	20159714 / 2015-32-0714
7. Paper title	Research on Method for Classifying Injury Severity Using Motorcycle Accident Data for ISO 26262
8. Authors (Affiliation)	Yuji Arai, Makoto Hasegawa, Takeshi Harigae (Japan Automobile Research Institute)

9. Abstract

ISO 26262 was established in 2011 as a functional safety standard for passenger cars. In this standard, ASILs (Automotive Safety Integrity Levels) representing safety levels for passenger cars are determined by evaluating the hazardous events associated with each item constituting an electrical and/or electronic safety-related system according to three evaluation criteria including injury severity. On the other hand, motorcycles will be included in the scope of application of ISO 26262 in the next revision. It is expected that a severity evaluation for motorcycles will be needed because motorcycles are clearly different from passenger cars in vehicle mass and structure. Therefore, this study focused on severity class evaluation for motorcycles. A method of classifying injury severity according to vehicle speed was developed on the basis of accident data. In addition, a severity table for motorcycles classifying injury severity according to vehicle speed for each accident type was produced using accident data involved with motorcycles in Japan.

6. Paper No.(JSAE/SAE)	20159746 / 2015-32-0746
7. Paper title	ISO 26262 Controllability Evaluation Technique by Expert Riders
8. Authors (Affiliation)	Maki Kawakoshi, Takashi Kobayashi, Makoto Hasegawa (Japan Automobile Research Institute)

9. Abstract

Controllability (C class) represents the level of the ability to avoid harm and is one of the parameters that determine the Automotive Safety Integrity Level in the ISO 26262 functional safety standard, which applies to the electrical and/or electronic systems. This study aimed to consider an appropriate C class evaluation technique for expert riders in applying ISO 26262 to motorcycles.

This study attempted to show a C class evaluation method without deviation by the riders and presented examples of the evaluation of three hazardous events in actual vehicle tests. In addition, riders' comments regarding their understanding of the circumstances that resulted in the evaluation were collected, and the correspondence of these comments was examined.

We selected "unintended acceleration" or "unintended deceleration" due to the malfunction of the electronic throttle control system as hazard examples and conducted tests to reproduce hazardous events. The expert riders evaluated the C class using the evaluation method that we considered. For unintended acceleration when following a preceding vehicle or during turning, the C classes were evaluated from C0 (control in general) to C3 (difficult to control or uncontrollable) depending on the acceleration level. The results of C class evaluation by all riders were found to be similar. For unintended deceleration during turning, all riders...

6. Paper No.(JSAE/SAE)	20159794 / 2015-32-0794
7. Paper title	Examination of the Validity of Connections between MSILs and ASILs in the Functional Safety Standard for Motor Vehicles
8. Authors (Affiliation)	Sei Takahashi, Hideo Nakamura (College of Science and Technology, Nihon University), Makoto Hasegawa (Japan Automobile Research Institute)

9. Abstract

ISO 26262 (Road vehicles – Functional safety), a functional safety standard for motor vehicles, was published in November 2011. In this standard, hazardous events associated with each item constituting a safety-related system are assessed according to three criteria, namely, Severity, Exposure, and Controllability, thereby determining ASILs (Automotive Safety Integrity Levels) representing safety levels for motor vehicles. Although motorcycles are not included in the scope of application of the current edition of ISO 26262, it is expected that motorcycles will be included in the next revision. However, it is not appropriate to directly apply ASILs to motorcycles, because the situation of usage in practice presumably differs between motorcycles and motor vehicles.



Abstracts of Technical Sessions

1. Date Thursday, November 19
 2. Room. 1005
 3. Time 11 : 00 - 12 : 30
 4. Session HCCI II
 5. Chair (Affiliation), Tatsuya Kuboyama (Chiba University)
 Co-chair (Affiliation) Francesco Balduzzi (University of Florence)

6. Paper No.(JSAE/SAE)	20159790 / 2015-32-0790
7. Paper title	Influence of Combustion Chamber Wall Temperature on Combustion in an HCCI Engine Using an Alternative Fuel
8. Authors (Affiliation)	Takahiro Shima, Yuki Takamura, Hirotaka Suzuki, Keisuke Mochizuki, Akira Iijima, Koji Yoshida, Hideo Shoji (Nihon University)

9. Abstract

Internal combustion engines today are required to achieve even higher efficiency and cleaner exhaust emissions. Currently, research interest is focused on premixed compression ignition (Homogeneous Charge Compression Ignition, HCCI) combustion. However, HCCI engines have no physical means of initiating ignition such as a spark plug or the fuel injection timing and quantity. Therefore, it is difficult to control the ignition timing. In addition, combustion occurs simultaneously at multiple sites in the combustion chamber. As a result, combustion takes place extremely rapidly especially in the high load region. That makes it difficult for the engine to operate stably at high loads. This study focused on the fuel composition as a possible means to solve these problems. The effect of using fuel blends on the HCCI operating region and combustion characteristics was investigated using a single-cylinder test engine.

6. Paper No.(JSAE/SAE)	20159807 / 2015-32-0807
7. Paper title	Influence of Internal EGR on Knocking in an HCCI Engine
8. Authors (Affiliation)	Takashi Shimada, Yuki Yoshida, Chibin Rin, Masanori Yamada, Naoya Ito, Akira Iijima, Koji Yoshida, Hideo Shoji (Nihon University)

9. Abstract

Homogeneous Charge Compression Ignition (HCCI) engines have attracted much attention and are being widely researched as engines characterized by low emissions and high efficiency. However, one issue of HCCI engines is their limited operating range because of the occurrence of rapid combustion at high loads and misfiring at low loads. It is known that knocking accompanied by in-cylinder pressure oscillations also occurs in HCCI engines at high loads, similar to knocking seen in spark-ignition engines. In this study, HCCI combustion accompanied by in-cylinder pressure oscillations was visualized by taking high-speed photographs of the entire bore area. In addition, the influence of internal exhaust gas circulation (EGR) on HCCI knocking was also investigated. The visualized combustion images revealed that rapid autoignition occurred in the end-gas region during the latter half of the HCCI combustion process when accompanied by in-cylinder pressure oscillations. It was also found that applying internal EGR had the effect of moderating combustion by delaying the ignition timing, thereby suppressing in-cylinder pressure oscillations.

6. Paper No.(JSAE/SAE)	20159847 / 2015-32-0847
7. Paper title	Numerical performance prediction using experimental combustion model for controlled-auto-ignition natural gas engines
8. Authors (Affiliation)	Toshiro Kiura, Hibiki Koga (Honda R&D Co., Ltd.)

9. Abstract

This study was undertaken to develop a method of numerical performance prediction for application to the development of controlled-auto-ignition (CAI) natural gas engines. By using a combustion model based on analyzed combustion data and introducing this to a commercial one-dimensional gas dynamic simulator, we attempted to establish a means of attaining a highly accurate performance prediction while reducing the calculation load. The combustion model was separately calibrated for two models, namely, the auto-ignition timing of the combustion and the mass fraction burned. As a result, the combustion modeling was able to successfully predict the accuracy of the auto-ignition timing difference at 0.03 degree of crank angle on average, and 0.95 degree in the 2σ region. Furthermore, the functions of the mass fraction burned were expressed using closely correlated in-cylinder parameters. To investigate the application of this numerical performance prediction method, a parametric study to maximize the thermal efficiency of CAI natural gas engines was conducted. Different engine configurations with stroke /bore ratios of 1.0 to 2.5 and intake/exhaust valve diameter ratios of 0.8 to 1.4 were examined, with the maximum net indicated thermal efficiency being 45% for a stroke/bore ratio of about 2.0 and an intake/exhaust valve diameter ratio of 1.0. Using this approach, it is possible to predict the performance electric control unit to ensure the stable running of a CAI natural gas engine....



Abstracts of Technical Sessions

1. Date	Thursday, November 19
2. Room.	1006
3. Time	11 : 00 - 12 : 00
4. Session	Emissions II
5. Chair (Affiliation),	Hiroshi Deguchi (SUZUKI MOTOR CORPORATION)
Co-chair (Affiliation)	Leonid Tartakovsky (Technion - Israel Institute of Technology)

6. Paper No.(JSAE/SAE)	20159824 / 2015-32-0824
7. Paper title	Enhancing the performance of a catalyst formulation for a big displacement motorcycle for future emission regulations, part 2
8. Authors (Affiliation)	Marcus Bonifer, Rainer Kiemel (Heraeus Chemicals)

9. Abstract

In Europe the next level of emission regulations for motorcycles, Euro IV, is on the verge of introduction, followed by Euro V around 2021. Together with the new emission regulations, the ECE R 40 testing cycle will become obsolete and the more realistic World Motorcycle Testing Cycle (WMTC) will be introduced. Current catalytic solutions for gasoline engines consist of so-called three way catalysts (TWC) that are able to reduce the emissions of CO, NOx and hydrocarbons (HC) below the regulatory emission limit. These catalysts mostly contain platinum (Pt), palladium (Pd) and rhodium (Rh) in different concentrations and ratios. Another important component is the so-called oxygen storage material (OSC) which compensates for the fluctuations in lambda during acceleration and deceleration. Currently existing catalyst formulations must be modified to fulfil the more stringent emission limits with simultaneous consideration of a more realistic test cycle. Last year we presented modifications of an existing Euro III catalyst formulation for a 690 cc motorcycle from model year (MY) 2012. According to our customer, the result was a formulation that fulfilled the Euro IV emission regulation. We would like to present results of our further modified Euro IV solution. For our tests, we used a 690cc motorcycle from MY2014; this motorcycle was as a reference source of emissions to be able to compare the performance of different catalyst formulations. With our results, we want to show that Euro V for motorcycles is technically possible.

6. Paper No.(JSAE/SAE)	20159707 / 2015-32-0707
7. Paper title	Development of Bengaluru Motorcycle Drive Cycle from Real World Data for Accurate Prediction of Exhaust Emissions and Fuel Economy
8. Authors (Affiliation)	Rashmita Khare, Pramod Reddemreddy, Abhijit Shankar Bahirat, Prashanth Anantha (Bosch Ltd. India, Robert Bosch Engineering and Business Solutions Pvt. Ltd. India)

9. Abstract

Urban transportation significantly contributes towards the rapid deterioration of air quality in the Indian cities. Growing affordability has resulted in an increased two wheeler population across India. The Indian government has instituted introduction of emission legislation in phases to mitigate the impact on environment due to the increased growth. As a signatory to the United Nations Economic Commission for Europe (UN-ECE) Global Technical Regulation (GTR)-2, the Worldwide Harmonized Motorcycle Test cycle (WMTC) will be adopted as a standard test cycle for emission assessment beginning 2016. This cycle development was based on the collection and analysis of driving behavior data and statistical information about motorcycles used in three different regions (Europe, Japan and USA). To understand the relevance in the context of driving patterns found in the India, the team developed a city specific drive cycle which involved logging on-road vehicle data from several trips and dividing them into a database of microtrips. Using a customized script on MATLAB, these microtrips were first segregated into different classes based on maximum speed attained. Minimum error criteria for different parameters such as average speed, average acceleration, average deceleration, percentage acceleration, percentage deceleration, percentage idle and percentage cruise were applied to select the microtrips from each class. A concatenation of these individual microtrips resulted in a city specific drive cycle which incorporates the urban driving pattern of the city of Bengaluru. During the process of data logging, evaluation and scripting, the team also developed a standard procedure to simplify repeating such an exercise at other urban locations.



Abstracts of Technical Sessions

1. Date	Thursday, November 19
2. Room.	1007
3. Time	11 : 00 - 12 : 30
4. Session	Measurement & Simulation V
5. Chair (Affiliation),	Tadao Okazaki (LEMA / Kubota Corporation)
Co-chair (Affiliation)	Stephan Schmidt (Graz University of Technology)

6. Paper No.(JSAE/SAE)	20159766 / 2015-32-0766
7. Paper title	A reduced order turbo-charging model for real time engine torque profile control
8. Authors (Affiliation)	Kazuhide Togai (Osaka Sangyo University), Hiroki Yamaura (Mitsubishi Motors Engineering), Naoto Fujinaga (Mitsubishi Motors Corporation)

9. Abstract

Torque profile control is one of required technologies for propulsion engines. A smaller parametric model is more preferable for control algorithm design and evaluation. Mean value engine torque can be obtained from throttle opening change using a transfer function. A transfer function for a turbocharged engine was investigated with thermo-dynamic equations for a turbine and a compressor and test data. A small turbocharged engine was tested to model the air transfer process. Turbine speed was measured with temperatures, pressures and air mass flow. Turbine speed response is like a first order system to air mass flow into a combustion chamber. The pressure ratio at the compressor is approximated by a curve proportional to the turbine speed square. Based on those findings, a reduced order model for describing dynamic air transfer process with a turbocharger was constructed. The proposed model is compact and suitable for engine torque control design and controller implementation.

6. Paper No.(JSAE/SAE)	20159828 / 2015-32-0828
7. Paper title	Development of data logger for motorcycles
8. Author (Affiliation)	Masashi Matsuo, Takeshi Morioka, Hitoshi Watanabe (Yamaha Motor CO., LTD)

9. Abstract

The data loggers that are used on motorcycles are intended to measure the running data during races and when driving on closed courses. These data loggers are small in size, lightweight, and optimized for mounting on motorcycles so that they do not affect the vehicle dynamics. Consequently, almost all of these data loggers are not equipped with the amplifiers and filters necessary for taking measurements from strain sensors. Most of the data loggers that have amplifiers and filters built into them are large in size and cannot be used on a motorcycle while it is being driven because of their poor durability, poor water resistance, and poor dust resistance. However, it is necessary to carry out strain and acceleration measurements when developing a new motorcycle body so that the body strength and motion characteristics can be understood [2][3]. Furthermore, the ability to increase the number of measurement channels and acquire position information is also being demanded to improve the efficiency of development and deepen our understanding of the phenomena that occur during driving. Consequently, a new data logger was developed for use during the development of new motorcycle bodies....

6. Paper No.(JSAE/SAE)	20159763 / 2015-32-0763
7. Paper title	Innovative approach and tools to design future two-wheeler powertrain
8. Authors (Affiliation)	MILOSAVLJEVIC Misa, VENTURI Stephane, LE BERR Fabrice, DEGEILH Philippe, LAABIDI Samy, ZITO Gianluca, MAGAND Sebastien (IFP Energies nouvelles), RAYMOND Francois (D2T Powertrain Technologies)

9. Abstract

As congestion increases and commute times lengthen with the growing urbanization, many customers will look for effective mobility solutions. Two-wheeler are one of the solutions to deal with these issues, in particular if equipped with electrified powertrains for minimized local noise and air pollutant emissions. Scooters powertrain technology is predominantly based on Spark Ignition Engine (ICE) associated with a Continuously Variable Transmissions (CVT) and a Centrifugal Clutch. Nevertheless, even though CVT gives satisfaction in simplicity, fun to drive, cost effectiveness and vehicle dynamics, its efficiency is an undeniable drawback. Indeed, a conventional CVT is wasting more than 50% of ICE effective power in customer driving conditions. Consequently, those vehicles have high fuel consumption relative to their size, and are equipped with overpowered and heavy internal combustion engines, allowing a large area for further improvements. Therefore, IFP Energies nouvelles (IFPEN) has developed a physically based simulation tools for scooters powertrain analysis, design and control. ICE model is based on an analytical calculation for indicated efficiency and frictions. CVT and centrifugal clutch are modeled using existing LMS Amesim components and a specifically developed physical transfer function. The final model is in a good agreement with real figures, such as fuel consumption and dynamics behavior of each system. Therefore, these methods and tools have proven to be relevant and time effective to study....



Abstracts of Technical Sessions

1. Date	Thursday, November 19
2. Room.	1008
3. Time	11 : 00 - 12 : 30
4. Session	Vehicle Components
5. Chair (Affiliation),	Masayuki Baba (Honda R&D Co., Ltd.)
Co-chair (Affiliation)	Thomas Lagö (QirraSound Technologies Europe AB)

6. Paper No.(JSAE/SAE)	20159750 / 2015-32-0750
7. Paper title	Development of Cost Advantageous Designs for Headlight System Using Light Emitting Diodes
8. Authors (Affiliation)	Yosuke Tsuchiya, Teppei Matsuzaki, Tetsuo Takeshige, Tsuyoshi Oguchi (Honda R&D Co., Ltd.)

9. Abstract

So far, the application of LED headlights to the motorcycle has been limited for only high-priced models, because LED light units and the drivers are expensive. In our development, the cost reduction of light source units was examined by implementing multiple medium intensity LEDs. Distributed mounting scheme was created for LEDs placed on the circuit board to meet the heat dissipation requirement without a heat sink, which is usually installed. By new mounting scheme, the requirement of heat dissipation has been successfully fulfilled by only using the copper foil layer. Moreover, by connecting LEDs in series, the driver circuit configuration was made simple while separate circuits are generally required both for a high-beam and a low-beam. By this configuration, the driver cost was reduced. With this circuitry change, some associated issues arose and measures were devised to cope with them. In addition, the method of driver circuitry, established through applications for conventional incandescent light sources, was applied to provide a discrete voltage in half-waves from the ACG apart from the supply from the battery. Using this method, the circuit was made configurable to manage the situation, in which the forward voltage drop of LED exceeds the output voltage of the battery, without using a booster circuit. With these measures, a significant cost reduction was made feasible....

6. Paper No.(JSAE/SAE)	20159785 / 2015-32-0785
7. Paper title	A Shock Absorber Design with Position Sensitive Damper and its Performance Evaluation
8. Authors (Affiliation)	Girish Kokane, Nizar Ahamed, Ravindra Kharul (Endurance Technologies Pvt. Ltd)

9. Abstract

Ride comfort and handling present conflicting requirements on damping properties of a suspension system. While ride comfort demands a softer damping, a higher damping force makes the ride handling better. Conventional dampers, being solely velocity dependent, are always a compromise between these two requirements. A damper can be made position sensitive, in addition to its velocity dependence to obtain the best of both the worlds. A position sensitive damper can have a softer damping force for low amplitude road excitations, as observed on highways and a higher damping force for higher amplitude road excitations, as observed in off-road conditions. Thus such a damper can be optimized not only for a good comfort, but for a good handling performance also. General designs for a position sensitive damper involve a bypass arrangement around the piston. This paper discusses an alternate arrangement for achieving position sensitive damping and its benefits. Prototypes of the same have been made and tested on a servo-hydraulic damper performance testing machine. Extensive analysis has been done to validate the position dependency. Further the prototypes have been tested on a vehicle....

6. Paper No.(JSAE/SAE)	20159786 / 2015-32-0786
7. Paper title	Development of an Integrated Approach for Suspension Performance Evaluation
8. Authors (Affiliation)	Kishor Kothe, Nizar Ahamed, Girish Kokane, Ravindra Kharul (Endurance Technologies Pvt. Ltd)

9. Abstract

Vehicle suspension systems are designed keeping in mind the requirement for vehicle articulations and load transfer between chassis & tires. Another factor which is given due importance is the avoidance of extremities with end cushions. As such extremities result in generation of impact loads which could eventually lead to failure of end cushions and the vehicle chassis. Number of occurrences of these extremities is an indication of how good a vehicle suspension design is. This paper presents a methodology developed that converts a shock absorber to a potential sensor that not only measures the travel and velocity, but also the different kind of loads generated at different events. It includes instrumentation, data acquisition and its analysis for evaluating the performance of the shock absorber and also to provide additional insights into its design. Based on these measurements, a virtual simulation model is built, validated and used for subsequent sensitivity study to optimize the damper design.

