SETC2024 Session Timetable

			Jubilee A	Jubilee B	Mulberry	Palladium Hall A
November 5, 2024	9:00-10:30 hrs.		Opening Ceremony & Keynote Addresses (Palladium Hall A)			
	10:30-11:00 hrs.		Networking Break (Palladium Hall B)			
	11:00-12:00 hrs.		Diesel Engine	Materials and Manufacturing Part 1 of 2	Vehicle Components	New Product Technology Part 1 of 5
		Chair	Koji Yoshida	Hirotaka Kurita	Shingo Ueda	Gaku Naoe
		Co-Chair	Luca Romani	Jürgen Tromayer	Giovanni Ferrara	Roland Kirchberger
			20249116/2024-32-0116	20249026/2024-32-0026	20249051/2024-32-0051	NPT2024-017
				20249076/2024-32-0076	20249046/2024-32-0046	NPT2024-004
	12:00-13:00 hrs.		Lunch (Dining Room) & Poster Session (Palladium Hall B)			
	13:00-15:00 hrs.		Renewable Energy and Alternative Fuels Part 1 of 3	Advanced Combustion Part 1 of 3	Hybrid and Electric Drives Part 1 of 2	New Product Technology Part 2 of 5
		Chair	Peerawat Saisirirat	Keiya Nishida	Yasuyuki Muramatsu	Hiroya Ueda
		Co-Chair	Sebastian Schurl	Simona Silvia Merola	Kai Beck	Roland Kirchberger
			20249068/2024-32-0068	20249022/2024-32-0022	20249062/2024-32-0062	NPT2024-019
			20249085/2024-32-0085	20249044/2024-32-0044	20249066/2024-32-0066	NPT2024-002
			20249086/2024-32-0086	20249063/2024-32-0063	20249122/2024-32-0122	NPT2024-011
			20249123/2024-32-0123	20249095/2024-32-0095	20249070/2024-32-0070	NPT2024-021
	15:00-15:30 hrs.		Networking Break & Poster Session (Palladium Hall B)			
	15:30-18:05 hrs.		Powertrain Control	Advanced Combustion Part 2 of 3	Hybrid and Electric Drives Part 2 of 2	New Product Technology Part 3 of 5
		Chair	Shigeho Sakoda	Satoshi Takayama	Stephen Teng	Kensuke Suzuki
		Co-Chair	Alexander Winkler	Simona Silvia Merola	Kai Beck	Sebastian Schurl
			20249019/2024-32-0019	20249008/2024-32-0008	20249029/2024-32-0029	NPT2024-005
			20249078/2024-32-0078	20249023/2024-32-0023	20249067/2024-32-0067	NPT2024-006
			20249103/2024-32-0103	20249104/2024-32-0104	20249069/2024-32-0069	NPT2024-015
			5 min. Break	20249108/2024-32-0108	5 min. Break	NPT2024-003
			20249024/2024-32-0024		20249007/2024-32-0007	
			20249061/2024-32-0061		20249027/2024-32-0027	
November 6, 2024	8:00-10:00 hrs.		Renewable Energy and Alternative Fuels Part 2 of 3	Advanced Combustion Part 3 of 3	Materials and Manufacturing Part 2 of 2	New Product Technology Part 4 of 5
		Chair	Yuji Araki	Tatsuya Kuboyama	Hirotaka Kurita	Michihisa Nakagawa
		Co-Chair	Adrian Irimescu	Simona Silvia Merola	Jürgen Tromayer	Kai Beck
			20249111/2024-32-0111	20249079/2024-32-0079		NPT2024-016
			20249117/2024-32-0117	20249094/2024-32-0094	20249006/2024-32-0006	NPT2024-020
			20249065/2024-32-0065	20249119/2024-32-0119	20249020/2024-32-0020	NPT2024-014
			20249118/2024-32-0118	20249120/2024-32-0120	20249040/2024-32-0040	NPT2024-009
	10:00-10:30 hrs.		Networking Break & Poster Session (Palladium Hall B)			
	10:30-12:00 hrs.		Engine Technology	Measurment and Simulation Part 1 of 4	Lubricant and Tribology	New Product Technology Part 5 of 5
		Chair	Shogo Tadakuma	Keisuke Ito	Yuji Mihara	Takuya Warashina
		Co-Chair	Jürgen Tromayer	Stephan Schmidt	Marcus Gohl	Kai Beck
			20249033/2024-32-0033	20249036/2024-32-0036	20249030/2024-32-0030	NPT2024-018
			20249058/2024-32-0058	20249047/2024-32-0047	20249099/2024-32-0099	NPT2024-001
			20249096/2024-32-0096	20249072/2024-32-0072	20249100/2024-32-0100	NPT2024-010
	12:00-13:00 hrs.		Lunch (Dining Room) & Poster Session (Palladium Hall B)			
	13:00-15:00 hrs.		Renewable Energy and Alternative Fuels Part 3 of 3	Measurment and Simulation Part 2 of 4	Emission and Environmental Impacts Part 1 of 2	Vehicle Dynamics and Safety part 1 of 2
		Chair	Yoshimitsu Kobashi	Tadao Okazaki	Yusuke Suzuki	Shingo Ueda
		Co-Chair	Adrian Irimescu	Stephan Schmidt	Sebastian Schurl	Alexander Winkler
			20249050/2024-32-0050	20249017/2024-32-0017		
			20249060/2024-32-0060	20249035/2024-32-0035	20249025/2024-32-0025	20249013/2024-32-0013
			20249010/2024-32-0010	20249038/2024-32-0038	20249081/2024-32-0081	20249005/2024-32-0005
			20249057/2024-32-0057	20249037/2024-32-0037	20249113/2024-32-0113	20249028/2024-32-0028
	15:00-15:30 hrs.		Networking Break (Palladium Hall B)			
	15:30-18:00 hrs.		Plenary Session (Palladium Hall A)			
November 7, 2024	8:00-10:35 hrs.		NVH Technolgy	Measurment and Simulation Part 3 of 4	Emission and Environmental Impacts Part 2 of 2	Vehicle Dynamics and Safety Part 2 of 2
		Chair	Gaku Naoe	Tomoaki Yatsufusa	Stephan Schmidt	Hisayuki Sugita
		Co-Chair	Maurice Kettner	Luca Romani	Francesco Balduzzi	Alexander Winkler
						20249012/2024-32-0012
			20249032/2024-32-0032	20249071/2024-32-0071	20249004/2024-32-0004	20249080/2024-32-0080
			20249059/2024-32-0059	20249073/2024-32-0073	20249016/2024-32-0016	20249034/2024-32-0034
			20249015/2024-32-0015	20249083/2024-32-0083	20249097/2024-32-0097	5 min. Break
				20249084/2024-32-0084	20249041/2024-32-0041	20249043/2024-32-0043
						20249049/2024-32-0049
	10:35-11:00 hrs.		Networking Break (Palladium Hall B)			
	11:00-12:30 hrs.		Engine Components and Fuel Supply System	Measurment and Simulation Part 4 of 4	Two Stroke Engine	Data Driven Digitalization / Organized Session
		Chair	Wataru Yamamoto	Takashi Mitome	Akira Iijima	Nuksit Noomwong
		Co-Chair	Francesco Balduzzi	Giovanni Ferrara	Roland Kirchberger	Stephan Schmidt
				20249055/2024-32-0055	20249039/2024-32-0039	
			20249105/2024-32-0105	20249074/2024-32-0074	20249054/2024-32-0054	20249121/2024-32-0121
			20249109/2024-32-0109	20249115/2024-32-0115	20249112/2024-32-0112	Organized Session
	12:30-13:30 hrs.		Break / Lunch (Dining Room)			
	13:30-15:00 hrs.		Award and Closing Ceremony (Palladium Hall A)			

Abstracts of Technical Sessions

1. Date — November 5, 2024
2. Room — Jubilee A
3. Time — 11:00 - 12:00 hrs.
4. Session — Diesel Engine
5. Chair (Affiliation), Co-chair (Affiliation) — Koji Yoshida (Nihon University), Luca Romani (University of Florence)

6. Paper No. (JSAE/SAE)	20249116/2024-32-0116
7. Paper Title	Techniques and Analysis Methods Used in Development of 13.4kW Horizontal Water-Cooled Diesel Engine
8. Authors (Affiliation)	Kenta Shiomi, Ryosuke Hosoya, Yoshinobu Komai, Yusuke Takashima, Takahiro Kitamura, Tsukasa Fujiwara, Kosuke Suematsu (KUBOTA Corporation)

9. Abstract

Horizontal water-cooled diesel engines are single-cylinder engines equipped with all the necessary components for operation such as a fuel tank and a radiator. Due to their versatility, there are used in a wide range of applications in Asia, Africa, South America, etc. It is necessary to comply with strengthened emissions regulations year by year in countries where environmental awareness is increasing such as China, India, etc.

We have developed a new compact and high-power 13.4kW(18HP) engine which meets these needs. We realized a high-power density by using our unique expertise to maintain an engine size and increase a displacement. In addition, by optimizing a layout of crankcase ribs through structural analysis, we have achieved a maximum bore and "Reduction of the weight of the crankcase and lubricating oil consumption (LOC), and reduction of friction with narrow-width low-tangential load piston rings". Furthermore, by designing an intake port using 3D CFD, we have optimized a swirl ratio and improved a flow coefficient to improve a fuel efficiency. About conforming to emissions regulations, we utilized 3D CFD to select an optimized nozzle specification and 1D CAE to optimize internal EGR. As a result, we have showed a potential to conform to “Limits and measurement methods for exhaust pollutants from diesel engines of non-road mobile machinery (CHINA IV)” for the new engine with a mechanical injection system.

This paper introduces the technology to achieve a high-power density, a low fuel consumption, a high durability and a compliance with emissions regulations simultaneously.

Abstracts of Technical Sessions

1. Date November 5, 2024
2. Room Jubilee B
3. Time 11:00 - 12:00 hrs.
4. Session Materials and Manufacturing Part 1 of 2
5. Chair (Affiliation), Co-chair (Affiliation) Hirotaka Kurita (Yamaha Motor Co., Ltd.), Jürgen Tromayer (Graz University of Technology)

6. Paper No. (JSAE/SAE)	20249026/2024-32-0026
7. Paper Title	Effect of Mesopore Structure of Carbon Gel on Improving the Capacity of Electric Double-Layer apacitors
8. Authors (Affiliation)	Zairan Cheng[1, 2], Tsubasa Okamura[1, 2], Yuto Ohnishi[2], Kiyoharu Nakagawa[2] 1 Yamaha Motor Co., Ltd., 2 Kansai University

9. Abstract

Electric double-layer capacitors (EDLCs) store charge by adsorbing ions at the electrode-electrolyte interface, offering fast charge/discharge rates, high power density, minimal heat generation, and long cycle life. These characteristics make EDLCs ideal for memory backup in electronic devices and power assistance in electric and hybrid vehicles. However, their energy density is lower than that of batteries, necessitating improvements in electrical capacity and potential. Traditionally, activated carbon with a high specific surface area has been used, but recent research focuses on mesoporous carbon materials for better ion diffusion. This study uses resorcinol-formaldehyde-carbon cryogel (RFCC) with mesopores and organic electrolytes with a wider electrochemical window. Various RFCCs with different pore sizes were synthesized and evaluated. Comprehensive investigations into the pore structures and surface properties of both synthesized carbon gels and commercial mesoporous materials were conducted. EDLCs with organic electrolytes were fabricated, and their electrochemical performance was analyzed. Findings indicate that mesoporous carbon gels significantly enhance capacity in high-rate charge-discharge cycles due to improved ion diffusion, highlighting their potential in optimizing EDLC performance.

6. Paper No. (JSAE/SAE)	20249076/2024-32-0076
7. Paper Title	Study on Flex Fuel Compatible Coatings for Automotive Fuel Tank
8. Authors (Affiliation)	Dinesh Babu Pandi, Gomathy Priya Shanmugam, Arun Nagarkatti, Manish Gopal, Prathap Anbalagan (TVS Motor Company Limited)

9. Abstract

Reducing CO2 emissions is now a major focus in India heading towards net zero emissions by 2070. India is the 3rd largest automobile market in the world and the transportation sector is the 3rd largest CO2 emitter. In this direction, it is necessary to reduce the carbon footprint from the automobile sector to combat climate change. The adoption of sustainable biofuels such as ethanol will enable us to reduce emissions, as ethanol is carbon neutral fuel. However, vehicle manufacturers are facing challenges in manufacturing flex fuel compatible parts in the vehicle mainly fuel systems. Ethanol has both nonpolar and polar bonds, making it miscible to both gasoline and water, thereby water contamination is inevitable in ethanol blend fuels. In addition, control of ethanol contamination by sulfates and chlorides during ethanol production is challenging. Thus, ethanol blend fuels are considered more corrosive and tendency towards deposit formation than normal gasoline fuels. Design and development of corrosion resistant and flex fuel compatible materials for fuel systems are important without compromising the functional requirements. In fuel systems, fuel tank is one of the major parts, which acts as a reservoir for fuel supply and needs to have good chemical and corrosion resistance. This paper describes the comparative study of three different coating systems of single layer coating with and without topcoat on top of steel sheet to withstand up to 85% ethanol fuel blends. In all these coated samples, base metal used is low carbon steel sheet which is commonly used for automotive fuel tank application. The fuel tank internal corrosion study is conducted using test fuel as aggressive ethanol blend fuel at coupon level as per SAE J1747. The test fuel has been selected to simulate the effect of possible contamination in the real usage condition and to provide accelerated corrosion test. The selection criteria used for the evaluation are base material corrosion, pitting, weight loss, formation of reaction products and its elution behavior into the test fuel. No pitting, perforation and weight loss were observed in all the coating systems after the test. Base material corrosion was encountered in only 2 coating systems and reaction products were observed as deposits in all coating systems for higher ethanol blend test fuels. The reaction products were analyzed in SEM-EDS and their elution effect into the fuel was studied under both static and dynamic fluid conditions.

Abstracts of Technical Sessions

1. Date — November 5, 2024
2. Room — Mulberry
3. Time — 11:00 - 12:00 hrs.
4. Session — Vehicle Components
5. Chair (Affiliation), Co-chair (Affiliation) — Shingo Ueda (Honda Motor Co., Ltd.), Giovanni Ferrara (University of Florence)

6. Paper No. (JSAE/SAE)	20249051 / 2024-32-0051
7. Paper Title	Dynamic Nonlinear Viscoelastic Measurements of Vehicle Seat Components for Ride Comfort Evaluation
8. Authors (Affiliation)	Chihiro Kamio, Takao Yamaguchi, Shinichi Maruyama (Gunma University), Kazuto Hanawa (SUBARU CORPORATION), Tsutomu Iwase (Gunma University and SUBARU CORPORATION), Tatsuo Hayashi, Toshiharu Sato, and Hajime Mogawa (NHK SPRING CO., LTD.)

9. Abstract
Ride comfort is an important factor in the development of vehicles. Understanding the characteristics of seat components allows more accurate analysis of ride comfort.
This study focuses on urethane foam, which is commonly used in vehicle seats. Soft materials such as urethane foam have both elastic and viscous properties that vary with frequency and temperature. Dynamic viscoelastic measurements are effective for investigating the vibrational characteristics of such materials. Although there have been many studies on the viscoelastic properties of urethane foam, no prior research has focused on dynamic viscoelastic measurements during compression to simulate the condition of a person sitting on a seat. In this study, dynamic viscoelastic measurements were performed on compressed urethane foam. Moreover, measurements were conducted at low temperatures, and a master curve using the Williams–Landel–Ferry (WLF) formula (temperature–frequency conversion law) was created.

6. Paper No. (JSAE/SAE)	20249046 / 2024-32-0046
7. Paper Title	Fatigue Analysis of Motorcycle Rear Swing Arm on Different Road Surfaces
8. Authors (Affiliation)	Yi-Hau Chiou, Hsiu-Ying Hwang, Liang-Yu Huang (National Taipei University of Technology)

9. Abstract
The rear swing arm, a crucial motorcycle component, connects the frame and wheel, absorbing the vehicle's load and various road impacts. Over time, these forces can damage the swing arm, highlighting the need for robust design to ensure safety. Identifying potential vulnerabilities through simulation reduces the risk of failure during the design phase.
This study performs a detailed fatigue analysis of the swing arm across different road conditions.
Data for this research were collected from real-vehicle experiments and simulation analyses, ensuring accuracy by comparing against actual performance. Following CNS 15819-5 standards, road surfaces such as poorly maintained, bumpy, and uneven roads were tested. Using Motion View, a comprehensive multi-body dynamic model was created for thorough fatigue analysis.
The results identified the most stress-prone areas on the swing arm, with maximum stress recorded at 109.6N on poorly maintained roads, 218.3N on bumpy surfaces, and 104.8N on uneven roads. These stress points consistently appeared near the connection of the rear shock absorber. This analysis not only minimizes the need for extensive realvehicle testing but also swiftly identifies structural weaknesses, reducing both time and costs. It provides valuable insights for design optimization, serving as a key reference for future product development in the industry.

Abstracts of New Product Technology Session

1. Date — November 5, 2024
2. Room — Palladium Hall A
3. Time — 11:00 - 12:00 hrs.
4. Session — New Product Technology Session Part 1 of 5
5. Chair (Affiliation), Co-chair (Affiliation) — Gaku Naoe (Honda Motor Co., Ltd.) Roland Kirchberger (Graz University of Technology)

6. Paper No.	NPT2024-017
7. Paper Title	New High Efficiency 2-Stroke Engine Combining Stratified-Scavenging with STIHL Fuel Injection Technology
8. Authors (Affiliation)	Kai Beck (ANDREAS STIHL AG & Co. KG)

9. Abstract
STIHL's small new spark ignition engines TS910i (TS710i) is the world's first stratified-scavenging 2-stroke engine with electronically controlled fuel injection for handheld outdoor power equipment. The cutting-edge engine comprises outstanding power, high low-end torque, a very high reduction of raw exhaust emissions with a wide operating range free from irregular combustion phenomena such as knocking. With this powerful product in the over 6KW class, with the same weight as its predecessor, optimum use of the 400mm cutting discs and significantly increase the efficiency of use to complete a work task in the most resource-saving way possible.

6. Paper No.	NPT2024-004
7. Paper Title	Application of Model Based Development of Noise Reduction for Outboard Motors
8. Authors (Affiliation)	Kazuhiro Hara (Yamaha Motor Co., Ltd.)

9. Abstract
Yamaha Motor Co., Ltd. developed the new 450-HP outboard motors F450A/FL450A and then released them in 2023. The F450A boasts the maximum horsepower in our lineup of outboard motors and has been developed based on the F425A/FL425A, which have been receiving high evaluations in the market. The world's outboard motor market centering around the North American market has been steadily growing, and in the North American market in particular, the demand for large outboard motors has been increasing in association with the shift in boat users' preferences to larger boats. On the other hand, as radiation noise increases because of the increase in motor size and the employment of multiple motors on a single boat and as changes in the user base and usage of those products take place, the demand for comfort has also been increasing. Meanwhile, the product release intervals are becoming shorter, forcing developers to achieve a higher competitiveness in a shorter period of time. To meet these demands, we applied a new method called "Model Based Development (MBD)" to outboard motor noise development and then achieved a power increase of 25 HP and a noise reduction of 4 dBA compared to the conventional F425A flagship model.

Abstracts of Technical Sessions

1. Date: November 5, 2024
2. Room: Jubilee A
3. Time: 13:00 - 15:00 hrs.
4. Session: Renewable Energy and Alternative Fuels Part 1 of 3
5. Chair (Affiliation), Co-chair (Affiliation): Peerawat Saisirirat (National Energy Technology Center), Sebastian Schurl (Graz University of Technology)

6. Paper No. (JSAE/SAE)	20249068/2024-32-0068
7. Paper Title	Numerical Investigation of Electrolyte Feed System Designs at the Stack Level of Vanadium Redox Flow Batteries
8. Authors (Affiliation)	Nut Suwanpakdee, Poramet Aiemsathit, Patcharawat Charoen-amornkitt (King Mongkut's University of Technology Thonburi), Takahiro Suzuki, Shohji Tsushima (Osaka University)

9. Abstract

The rise of electric vehicles (EVs) highlights the need to transition to a renewable energy society, where power is generated from sustainable sources. This shift is driven by environmental, economic, and energy security concerns. However, renewable energy sources like wind and solar are intermittent, necessitating extensive energy storage systems. Vanadium redox flow batteries (VRFBs) are promising for large-scale energy storage due to their long cycle life, scalability, and safety. In VRFBs, cells are typically connected in series to increase voltage, with electrolytes introduced through parallel flow channels using a single manifold. This design, while simple and low in pressure drop, often leads to imbalanced flow rates among cells, ...

6. Paper No. (JSAE/SAE)	20249085/2024-32-0085
7. Paper Title	Optimal Porous Electrode Structures in All-Vanadium Redox Flow Batteries
8. Authors (Affiliation)	Poramet Aiemsathit[1], Pengfei Sun[2], Mehrzad Alizadeh[2], Yossapong Laoonual[1], Patcharawat Charoen-amornkitt[1], Takahiro Suzuki[2], Shohji Tsushima[2] , 1 King Mongkut's University of Technology Thonburi, 2 Graduate School of Engineering, Osaka University

9. Abstract

proposed. The vanadium redox flow battery (VRFB) is gaining significant attention due to its extended lifespan, durability, thermal safety, and independent power capacity, despite its high cost. Key components of the VRFB include a membrane, carbon electrode, bipolar plate, gasket, current collector, electrolyte, and pump. Among these, the carbon electrode and bipolar plate are the most expensive. Reducing capital costs in VRFB systems is crucial for advancing clean energy solutions. Conventional flow field designs like interdigitated flow field (IFF), serpentine flow field (SFF), and parallel flow field (PFF) ...

6. Paper No. (JSAE/SAE)	20249086/2024-32-0086
7. Paper Title	Multi-Objective Optimization of Material Distribution in the Anode Catalyst Layer for Proton Exchange Membrane Water Electrolyzer Applications
8. Authors (Affiliation)	Peerapat Orncompa, Phonlakrit Passakornjaras, Patcharawat Charoen-amornkitt (King Mongkut's University of Technology Thonburi), Mehrzad Alizadeh, Takahiro Suzuki, Shohji Tsushima (Osaka University)

9. Abstract

While hydrogen is a clean and renewable energy source for fuel cell vehicles, its production involves various costly methods, with steam reforming being the current popular yet environmentally detrimental technique. An alternative approach involves the use of electrochemical devices such as proton exchange membrane water electrolyzers (PEMWE), capable of producing pure hydrogen through renewable energies. Nevertheless, these devices face challenges in improving their performance, with the most challenging aspect found in PEMWE being the anode, where the oxygen evolution reaction (OER) occurs. This poses a bottleneck issue because the generated oxygen does not exist solely in dissolved form but also as a gas. The released ...

6. Paper No. (JSAE/SAE)	20249123/2024-32-0123
7. Paper Title	Optimization of Combustion and Conversion Efficiency in Spark-Ignited Engine Using Taguchi Methods Robust Optimization Technique for Flex Fuel Application
8. Authors (Affiliation)	Balaji Vaidyanathan, Praveenkumar Arunkumar, Palani Shunmugasundaram, Manickam Murugesan, Vedhanayagam Jayajothijohnson (TVS Motor Company Limited.)

9. Abstract

Flex fuel vehicles (FFV) can operate effectively from E5 (Gasoline 95%, ethanol 5%) fuel to E100 (Gasoline 0%, ethanol 100%) fuel. It is necessary to meet the performance, drivability, emission targets and regulatory requirements irrespective of fuel mixture combination. This research work focuses on optimizing the combustion and conversion efficiency of a spark-ignited less than 200 cc engine for FFV using Taguchi methods robust optimization technique. The study employs an eight-step robust optimization approach to simultaneously minimize engine out emissions and maximize catalytic converter efficiency. Six control factors including type of fuel, catalyst heating rpm, lambda (excess-air ratio), injection end angle, lambda controller delay, ...

Abstracts of Technical Sessions

1. Date — November 5, 2024
2. Room — Jubilee B
3. Time — 13:00 - 15:00 hrs.
4. Session — Advanced Combustion Part 1 of 3
5. Chair (Affiliation), Co-chair (Affiliation) — Keiya Nishida (The University of Hiroshima), Simona Silvia Merola (STEMS-CNR)

6. Paper No. (JSAE/SAE)	20249022/2024-32-0022
7. Paper Title	Effect of Ignition Position on Lean Limit of Main Chamber Combustion in Pre-Chamber Ignition
8. Authors (Affiliation)	Takeru Onuma, Hiroto Yamada, Taisei Ugajin, Kaito Shinozaki, Ryota Tahara, Akira Iijima (Nihon University)

9. Abstract

An engine was built in this study that enabled the conditions in a pre-chamber and in the main combustion chamber to be visualized simultaneously for the purpose of elucidating the mechanism of pre-chamber combustion. An investigation was made of how the state of pre-chamber combustion, including the location of initial flame generation and its subsequent propagation, influenced pre-chamber jet combustion. The state of pre-chamber combustion was intentionally varied by changing the position of pre-chamber ignition. As a result, it was found that changing the position of pre-chamber ignition varied the location where the pre-chamber flame occurred, how the flame propagated and the timing and strength of ...

6. Paper No. (JSAE/SAE)	20249044/2024-32-0044
7. Paper Title	Enhancing Low Temperature Lean Combustion of CH4-H2 Blends Through a Prechamber Equipped Engine
8. Authors (Affiliation)	Francesco Balduzzi, Giovanni Ferrara (University of Florence), Silvana Di Iorio, Paolo Sementa (STEMS–CNR)

9. Abstract

The use of hydrogen as a sustainable fuel in the short term is hampered by the impossibility of large scale use due low availability. In order to promote decarbonization, complementary solution for a smooth transition is to dilute it in a mixture with methane, in a current Port Fuel Injection (PFI) internal combustion engine (ICE). This can be done as a retrofit after limited structural modifications, such as the introduction of a passive prechamber. Such a solution allows a reduction of the carbon footprint of traditional ICEs through more efficient combustion (both the prechamber technology and the hydrogen fuel properties promote an increase in combustion speed) and a reduced carbon content in the fuel. ...

6. Paper No. (JSAE/SAE)	20249063/2024-32-0063
7. Paper Title	Detailed Approach for Pre-Chamber Heat Release Analysis for the HSASI Pre-Chamber Spark Plug Using a Pressure Sensor Glow Plug
8. Authors (Affiliation)	Sascha Holzberger, Maurice Kettner (University of Applied Sciences Karlsruhe), Roland Kirchberger (Graz University of Technology)

9. Abstract

The hot surface-assisted spark ignition (HSASI) pre-chamber spark plug, which was developed at the Karlsruhe University of Applied Sciences, increases the dilution limit with excess air and the tolerance to residual gas in the pre-chamber compared to a conventional passive pre-chamber spark plug. In this study, the conventional glow plug which is integrated in the pre-chamber of the HSASI pre-chamber spark plug was replaced by a pressure sensor glow plug (PSG) from BERU. This allows for a detailed combustion analysis in the pre-chamber. The signal of the PSG was validated with a piezoelectric cylinder pressure sensor and a method to analyse the pre-chamber heat release was introduced. Experimental investigations were carried out on a ...

6. Paper No. (JSAE/SAE)	20249095/2024-32-0095
7. Paper Title	Simultaneous Direct-Photography of Flame Propagation Inside Pre-Chamber and Main-Chamber in Gasoline Engine with Passive Pre-Chamber
8. Authors (Affiliation)	Satoshi Hokimoto (Sustainable Engine Research Center Co., Ltd.), Yasuo Moriyoshi , Tatsuya Kuboyama (Chiba University), Shuichi Egashira , Yoshitaka Nagai (Yamaha Motor Co., Ltd.)

9. Abstract

Pre-chamber combustion is known for an effective way to improve thermal efficiency in internal combustion engines. An active pre-chamber can accomplish super lean burn, a passive pre-chamber can easily improve combustion in low-cost. Therefore, various studies have been carried out. However, its combustion characteristics are very complicated, the sequence of events for torch ignition and flame propagation in main-chamber from ignition and flame propagation inside pre-chamber have not been well clarified. Especially, investigation of the process from torch ejection to ignition mixture in main-chamber has been carried out using combustion vessel and rapid compression machine, but this phenomenon had not been well clarified. In this ...

Abstracts of Technical Sessions

1. Date — November 5, 2024
2. Room — Mulberry
3. Time — 13:00 – 15:00 hrs.
4. Session — Hybrid and Electric Drives Part 1 of 2
5. Chair (Affiliation), Co-chair (Affiliation) — Yasuyuki Muramatsu (Yamaha Motor Co., Ltd.), Kai Beck (ANDREAS STIHL AG & Co. KG)

6. Paper No. (JSAE/SAE)	20249062 / 2024-32-0062
7. Paper Title	Traction Voltage Level in Two-Wheelers: Considerations on Safety and Performance
8. Authors (Affiliation)	Stefan Schmitt (Vitesco Technologies)

9. Abstract

Most electric 2-wheelers on the market today seek to replace combustion engine vehicles from 50cc to 150cc which equates to an electric motor power between 2 and 12 kW. The traction voltage level of these vehicles is mostly between 44V and 96V. However, the actual choice of voltage on a specific vehicle seems to be arbitrary and higher voltage does not necessarily correlate with higher motor power.
This paper seeks to highlight considerations and tradeoffs which feed the choice of traction voltage levels. Important criteria are electrical safety standards and their impact on vehicle electrical architecture, the performance and availability of key electronics parts such as capacitors, MOSFETs, and gate drivers, while also highlighting functional safety aspects....

6. Paper No. (JSAE/SAE)	20249066 / 2024-32-0066
7. Paper Title	Virtual Calibration Approach to the Development of Control Systems and Strategies for Hybrid L-Category Vehicles
8. Authors (Affiliation)	Christian Antoniutti, David Sweet, Sandra Hounsham (Ricardo Plc, UK & DE)

9. Abstract

Hybrid powertrain for motorcycles has not been widely adopted to date but has recently shown significant increased interest and it is believed to have great potential for fuel economy containment in real driving conditions. Moreover, this technology is suitable for the expected new legislations, reduced emissions and enables riding in Zero Emissions Zones, so towards a more carbon neutral society while still guaranteeing “motorcycle passion” for the product.
Several simulation tools and methods are available for the concept phase of the hybrid system design, allowing definition of the hybrid components and the basic hybrid strategies, but they are not able to properly represent the real on-road behaviour of the hybrid vehicle and its specific control system, making the fine tuning and validation work very difficult. ...

6. Paper No. (JSAE/SAE)	20249122 / 2024-32-0122
7. Paper Title	Assessing Lithium-Ion Battery Functionality Post-Thermal Management with Water Mist
8. Authors (Affiliation)	Piyatida Trinuruk, Pathomporn Patthathum, Apiwit Jumnongjit (King Mongkut's University of Technology Thonburi)

9. Abstract

The danger of lithium-ion batteries in electric vehicles (EVs) is intensified when they are used at inappropriate temperatures, leading to self-heating and eventually contributing to thermal runaway. Nevertheless, there is uncertainty through the safety of reusing batteries after they have been exposed to heat damage and water mist from fire extinguishers. To address these concerns, this study aimed to experimentally investigate the impact of temperature on batteries and introduce a thermal management using a water mist. Subjecting a battery to a temperature of 100°C for a duration of 39 minutes can immediately detect inoperability from a sudden drop in voltage. The use of water mist was proposed to rapidly mitigate the heat production inside the battery. The state of health (SOH) and the impedance were employed to confirm the battery’s functionality ...

6. Paper No. (JSAE/SAE)	20249070 / 2024-32-0070
7. Paper Title	Impacts of Pulsating Flow on Topologically Optimized Porous Reactors in Convection-Diffusion-Reaction Systems
8. Authors (Affiliation)	Mengly Long[1], Mehrzad Alizadeh[2], Pengfei Sun[2], Patcharawat Charoen-amornkitt[1], Takahiro Suzuki[2], Shohji Tsushima[2] 1 King Mongkut's University of Technology Thonburi 2 Osaka University

9. Abstract

Topology optimization (TO) in electrochemical systems has recently attracted many researchers. Previous studies suggested minimal performance differences between 2D and 3D designs, indicating that 2D models suffice to enhance performance, especially in unidirectional flow scenarios. A later study found that the concentration distribution in an optimized 2D flow system differed from that in a unidirectional flow system. We posited that pulsating flow could further enhance the performance of such systems. First, we initiated TO for a diffusion-reaction system in a steady state. The optimized structure obtained from this process served as the foundation for subsequent investigations involving a pulsating flow source in ...

Abstracts of New Product Technology Session

1. Date — November 5, 2024
2. Room — Palladium Hall A
3. Time — 13:00 - 15:00 hrs.
4. Session — New Product Technology Session Part 2 of 5
5. Chair (Affiliation), Co-chair (Affiliation) — Hiroya Ueda (Honda Motor Co., Ltd.) Roland Kirchberger (Graz University of Technology)

6. Paper No.	NPT2024-019
7. Paper Title	The Changing Roles of (Precious Metal) Catalysts with Advancing Decarbonization–What Happened Since Last Year?
8. Authors (Affiliation)	Christian Breuer, Marcus Bonifer, Pragati Joshi (Heraeus Precious Metals GmbH), Christian Hulteberg (Hulteberg Chemistry & Engineering AB)

9. Abstract

With the advancing energy transition and the need for further decarbonization in the mobility and industrial sectors, technologies used here are also bound to change. Switching to carbon neutral e-fuels or even to a completely carbon-free green hydrogen economy, using hydrogen or ammonia directly poses completely new challenges to the catalytic exhaust gas aftertreatment in an internal combustion engine. Furthermore, even regardless of whether these fuels are then used in a combustion engine or for a fuel cell, additional catalytic requirements arise from the fuel management. In the present article, we focus on the development of catalytic solutions in the various fields such as H2 economy, catalytic combustion and emission management, catalysts for Balance of Plant (BOP) components in a Solid Oxide Fuel Cell (SOFC) system etc.

6. Paper No.	NPT2024-002
7. Paper Title	2025 Model ROV WOLVERINE RMAX
8. Authors (Affiliation)	Daisuke Tanaka, Yuichi Ueki (Yamaha Motor Co., Ltd.)

9. Abstract

Principally in North America, the ROV (Recreational Off-Highway Vehicle) market enjoys high demand with its wide range of uses from agricultural and dairy farming work to recreational uses such as hunting and trail driving, as well as for sport driving and racing. Demand is expected to increase further in the future. To cover this wide range of uses, since 2013 Yamaha Motor has developed and launched VIKING, WOLVERINE, and YXZ series of models. Yamaha has been producing ROV under our brand proposition “The Ultimate Outdoor Adventure Partner”. And commit to customer “Realize Your Adventure” with “3C” (Capability, Comfort and Confidence).
RMAX series were launched in 2020 for recreational usage and well received by customers. This year, they were updated to improve both capability and comfort without sacrificing durability. Additionally, the RMAX4 has been added to the lineup as a model with improved Capability/Comfort, offering improved rear seat comfort and performance on undulating roads and climbing steep hills. Here, we introduce the 2025 model WOLVERINE RMAX (hereinafter referred to as this model) updated with new feature for enjoyment driving in a range of areas more comfortably and with greater confidence. (RMAX2: 2-seat model, RMAX4 Compact: short wheelbase 4-seat model, RMAX4: long wheelbase 4-seat model.

6. Paper No.	NPT2024-011
7. Paper Title	Development of New Power-Unit for Ninja 7 Hybrid as Strong-Hybrid Motorcycle
8. Authors (Affiliation)	Tetsuji Yamamoto (Kawasaki Motors, Ltd.)

9. Abstract

Kawasaki has developed the Ninja 7 Hybrid (Fig.1) as a motorcycle that provides "Fun to ride" for a wide range of riders. The hybrid power unit combines a parallel twin-cylinder 451cm3 ICE (Internal Combustion Engine) with a traction motor, allowing for motor-only riding and sport riding in HEV mode with intense acceleration from the traction motor during start-up.

6. Paper No.	NPT2024-021
7. Paper Title	The Design, Development, and Industrialization of a New Single Cylinder Snowmobile Engine
8. Authors (Affiliation)	Paul Whitaker, Sriprakash B.D., Vellingiri T.I., Faiz Ahmed (Hinduja Tech Ltd.)

9. Abstract

This paper outlines a project to design and develop a bespoke new engine designed to meet challenging functional requirements for a novel new type of snowmobile. The project for a North American customer, was delivered ‘turnkey’ from concept to production by Drive System Design (DSD) working with parent company, Hinduja Tech’s (HT), high value engineering teams in India, (the team). The project followed a typical DVP process tailored for the application, with extensive use of virtual validation. The team sourced Indian suppliers for engine components, managed the supply chain and developed the production assembly line. By bringing production suppliers onboard early in the project, the team was able to apply its ‘frugal engineering’ philosophy to the design of the engine – a proven approach to design for manufacture at optimal cost. The project was executed with an engineering budget of less than $3 million and a target product cost of $500 for a low volume single cylinder engine with electronic fuel injection.

Abstracts of Technical Sessions

1. Date — November 5, 2024
2. Room — Jubilee A
3. Time — 15:30 – 18:05 hrs.
4. Session — Powertrain Controls
5. Chair (Affiliation), Co-chair (Affiliation) — Shigeho Sakoda (Yamaha Motor Co., Ltd.) Alexander Winkler (University of Applied Sciences Upper Austria)

6. Paper No. (JSAE/SAE)	20249019 / 2024-32-0019
7. Paper Title	Development of Cylinder Deactivation Control During Idle for Conventional Engines
8. Authors (Affiliation)	Shoji Yanagida (Suzuki Motor Corporation)

9. Abstract
This report examines the advancement and utilization of cylinder deactivation technology that enhances fuel efficiency in conventional engines without hardware modifications. It operates by halting fuel supply to some of the cylinders in multi-cylinder engines and increasing the output power of the remaining active cylinders to maintain an idle state. By implementing this technology in the massproduced 90° V-twin engine, the U502, and deactivating one of its two cylinders, fuel consumption during idling is reduced by over 30%. The focus of this study is on the technology developed to minimize engine speed ...

6. Paper No. (JSAE/SAE)	20249078 / 2024-32-0078
7. Paper Title	Changes of Shifting Rate of Metal V-Belt Type CVT During Speed Up/Down Under Quasi-Idle Loading Condition
8. Authors (Affiliation)	Yuichirou Mori, Kazuya Okubo, Kiyotaka Obunai (Doshisha University)

9. Abstract
The objective of this experimental study was to investigate the change of shifting rate of metal V-belt type CVT during speed up/down under quasi-idle loading condition. Changes in the rotational speeds of the driving and driven pulleys were simultaneously measured by the rotational speed sensors installed on the driving and driven shafts during speed up/down shifting, respectively. In addition, the interaxial force applied to the driving and driven pulleys was measured by a load cell. The shifting rate was defined as the ratio of the calculated radial displacement to the tangential displacement of the belt ...

6. Paper No. (JSAE/SAE)	20249103/ 2024-32-0103
7. Paper Title	Real-Time Control of Hydrogen Injection in a PFI Internal Combustion Engine Based on an Online Physics-Based Model for Estimating Trapped Air and EGR
8. Authors (Affiliation)	Claudio Galli, Marco Ciampolini, Lorenzo Drovandi, Luca Romani, Francesco Balduzzi, Giovanni Ferrara (University of Florence), Giovanni Vichi (Yanmar R&D Europe SRL), Ryota Minamino (Yanmar Holdings Co., Ltd.)

9. Abstract
The use of hydrogen in port fuel injection (PFI) engines faces challenges related to abnormal combustions that must be addressed, especially in transient operation. The in-cylinder air-to-fuel ratio and the amount of trapped exhaust gas have a significant impact on the probability of abnormal combustion as well as NOx emissions, and should be real-time monitored in hydrogen engines. Thus, the real-time estimation of the composition and thermodynamic state of the trapped gas mixture is crucial during transient operations, although highly challenging. This study proposes an on-line real-time physics-based ...

6. Paper No. (JSAE/SAE)	20249024 / 2024-32-0024
7. Paper Title	Model-Based Calibration of ECU for Small Motorcycles
8. Authors (Affiliation)	Hirofumi Fujiwara, Atsushi Maruyama, Yoshiyuki Kasai (Honda Motor Co., Ltd.)

9. Abstract
To deal with the emission regulations it is necessary to produce ECU control maps that maintain balance of emissions of HC, NOX, CO, engine power output and fuel consumption during the motorcycle development. We have recently introduced the Model-Based Calibration (hereafter as MBC) for calibration of ECU control maps for small motorcycles, which share a big chunk of the market. When introducing we aimed at such a method that can simulate stable temperature conditions necessary for the measurement in order to make it applicable to air-cooled engines predominantly used in small motorcycle ...

6. Paper No. (JSAE/SAE)	20249061 / 2024-32-0061
7. Paper Title	Trends in the Automated and Automatic Transmission Systems for Two Wheeled Vehicles
8. Authors (Affiliation)	Prantik Kundu (Bosch Limited)

9. Abstract
The two-wheeler industry features a diverse range of transmission systems catering to varied riding preferences and market demands. Manual transmissions offer direct gear control, favored by enthusiasts for its precision and customizable performance. Automatic transmissions simplify riding, especially in urban settings, eliminating manual gear shifts and reducing rider fatigue. Understanding the dynamics of transmission systems in the two-wheeler space is crucial for manufacturers, engineers, policymakers, and riders alike. It informs product development, regulatory compliance efforts, and market ...

Abstracts of Technical Sessions

1. Date — November 5, 2024
2. Room — Jubilee B
3. Time — 15:30 - 17:30 hrs.
4. Session — Advanced Combustion Part 2 of 3
5. Chair (Affiliation), Co-chair (Affiliation) — Satoshi Takayama (Suzuki Motor Corporation); Simona Silvia Merola (STEMS-CNR)

6. Paper No. (JSAE/SAE)	20249008/2024-32-0008
7. Paper Title	Prediction of Pre-Ignition Borderline on Supercharged SI Engine by Livengood-Wu Integral
8. Authors (Affiliation)	Takaya Omori (Graduate School of Kogakuin University), Junya Tanaka (Kogakuin University)

9. Abstract

The LSPI (Low Speed Pre-Ignition) is one of the consecutive abnormal combustion cycles of supercharged SI engine with direct injection fuel supply system. The LSPI occurs when the engine is running at low speed and high load condition. It is important for the SI engine to control essentially with alternative fuel, e-fuel and hydrogen in the future.
It is considered that the LSPI would be caused by the autoignition of the deposit, the lubricating oil from ring crevice, the lubricating oil from piston crown and so on. Among of these causes, this research focuses on the scattering lubricating oil from the piston crown. The previous our research has reported on the two points. One is about the frequency and quantity of the lubricating oil scattering from the piston crown. Another is about the frequency of abnormal combustion by the engine test. ...

6. Paper No. (JSAE/SAE)	20249023/2024-32-0023
7. Paper Title	Study on the Optimal Pre-Chamber Geometry for Active Pre-Chamber Gas Engines
8. Authors (Affiliation)	Kotaro Yasuda, Yudai Yamasaki (The University of Tokyo), Takahiro Sako, Yoshitane Takashima (Osaka Gas Co., Ltd.), Kenta Suzuki (Isuzu Motors Limited)

9. Abstract

In a pre-chamber engine, fuel in the main-chamber is ignited and burned by the combustion gas injected from the pre-chamber. Since combustion gas from the pre-chamber are used to ignite in the main-chamber, further fuel dilution is possible and thermal efficiency can be improved. However, the addition of a pre-chamber to an engine increases the number of design parameters, such as the volume of the pre-chamber and the specifications of the nozzle hole that jets the combustion gas from the pre-chamber to the main-chamber, and it has a significant impact on main combustion and the exhaust gas. Therefore, in this study, the optimum geometry of the pre-chamber in an active pre-chamber gas engine was investigated. The parameters of the pre-chamber shape considered in this study were the volume of pre-chamber, the diameter of a nozzle hole, and the number...

6. Paper No. (JSAE/SAE)	20249104/2024-32-0104
7. Paper Title	Improvement of Lean Burn Characteristics with Ozone Addition in a Diesel Micro-Pilot Natural Gas Engine
8. Authors (Affiliation)	Yoshimitsu Kobashi, Shoki Miyata, Nobuyuki Kawahara (Okayama University), Ryuya Inagaki (Hokkaido University)

9. Abstract

Ozone (O3) was introduced into the intake air in a natural gas fueled engine ignited by micro-pilot of diesel fuel, to utilize the reactive O-radicals decomposed from the O3 for the promotion of the combustion and for improvements in the thermal efficiency and exhaust emissions. Experiments were carried out in a single cylinder engine to elucidate the effects of the ozone addition under the lean burn conditions. A supercharger was employed to increase the intake air amount and vary the equivalence ratio of natural gas. The experimental results showed that the O3 addition has a limited effect on the ignition of the diesel fuel injected near top dead center, while the heat release during the flame propagation in the natural gas/air mixture was increased at the lower equivalence ratio of natural gas. Further the ignition of natural gas was promoted, resulting in the ...

6. Paper No. (JSAE/SAE)	20249108/2024-32-0108
7. Paper Title	Effects of Hydrogen Addition on Spark Knock Suppression Under High Engine Speed and Boosted Conditions
8. Authors (Affiliation)	Jun Goto[1], Yoshito Ueno[2], Yoshimitsu Kobashi[3], Gen Shibata[2], Hideyuki Ogawa[2], Kentaro Kojima[1] 1 Yamaha Motor Co., Ltd., 2 Hokkaido University, 3 Okayama University

9. Abstract

The effect of hydrogen addition on spark knock suppression under high engine speed (4800 rpm) was investigated at the intake pressures of 96 kPa and 120 kPa. The experimental results showed that hydrogen addition has a slight effect on advancing the knock limit at 96 kPa, whereas a greater spark knock suppression effect can be achieved by increasing the intake pressure. To elucidate the influences and differences of hydrogen addition on the ignition process under low and high intake pressures, chemical kinetic analyses were performed using a two-zone combustion model. The calculation results showed that the reduction of heat release in the end gas resulting from the consumption of OH radicals by hydrogen can only be achieved at the initial stage of the ignition process. This leads to the smaller knock suppression effect at low intake pressures, where a remarkable ...

Abstracts of Technical Sessions

1. Date — November 5, 2024
2. Room — Mulberry
3. Time — 15:30 – 18:05 hrs.
4. Session — Hybrid and Electric Drives Part 2 of 2
5. Chair (Affiliation), Co-chair (Affiliation) — Stephen Teng (Automotive Research & Testing Center), Kai Beck (ANDREAS STIHL AG & Co. KG)

6. Paper No. (JSAE/SAE)	20249029 / 2024-32-0029
7. Paper Title	A Power Split eCVT Hybrid for Sustainable Urban Mobility
8. Authors (Affiliation)	W. Schoeffmann, G. Fuckar, C. Hubmann, M. Gruber (AVL List GmbH)

9. Abstract

The main drivers for powertrain electrification of two-wheelers, motorcycles and ATVs are increasingly stringent emission and noise limitations as well as the upcoming demand for carbon neutrality. Two-wheeler applications face significantly different constraints, such as packaging and mass targets, limited charging infrastructure in urban areas and demanding cost targets.
Battery electric two wheelers are the optimal choice for transient city driving with limited range requirements. Hybridization provides considerable advantages and extended operation limits. Beside efficiency improvement, silent and zero emission ...

6. Paper No. (JSAE/SAE)	20249067 / 2024-32-0067
7. Paper Title	Development of the Mild Hybrid System for Off-Road Machinery
8. Authors (Affiliation)	Kazuaki Koyama, Ryota Kimura, Yuko Nagamori, Tatsuhiko Horita, Kento Nosaka (KUBOTA Corporation)

9. Abstract

In recent years, the importance of achieving carbon neutrality has been highlighted in response to the escalating severity of climate change. In the leading automobile market, the share of electric vehicles is gradually expanding, especially in passenger car sector. However, it is not same in commercial vehicle sector. In the off-road machinery market, as with electrification in commercial vehicles, the factors such as the need to install charging infrastructure and the requirement for large batteries to expand operating duration are significant challenge to full electrification. As one of the realistic solutions toward carbon ...

6. Paper No. (JSAE/SAE)	20249069 / 2024-32-0069
7. Paper Title	Local and Global Entropy Generation of Topographically Optimized Porous Reactors in Reaction-Diffusion Systems Considering Coupling Effects Between Heat and Mass Transfer
8. Authors (Affiliation)	Rotanak Visal Sok Tep[1], Mengly Long[1], Mehrzad Alizadeh[2], Patcharawat Charoen-amornkitt[1], Takahiro Suzuki[2], Shohji Tsushima[2] 1 King Mongkut's University of Technology Thonburi, 2 Osaka University

9. Abstract

As the automotive sector shifts towards cleaner and more sustainable technologies, fuel cells and batteries have emerged as promising technologies with revolutionary potential. Hydrogen fuel cell vehicles offer faster refueling times, extended driving ranges, and reduced weight and space requirements compared to battery electric vehicles, making them highly appealing for future transportation applications. Despite these advantages, optimizing electrode structures and balancing various transport mechanisms are crucial for improving PEFCs' performance for widespread commercial viability. Previous research has ...

6. Paper No. (JSAE/SAE)	20249007 / 2024-32-0007
7. Paper Title	A Study on Optimal Combinations of Winding and Cooling Methods for Downsizing Power Units in Motorcycles
8. Authors (Affiliation)	Ryota Otaki, Teruyuki Tsuchiya, Yu Sakai, Takuya Yamauchi, Tsukasa Shimizu (Yamaha Motor Co., Ltd.)

9. Abstract

In commercially available electric motorcycles, there is a notable shift in the cooling method, moving from air cooling to water cooling, and in the winding method, moving from concentrated winding to distributed winding, as the output increases. This shift occurs around 8 to 10 kW. However, there is a paucity of empirical investigations examining these combinations to ascertain their optimality.
In order to verify this trend, a verification model has been constructed which allows for the comparison of the capacity and ...

6. Paper No. (JSAE/SAE)	20249027 / 2024-32-0027
7. Paper Title	Operating Characteristics of an Automotive Adjustable-Field Permanent Magnet Motors with 3D Magnetic Paths and Asymmetric Magnet Arrangement
8. Authors (Affiliation)	Yutaro Hiyoshi[1,2], Kotaro Doi[2], Toshihiko Noguchi[2] 1 Yamaha Motor Co., Ltd., 2 Shizuoka University

9. Abstract

This paper describes a three-dimensional structure of an adjustable field magnetization permanent magnet (PM) motor and a high-power density rotor structure with asymmetric permanent magnet arrangement for both high torque and high efficiency operation in the high speed and low torque range. 3D-FEA has confirmed that it is possible to achieve both high torque density and adjustable field magnetization. Load testing using the prototype proposed motor confirmed that high motor efficiency can be achieved even during highspeed operation.

Abstracts of New Product Technology Session

1. Date — November 5, 2024
2. Room — Palladium Hall A
3. Time — 15:30 - 17:30 hrs.
4. Session — New Product Technology Session Part 3 of 5
5. Chair (Affiliation), Co-chair (Affiliation) — Kensuke Suzuki (Suzuki Motor Corporation), Sebastian Schurl (Graz University of Technology)

6. Paper No.	NPT2024-005
7. Paper Title	Development of GX430T Engine Unit
8. Authors (Affiliation)	Toshiki Shinohara, Kento Shimizu (Honda Motor Co., Ltd.)

9. Abstract

To meet market demand for higher output, a new general-purpose engine, GX430T, was developed by increasing the displacement of the GX390. This paper presents the compatibility of higher output with overall performance in terms of vibration, noise, and fuel consumption.
It was confirmed that vibration, noise, and fuel consumption worsen with higher displacement. In terms of vibration and noise countermeasures, vibration was reduced by 40% and noise by 2% by optimizing the connecting rod length. As a result, performance equivalent to that of the GX390 was achieved.
In terms of fuel efficiency measures, various changes were made to the compression ratio, exhaust system, cooling fan, etc., to achieve a 8% reduction at rated load. As a result, the performance is equivalent to that of the GX390 even when E10 fuel is ...

6. Paper No.	NPT2024-006
7. Paper Title	GX430T Mega New Engine for Long Tail Boat
8. Authors (Affiliation)	Sahachai Lerdpakavanich (Honda R&D Southeast Asia Co., Ltd.)

9. Abstract

The long-tail boat (hereafter called LTB) was invented over 80 years ago. This application is gradually developed and applied by either a gasoline or diesel engine. But the most popular one is the single-cylinder gasoline engine, which is mainly used for artisanal fisheries. Because of its ease of possession, low price, low running cost, and good accessibility in shallow water zones, LTB has become popular and widely used, especially in Southeast Asia and South America.
Due to their power and affordable operating costs, single-cylinder gasoline engines larger than 400 cc are becoming increasingly in demand. The main customer of LTB is a fisherman who has been having trouble obtaining fishery supplies lately. To reach the deeper water zone, they must move farther and longer each day. To keep their fishes alive or fresh when they return home, travel time is crucial. Boat acceleration and speed are important for maintaining their safety when facing large ...

6. Paper No.	NPT2024-015
7. Paper Title	Improvement of 2.4L Diesel Engine "V2403" That Meets 2023 CARB Emission Regulation of Transport Refrigeration Units
8. Authors (Affiliation)	Yuichi Tamaki, Noriyoshi Eguchi, Mariko Ban, Naohiko Nishioka, Masato Ueda (KUBOTA Corporation)

9. Abstract

Transport Refrigeration Units (TRUs) are the applications powered by engines or other sources designed to cool perishable products and pharmaceuticals that are transported in containers. Since 2013, the off-road EPA/CARB Tier4 emission regulations have been enforced in North America. The California Air Resources Board (CARB) has focused on a TRU market trend after the start of this regulation, and forced more stringent emission standards than those of the off-road Tier4, starting from 2023 for TRUs below 19 kW output range. Compared to the off-load EPA/CARB Tier4 regulation, the 2023 CARB TRU regulation keeps same NOx+HC emission standard of 7.5g/kWh, but the PM emission limit is lowered from 0.4 to 0.03g/kWh. Thereby, we have developed a new electronic controlled engine "V2403" below 19 kW that complies with the CARB TRU regulations. This engine adopts the Common Rail System (CRS), achieves low emission and low fuel consumption simultaneously through ECU ....

6. Paper No.	NPT2024-003
7. Paper Title	Exhaust and Evaporative Emission Control in EU7000is Generator to Comply with CARB SORE Tier4
8. Authors (Affiliation)	Daisuke Matsukawa, Keigo Yoshida, Shohei Urano, Kouki Tsuruda (Honda Motor Co., Ltd.)

9. Abstract

We developed 2024 EU7000is electric generator complying with CARB (California Air Resources Board) SORE (Small Off-road Engines) Tier4 emission standards. Introduced in this paper are two major technical measures to deal with the regulations, the exhaust emission control, and the evaporative emission control. With respect to exhaust gas emissions, by decreasing space velocity from the upsizing of the three-way catalyst substrate and using A/F feedback control, the mode emissions reduced by 74% from the existing model. Regarding the evaporative emissions, by adding the PCSV (Purge Cut Solenoid Valve) in the purge line in addition to the employment of the use enhanced performance canister, the emissions have been reduced by 79% from the existing model. With respect to the evaporative emissions, the test procedures have been changed. A step is added to turn the generator over by 90degrees before the measurement. It is necessary to block flow of fuel into the carbon canister and ...

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Jubilee A
3. Time — 8:00 - 10:00 hrs.
4. Session — Renewable Energy and Alternative Fuels Part 2 of 3
5. Chair (Affiliation), Co-chair (Affiliation) — Yuji Araki (Yamaha Motor Co., Ltd.), Adrian Irimescu (STEMS-CNR)

6. Paper No. (JSAE/SAE)	20249111/2024-32-0111
7. Paper Title	Effects of CO2 Concentration on Combustion Characteristics of Compressed Biomethane Gas
8. Authors (Affiliation)	Takuma Kobayashi[1], Taketoshi Shimizu[1], Kei Yoshimura[2], Ratnak Sok[1], Jin Kusaka[1] 1 Waseda University, 2 Suzuki Motor Corporation

9. Abstract

One way to decarbonize spark-ignition (SI) engines is to use alternative fuels to improve thermal efficiency. Compressed biomethane gas (CBG), mainly composed of methane and carbon dioxide produced from food waste, has attracted attention as an alternative fuel, but its carbon dioxide content is indeterminate. This study investigates the effects of carbon dioxide content on engine performance (thermal efficiency, etc.), emission characteristics, and turbulent burning velocity using a CBG surrogate fuel mixed with methane and carbon dioxide. A single-cylinder SI engine is used as the test engine, and experiments are conducted under different load conditions with a constant crank angle of 50% mass fraction burned (CA50). Engine performance is analyzed based on heat balance from in-cylinder pressure analysis. Emission characteristics are measured ...

6. Paper No. (JSAE/SAE)	20249117/2024-32-0117
7. Paper Title	Experimental Study on Pre-Chamber Hydrogen Flame Jet Ignition of Ammonia/Air Mixture in Constant Volume Combustion Chamber
8. Authors (Affiliation)	Shuo Yin[1], Jiangping Tian[1], Zechuan Cui[1], Xiaolei Zhang[1], Keiya Nishida[1,2], Pengbo Dong[1] 1 Dalian University of Technology, 2 University of Hiroshima

9. Abstract

To address the issues of difficult ignition and slow combustion when ammonia is used as engine fuel, a method of igniting ammonia/air mixture with hydrogen flame jet generated by a pre-chamber is proposed. The combustion characteristics of mixtures ignited by the hydrogen flame jet were studied in a constant volume combustion chamber with high-speed video camera and pressure acquisition in the main chamber. The characteristics were compared with those ignited by the ammonia flame jet. The introduction of the hydrogen flame jet notably improved mixture combustion and expanded the lean flammability limit. Combustion with hydrogen injection demonstrated reduced pressure rise delay and combustion duration, increased average heat release rate, and sustained combustion stability. This phenomenon was more pronounced under ...

6. Paper No. (JSAE/SAE)	20249065/2024-32-0065
7. Paper Title	Experimental Investigations of a Hydrogen Fueled Natural Gas Engine and Ion Current Measurement for Combustion Diagnostics in Pure Hydrogen Operation with Water Injection
8. Authors (Affiliation)	Naqib Salim, Youssef Beltaifa, Maurice Kettner (University of Applied Sciences Karlsruhe), Oliver Loose, Tycho Weissgerber (Weissgerber Engineering GmbH)

9. Abstract

In the ongoing effort to decarbonize energy supply, a notable shift involves the conversion or retrofitting of combined heat and power plants to operate on hydrogen as an alternative to natural gas. In this transformative landscape, extensive research is underway to develop and explore innovative combustion processes for hydrogen-fueled engines, aiming to comprehend and optimize combustion processes concerning both engine performance and emissions. Among the various methods available for monitoring the combustion process and engine control, ion current sensing presents itself as a viable option. A unique feature of this research lies in utilizing the engine's spark plug itself as an electrical sensor, measuring the ion current generated during the flame development and combustion processes. Given the limited research on ion current sensing for hydrogen ...

6. Paper No. (JSAE/SAE)	20249118/2024-32-0118
7. Paper Title	Experimental Study on Thermo-Catalytic Ammonia Decomposition into Hydrogen
8. Authors (Affiliation)	Ze Li[1], Tie Li[1,2], Run Chen[1,2], Shiyan Li[1,2], Xinyi Zhou[1,2], Ning Wang[1] 1 Shanghai Jiao Tong University, 2 SJTU-COSCO Joint Laboratory of Green and Intelligent Marine Power Systems

9. Abstract

In order to rapidly achieve the goal of global net-zero carbon emissions, ammonia (NH3) has been deemed as a potential alternative fuel, and reforming partial ammonia to hydrogen using engine exhaust waste heat is a promising technology which can improve the combustion performance and reduce the emission of ammonia-fueled engines. However, so far, comprehensive research on the correlation between the reforming characteristic for accessible engineering applications of ammonia catalytic decomposition is not abundant. Moreover, relevant experimental studies are far from sufficient. In this paper, we conducted the experiments of catalytic decomposition of ammonia into hydrogen based on a fixed-bed reactor with Ru-Al2O3 catalysts to study the effects of reaction temperature, gas hour space velocity (GHSV) and reaction pressure on the ...

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Jubilee B
3. Time — 8:00 - 10:00 hrs.
4. Session — Advanced Combustion Part 3 of 3
5. Chair (Affiliation), Co-chair (Affiliation) — Tatsuya Kuboyama (Chiba University); Simona Silvia Merola (STEMS-CNR)

6. Paper No. (JSAE/SAE)	20249079/2024-32-0079
7. Paper Title	Numerical Studies on the Relation Between the Multiple Auto-Ignition and Pressure Wave in the Premixed Charge
8. Authors (Affiliation)	Kota Iizumi, Kenji Yoshida (Hiroshima Institute of Technology)

9. Abstract

The relation between the multiple auto-ignition in the premixed charge with fuel concentration distribution and associated pressure wave are numerically investigated. This study assumes that the auto-ignition phenomenon in the end-gas of PCCI combustion, a next-generation combustion method which is expected to achieve both low fuel consumption and low emissions at a high level. Detailed numerical analysis considering the elementary chemical reactions of the compressible reacting fluid flow described in the one-dimensional coordinate system with high spatial and time resolution was performed to clarify the detailed phenomena of the onset of the multiple auto-ignition and the pressure wave propagation in the gas.

6. Paper No. (JSAE/SAE)	20249094/2024-32-0094
7. Paper Title	Research on the Combustion Characteristics of Port Injection Hydrogen Engines for Motorcycles
8. Authors (Affiliation)	Haruaki Suzuki, Taichi Inui, Takanori Okado, Shohei Tamura, Yuta Kagawa, Yoshinari Ninomiya (Suzuki Motor Corporation)

9. Abstract

To prevent global warming, reducing CO2 emissions is the most important issue, and for this reason, efforts are needed to realize a carbon neutral society. Since hydrogen can be stored and transported, and does not emit carbon dioxide when burned, it has attracted particular attention as a fuel for internal combustion engines in recent years and has been studied in various industrial fields. However, many of these studies have been conducted on commercial and passenger vehicle engines, and there has not yet been sufficient validation on small motorcycle engines. Therefore, in this study, a single cylinder gasoline engine for two-wheeled vehicles was converted into a hydrogen engine with port injection, and the abnormal combustion, which is a problem of hydrogen combustion, was verified. In this report, the parameters affecting the abnormal combustion are ...

6. Paper No. (JSAE/SAE)	20249119/2024-32-0119
7. Paper Title	The Similarity Study of the Transient Heat Transfer of Impinging Flames Under CI Engine-Like Conditions
8. Authors (Affiliation)	Jiale Cao[1,2], Tie Li[1], Xinyi Zhou[1], Xingyu Xu[1], Run Chen[1], Shiyan Li[1], Hideyuki Ogawa[3] 1 Shanghai Jiao Tong University, 2 University of New South Wales, 3 Hokkaido University

9. Abstract

The optimization of engine combustion systems based on scaled model experiments can reduce the cost of the development of large-bore marine diesel engines. Illustrating the transient heat transfer similarity of impinging flames would be beneficial to scaled engine model experiments in the development and optimization of large-bore compression ignition engines. In this work, the investigation of the similarity of the transient heat transfer of wall-impinging flames was performed in a high-pressure high-temperature constant-volume vessel. Two different injectors featuring different hole sizes and different flame impingement distances were applied to simulate the diesel spray impinging flames under the large-bore and the small-bore compression ignition engine-like conditions with a geometry similarity ratio equal to 0.7. By varying the injection parameters ...

6. Paper No. (JSAE/SAE)	20249120/2024-32-0120
7. Paper Title	Heat Transfer Characteristics of Lean Methane Flame in the Region near the Wall Boundary Layer
8. Authors (Affiliation)	Xuefeng Xue, Run Chen, Tie Li (Shanghai Jiao Tong University)

9. Abstract

Since proportion of wall heat loss takes as high as 20-30% of the total engine heat loss, the reduction of wall heat loss is considered as an effective way to improve the engine thermal efficiency. The heat transfer near the wall boundary layer plays a significant role on the exploration about the mechanism of wall heat transfer which contributes to figuring out the approach to the reduction of wall heat loss. However, the near wall characteristics of heat transfer are still unclear. In this study, the premixed lean methane flame propagation was captured by the high-speed schlieren and the flame behavior in the near-wall region was investigated by the micro CH*chemiluminescence. The temporal histories of the wall temperature and the heat flux are measured by the co-axial thermocouple. The factors including the convective heat transfer coefficient and ...

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Mulberry
3. Time — 8:30 - 10:00 hrs.
4. Session — Materials and Manufacturing Part 2 of 2
5. Chair (Affiliation), Co-chair (Affiliation) — Hirotaka Kurita (Yamaha Motor Co., Ltd.) Jürgen Tromayer (Graz University of Technology)

6. Paper No. (JSAE/SAE)	20249006/2024-32-0006
7. Paper Title	Reducing the Waste of Plating Solution for Magnetostrictive Torque Sensors
8. Authors (Affiliation)	Hiromichi Ohnishi (Yamaha Motor Electronics Co., Ltd.)

9. Abstract

The power assist system of an electric bicycle uses a magnetostrictive torque sensor to detect the pedal force based on the magnetic properties of the crankshaft, which change according to stress. Fe–Ni alloy plating is used to coat the surface of the crankshaft with a magnetic film to enhance the magnetostrictive effect. However, the sensor performance decreases as the plating solution degrades, which necessitates replacement of the plating solution. In this study, experiments were performed to investigate how to prevent or mitigate degradation of the plating solution to reduce waste. The amounts of carbon and sulfur in the magnetic film were found to increase with degradation of the plating solution. The carbon derived from organic reducing agents and their decomposition products, and the sulfur derived from stress relievers and their decomposition products. A method was developed for reducing the amounts of carbon and sulfur in the magnetic film, which would help maintain the sensor performance and thus reduce the waste of plating solution.

6. Paper No. (JSAE/SAE)	20249020/2024-32-0020
7. Paper Title	Dependency of Gear Honing Machine Processing Accuracy on Machine Vibration and the Vibration Reduction Considering Contribution
8. Authors (Affiliation)	Hiroaki Hanioka[1], Yunosuke Ogawa[1], Junji Yoshida[1], Yoichi Onishi[2], Yasuhiro Kurokawa[2] 1 Osaka Institute of Technology 2 Kanzaki Kokyukoki Mfg.Co.,Ltd.

9. Abstract

In recent years, accurate gear processing is required for various products to improve efficient power transmission and small noise and vibration. On the other hand, the accuracy tends to be worse by high speed processing for increasing production efficiency. Therefore, we investigated relationship between gear honing machine vibration and the accuracy. The vibration acceleration of the honing machine was measured at various conditions, and the gear accuracy was measured after processing. As results, the accuracy was observed to be affected by both the original gear accuracy before honing processing and the gear secondary rotational vibration of the machine in operation. Subsequently, we applied transfer path analysis (TPA) to investigate which directional force in operation increased the vibration. As the results, the contribution from the input force at gear processing point along normal direction was the main contributor. Then, vibration transmission characteristics of the machine body were obtained by hammering tests and the transfer function at 149 Hz (gear 2nd order at 1700 rpm) was found to be much lower than that at 197 Hz (2250 rpm) where the original rotational speed. Then, honing processing experiment was again conducted under the conditions in which the rotational speed was changed from the original speed to the speed where the transfer function was low. The result showed that the vibration was decreased significantly.

6. Paper No. (JSAE/SAE)	20249040/2024-32-0040
7. Paper Title	Development of Higher Clarity Injection Molded Windscreen for Motorcycles
8. Authors (Affiliation)	Atsushi Yamada, Sakae Endo (Honda Motor Co., Ltd.)

9. Abstract

The windscreen is one of the key elements to enhance passenger comfort of touring motorcycle. The clarity through the windscreen should not discomfort the rider. The discomfort we discuss here mainly refers to three factors: the “distortion,” the “blur,” and the “transparency.” Introduced in this paper is the technical measures to achieve sufficient clarity by the injection molding method. Firstly, with respect to the “distortion,” we determined the main cause was local unevenness of plate thickness. As the uneven thickness were related to the accuracy of the die, we clarified the tolerable zone and carried out higher precision machining of the die to satisfy the requirements. Regarding the “blur,” we analyzed the refractive power of the windscreen and found the main cause of blur is the microscopic roughness on the surface. As the microscopic roughness were attributable to the die surface, we clarified the tolerable zone and established the polishing conditions satisfactory for the requirements. With respect to the “transparency,” it is necessary to maintain transparency after being scratched and degraded by weather in long term use. We determined to use the bio polycarbonate because of its good scratch and weather resistance, which are necessary for maintaining transparency. With all these technical measures applied, we have established the new injection molding method for the windscreens featuring sufficient clarity while taking the environmental protection.

Abstracts of New Product Technology Session

1. Date — November 6, 2024
2. Room — Palladium Hall A
3. Time — 8:00 - 10:00 hrs.
4. Session — New Product Technology Session Part 4 of 5
5. Chair (Affiliation), Co-chair (Affiliation) — Michihisa Nakagawa (Kawasaki Motors, Ltd.), Kai Beck (ANDREAS STIHL AG & Co. KG)

6. Paper No.	NPT2024-016
7. Paper Title	Improvement of Corrosion Resistance of Engine Parts for New Outboard Motor by Anodizing Technology
8. Authors (Affiliation)	Tomoya Matsubara, Haruhiko Murakami, Tadaaki Morikami, Ayaka Nagai, Shintaro Ono, Masahiro Fujita, Kazuhira Shoji, Jiro Saiga, Takahiro Yuki (Suzuki Motor Corporation)

9. Abstract

We manufacture outboard motors and supply them all over the world. We have once again adopted the world's first mass-produced surface treatment technology for the DF140B, a medium-sized outboard motor equipped with the world's first Micro-Plastic Collecting Device. This surface treatment technology is part of Suzuki's Clean Ocean Project and contributes to CO_2 reduction. In this paper, we introduce the new outboard motor equipped with the new technology, and present our efforts to address the challenges and results of the mass production of the new surface treatment technology adopted by the new outboard motor.

6. Paper No.	NPT2024-020
7. Paper Title	Development Methodologies for a New Generation of Hydrogen-Compatible Pistons
8. Authors (Affiliation)	Giovanni Paolicelli (Asso Werke S.P.A.)

9. Abstract

The project “Tecnologie Innovative per lo Sviluppo di Motori ad Emissione di CO2 Neutra” (TISMEN) is focused on the development of advanced components for internal combustion engines. It is a joint project in collaboration with the university of Florence, the University of Pisa and Pontlab, an advanced material testing laboratory. This project seeks to harness the potential of new materials, innovative thermal and surface treatment processes, cutting-edge production techniques and optimized geometries. The primary aim of TISMEN is to facilitate the widespread adoption and use of hydrogen and carbon-neutral fuels in internal combustion engines on an industrial scale, making a significant contribution to reducing global carbon emissions. A key objective of the project is to empower Asso Werke, the leading company, to introduce a new range of high performance products to the market. These products include pistons, piston rings, and cylinders/liners that are not only fully ...

6. Paper No.	NPT2024-014
7. Paper Title	Advantages of the Features of a Small Gasoline Engine Driven Unmanned Helicopter for Forest DX Service "RINTO"
8. Authors (Affiliation)	Jun Yajima, Kaoru Kato (Yamaha Motor Co., Ltd.)

9. Abstract

In Japan, the artificial forests planted after World War II have reached the appropriate age for harvesting, and there is a need for construction and forest management. However, as times change, such as a declining population and falling lumber prices, there is a need to improve work efficiency to compensate for the decrease in the number of workers, and to increase added value to improve profitability. To help with this issue, Yamaha Motor has launched a new business called "RINTO", a forest information digitization service. One of its main features is that it provides a comprehensive and detailed understanding of the forest, right down to its interior. In forests where it is difficult to approach from the ground, aerial measurements are effective in obtaining information efficiently. At that time, to investigate the interior of the forest covered by the tree canopy, it is necessary to take measurements from low altitudes and at low speeds. Additionally, to measure large areas efficiently, it is effective to ...

6. Paper No.	NPT2024-009
7. Paper Title	Development of Electrically Assisted Hose Carts for Firefighting
8. Authors (Affiliation)	Yuki Mukai (Yamaha Motor Engineering Co., Ltd.)

9. Abstract

Yamaha Motor Engineering Co., Ltd. manufactures firefighting hose carts that facilitate the movement and extension of hoses during firefighting activities. There are three types of firefighting hose carts: ride-on type, non-powered towed type, and powered towed type, and we produce two types of firefighting hose carts: ride-on type and non-powered towed type. In recent years, in order to reduce the weight of fire trucks and secure space for mounting equipment, the downsizing and weight reduction of firefighting hose carts has become an important issue in the firefighting industry, and demand has shifted from ride-on to towed types. In addition, due to the aging of firefighters and the increase in the number of female firefighters, there is a growing need for powered towed hose carts that reduce the physical load. However, the existing powered towed hose cart uses the throttle to adjust the speed while accompanying the vehicle, so the movement of the vehicle and the person does ...

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Jubilee A
3. Time — 10:30 - 12:00 hrs.
4. Session — Engine Technology
5. Chair (Affiliation), Co-chair (Affiliation) — Shogo Tadakuma (Suzuki Motor Corporation); Jürgen Tromayer (Graz University of Technology)

6. Paper No. (JSAE/SAE)	20249033 / 2024-32-0033
7. Paper Title	Investigation on the Applicability of Passive Type Pre-Chamber with One Port Fuel Injection System to Small Gasoline Engines
8. Authors (Affiliation)	Yoshinori Nakao[1], Yota Sakurai[2], Atsushi Hisano[2], Masahito Saitou[2], Tomoharu Suzuki[1] 1 Kawasaki Motors, Ltd. 2 Kawasaki Heavy Industries, Ltd.

9. Abstract

Pre-chamber combustion has been applied as a method of low fuel consumption in spark ignition engines, and in recent years the application of pre-chambers to gasoline engines has also been actively studied. In many gasoline engines, stoichiometric combustion is common. We decided that a passive type pre-chamber with only one port fuel injection is sufficient for stoichiometric combustion. The pre-chamber system relatively has two merits of lower cost and ease of installing than other prechamber systems. Therefore, we focused on investigating the effects of improving combustion speed and knock resistance in use of the passive type pre-chamber and the applicability of the prechamber system in various operating points. As the concrete approach, we evaluated the heat balance and the knock resistance with and without a pre-chamber in engine bench test. As a result, the knock resistance and the fuel consumption were improved. In addition, as a result of considering lean burn in the passive type pre-chamber in order to further improve fuel consumption in the future, the fuel consumption in use of the passive type pre-chamber was also improved compared to that in case of no pre-chamber. Furthermore, as a result of evaluating the combustion characteristics of the pre-chamber due to differences in operating points depending on the ...

6. Paper No. (JSAE/SAE)	20249058 / 2024-32-0058
7. Paper Title	Studying the Lean Burn Operation in Two-Wheelers to Increase Fuel Efficiency and Investigate the Use of Lean NOx Trap Catalyst (LNT) for Lean Burn System
8. Authors (Affiliation)	Karthikeyan Somasundaram, Purushothaman Sivaji, John Derin C, Karwa Vishal, Manoj Kumar S (Bosch Limited)

9. Abstract

This study offers an overview of the impact of lean burn technology in two-wheeler vehicles, specifically concentrating on enhancing the fuel economy and addressing the challenges associated with its adoption. Lean burn systems, characterized by a fuel-air mixture with a higher air content than stoichiometric ratio. The study focuses on technology which meets stringent emission standards while enabling the optimization of fuel efficiency. The lean burn system employs strategies to optimize air-fuel ratio using electronic fuel injection, ignition timing control, and advanced engine control algorithms like - updated torque modulation control algorithm for drivability, lambda control algorithm for rich and lean switch and NOx modelling algorithm for LNT catalyst efficiency tracking. The challenges related to lean burn systems, includes issues related to combustion stability, nitrogen oxide (NOx) emissions, and their impact on drivability, is summarized in the study. Mitigation strategies, ranging from after-treatment systems to catalyst technologies, are discussed as means to address these challenges while preserving the benefits of lean burn operation. Furthermore, this study sheds light on the Lean NOx Trap (LNT) catalyst which is a critical component in modern emission control systems, particularly in the context of lean burn engines. Designed to reduce ...

6. Paper No. (JSAE/SAE)	20249096 / 2024-32-0096
7. Paper Title	Development of CO2 Emission Reduction Technology for Sport Motorcycles
8. Authors (Affiliation)	Naoki Makita, Masaki Torigoshi, Toshihiko Takahashi, Hiroki Takase (Yamaha Motor Co., Ltd.)

9. Abstract

With growing global concern about climate change, the challenge is to achieve carbon neutrality (CN) in motorcycles (MCs) as well, and various approaches are needed to achieve CN. For powertrains using internal combustion engines (ICEs), CN can be achieved by adopting CN fuels such as efuel and biofuel, but considering cost and supply, it is important to develop CO2 reduction technologies for ICEs. Compared with 4-wheel vehicles, MCs are required to be powerful, lightweight, compact and capable of travelling long distances, the CO2 reduction technologies that can be adopted tend to be a trade-off between dynamic performance and CO2 reduction, and a challenge is to achieve a high level of both requirements. We decided to focus on middle-class sports MCs, which require particularly high dynamic performance, and to develop CO2 reduction technologies. As a technology development target, CO2 emissions were set at 65 g/km in the worldwide-harmonized motorcycle test cycle (WMTC) class 3-2, while maintaining the dynamic performance required for sports MCs. The combination of technologies required to achieve the target was simulated and a concept was selected for technology demonstration. As a result, the downsizing concept with electrically assisted turbocharger (E-Turbo) was selected and CO2 emissions and ...

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Jubilee B
3. Time — 10:30 - 12:00 hrs.
4. Session — Measurement and Simulation Part 1 of 4
5. Chair (Affiliation), Co-chair (Affiliation) — Keisuke Ito (Suzuki Motor Corporation); Stephan Schmidt (Graz University of Technology)

6. Paper No. (JSAE/SAE)	20249036/2024-32-0036
7. Paper Title	Representative Point of Measurement of Engine ECU and Effect of Vortices and Ambient Wall on Forced Air-Cooling
8. Authors (Affiliation)	Jiajun Zhong, Kazuaki Inaba, Ryota Yamaguchi, Ryuta Yasui (Tokyo Institute of Technology), Masafumi Umeno (Denso Corporation)

9. Abstract

The Electric Control Unit (ECU) is a crucial computing unit responsible for engine regulating various functions. However, non-airflow thermal design due to the complexity of engine bay turbulent flow simulation is limiting ECU's potential with the increasing demand of computation power consumption, thermal design faced additional challenges.
Moreover, the lack of standardized ECU design guidelines forced substantial investments in customized thermal solutions for different engine bay packaging. Through this research, the method of finding representative points of ambient temperature efficiently and reliably is investigated, so that thermal design can be achieved by estimating flow properties during the ECU design stage efficiently. This research involves studying the effects of airflow on ECU cooling using experimental and numerical analysis in Computational Fluid Dynamics (CFD). Alongside the representative points of ambient temperature uncovered from the numerical result, experimental results were gathered and used as references to authenticate the findings. In the experiment, this study utilized a wind tunnel and retrieved measurements of the ECU. Advancing from the result, including visualization, and comparison to the simulation result was done to form a complete validation and alignment for CFD. ...

6. Paper No. (JSAE/SAE)	20249047/2024-32-0047
7. Paper Title	Enhancements in Hydrogen Low Pressure Injection on Small Two-Stroke Engines
8. Authors (Affiliation)	Stefano Caprioli[1], Oliver Schoegl[2], Roland Oswald[2], Roland Kirchberger[2], Enrico Mattarelli[1], Carlo Alberto Rinaldini[1] 1 University of Modena and Reggio Emilia 2 Graz University of Technology

9. Abstract

The use of small 2-stroke crankcase scavenged engines running on hydrogen is very attractive for low power rates, when low cost and compact dimensions are the fundamental design constraints. However, achieving optimal performance with hydrogen fuel presents challenges, including uneven airfuel mixtures, fuel losses, and crankcase backfiring.
This research focuses on a small 50cc 2-stroke loopscavenged engine equipped with a patented LowPressure Direct Injection (LPDI) system, modified for hydrogen use. Experimental results demonstrate performance comparable to the gasoline counterpart, but further optimizations are needed. Consequently, CFD3D simulations are employed to analyses the injection
process and guide engine development. The numerical analysis focuses on a fixed operating condition: 6000 rpm, Wide Open Throttle (WOT), with a slightly lean mixture and injection pressure fixed at 5 bar.
A numerical model of the entire engine is set up with the primary objective of improving injection efficiency by modifying the position and orientation of the injector, along with the piston dome shape. Seven configurations under the same operating conditions and injected mass are investigated to assess the impact of these modifications and find the best compromise. ...

6. Paper No. (JSAE/SAE)	20249072/2024-32-0072
7. Paper Title	Novel Statistical Modelling-Based Approach for Exhaust Mass Flow Calculation in Motorcycles
8. Authors (Affiliation)	Sebastian Schurl[1], Stefan Sturm[2], Stephan Schmidt[1], Roland Kirchberger[1] 1 Graz University of Technology 2 FVT

9. Abstract

The exhaust mass flow measurement for motorcycles poses a unique challenge due to presence of pulsations arising from an unfavorable combination of the engine displacement-toexhaust system volume ratio and the long or even unequal ignition intervals. This pulsation phenomenon significantly impacts the accuracy of the differential pressure-based measurement method commonly employed in on-board measurement systems for passenger cars. This paper introduces an alternative approach calculating exhaust mass flow in motorcycles, focusing on statistical modelling based on engine parameters.
The problem at hand is rooted in the adverse effects of pulsations on the differential pressure-based measurement method used in the EFM. The unfavorable combination of engine characteristics specific to motorcycles necessitates a novel approach. Our proposed alternative involves utilizing readily available OBD parameters, namely engine speed and calculated engine load as there is mostly no data for intake mass flow. The intake mass flow is then calculated using the SAE-based equation, offering a suitable and robust method for exhaust mass flow estimation in motorcycles.
Acknowledging certain simplifications in the model, such as the absence of lambda information and variations in engine ...

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Mulberry
3. Time — 10:30 – 12:00 hrs.
4. Session — Lubricant and Tribology
5. Chair (Affiliation), Co-chair (Affiliation) — Yuji Mihara (Tokyo City University); Marcus Gohl (APL Automobil PrÜftechnik Landau GmbH)

6. Paper No. (JSAE/SAE)	20249030/2024-32-0030
7. Paper Title	Development of Pistons Suitable for Compact Air-Cooled Engines
8. Authors (Affiliation)	Naoyuki Suda, Taiki Hihara, Yoshinari Ninomiya (Suzuki Motor Corporation)

9. Abstract

For the realization of carbon neutrality, we are working on research to improve the thermal efficiency of engines for motorcycles. Friction losses in the cylinder bore account for about 40% of the total friction losses of the engine (Figure 1), which is directly related to thermal efficiency improvement. [1] Air-cooled engines are suitable for motorcycles due to their simplicity and light weight, but it is difficult to achieve both efficiency and reliability. Friction in the cylinder is generated by piston scuffing. The oil film distribution of the piston-skirt(=skirt) is thin at the center of the skirt and thick at the edge. To reduce piston friction, it is effective to make the thin oil film at the center of the skirt thicker. On the other hand, to reduce oil consumption, the oil film must be thinned. However, air-cooled engines, which are difficult to keep the cylinder temperature constant, cannot make the clearance between the cylinder bore and the piston small. An increase in clearance is a cause of increased oil consumption. To achieve both high efficiency and reliability of air-cooled engines, optimal control of the oil film thickness on the scuffing parts of the piston is necessary. We developed a piston capable of solving this difficult problem by combining CAE and laboratory tests and visualization technology. The excellent performance of the developed piston was proved by friction tests using a small air-cooled engine and oil consumption measurement results.

6. Paper No. (JSAE/SAE)	20249099/2024-32-0099
7. Paper Title	Investigation on the Wear Regime of Plastic Gears Sliding Against Metal Gears.
8. Authors (Affiliation)	Jimpei Yamamoto, Takaharu Suzuki, Natsuki Ako, Shinya Iwasaki, Hirotaka Kurita (Yamaha Motor Co., Ltd)

9. Abstract

The use of plastic gears has expanded significantly due to their lightweight properties, low noise emission, and cost-effective manufacturing. Even in e-bikes, some metal gears are being replaced with plastic gears. It is expected that increasing the load capacity of the meshing between metal and plastic gears will result in further reduction in weight and noise. Different patterns of damage can occur in gear meshing due to high loads, but wear can occur even at relatively small loads. To enhance load capacity and reduce wear, it is essential to elucidate the wear mechanism, identify the contributing factors and investigate the impact of each, and then implement appropriate countermeasures. In gear testing, gear geometry has a significant influence, so it is necessary to perform tests with matching shapes to ensure high reproducibility, but it is difficult and time-consuming to accurately produce prototypes of plastic and metal gears with countermeasures incorporated. Simplified tests are therefore required to efficiently elucidate the wear mechanism and evaluate the effectiveness of countermeasures.
The objective of this study is to establish a test that can reproduce wear morphology similar to those observed in standard gear tests. Furthermore, the study also aims to clarify the wear regime using this test.
A reciprocating sliding test was chosen to mimic the sliding between metal and plastic in the gear test, with the lubrication …

6. Paper No. (JSAE/SAE)	20249100/2024-32-0100
7. Paper Title	Development of a High-Frequency Measurement Apparatus for Evaluating Piston Friction in a Small Gasoline Engines
8. Authors (Affiliation)	Riku Honda, Akemi Ito, Santa Saika, Ryouta Yamase, Tatsuhiko Hasegawa, Takeru Sakioka (Tokyo City University), Naoyuki Suda, Yoshinari Ninomiya (Suzuki Motor Corporation)

9. Abstract

Efforts towards efficient fuel economy in small gasoline engines, crucial for CO2 emission reduction, focus on mitigating piston friction losses. Balancing friction reduction with considerations such as preventing piston seizure and minimizing oil consumption poses challenges, particularly in small gasoline engines operating at higher speeds where the risk of piston seizure is critical. Hence, the need for accurate measurement methods for piston friction.
This study presents the development of a measurement apparatus utilizing the floating liner method, originally invented by Takiguchi and adapted by Yamasaka for a mono-cylinder air-cooled gasoline engine. Yamasaka's work successfully explored the relationship between the natural frequency of the apparatus and the maximum measurable engine speed, achieving piston friction measurement up to 5000 rpm.
Building upon this success, the focus of this research is to extend the applicability of the floating liner method to a mono-cylinder water-cooled gasoline engine, allowing accurate piston friction measurement up to 6000 rpm. The developed apparatus successfully measured piston friction forces at high engine speeds, providing insights into the characteristics of friction force generation during each engine stroke.Findings reveal that under low engine speeds, friction force is …

Abstracts of New Product Technology Session

1. Date — November 6, 2024
2. Room — Palladium Hall A
3. Time — 10:30 - 12:00 hrs.
4. Session — New Product Technology Session Part 5 of 5
5. Chair (Affiliation), Co-chair (Affiliation) — Takuya Warashina (Honda Motor Co., Ltd.) / Kai Beck (ANDREAS STIHL AG & Co. KG)

6. Paper No.	NPT2024-018
7. Paper Title	The EMR Bike – Cool System, Lasting Power
8. Authors (Affiliation)	Thomas Arnold, Jan BÖhme, Matthias Krause, Mirko Leesch, Masataka Aoki (IAV GmbH)

9. Abstract

Electrification of the powertrain isn't just taking place on the public roads; it's also making its way onto the racetrack. The current development focus for electric vehicles is the balance between driving power, range, and weight, which is given even greater weighting in racing. To redefine the current limits, IAV has developed a complete Electric Motocross Racing (EMR) powertrain and integrated it into a real drivable demonstrator. Equipped with an innovative direct phase-change cooling system (PCC) for the e-motor and its power electronics, it allows a significant increase in continuous power (Pe=40 kW from 7000 to 9000 rpm) without thermal derating. The bike is powered by a replaceable Lithium-Ion round cell battery (Ubatmax = 370V) with an energy storage capacity of Ebat = 5 kWh. The battery system is integrated into series chassis and is equipped with immersion cooling. The power transmission to the wheel realized by a single speed transmission and hydraulically actuated multi-plate wet clutch. The minimum running time under race conditions on a dirt track is 35 minutes. A swappable battery pack allows quick replacement and allowing more than one stint to be completed during a race weekend. The total weight of the motorcycle is located at the 450cc four-stroke class (mbike~113 kg), whereby the handling is implemented with a state-of-the-art chassis and suspension analogous to the classic fuel MX motorcycle. In addition, the drivability by means of adjustments to the e-motor characteristics (power and power output), recuperation, etc. is largely freely adaptable.

6. Paper No.	NPT2024-001
7. Paper Title	Introduction of a Front-Loading Method in the Development Stage of Outboard Engines
8. Authors (Affiliation)	Masanori Kobayashi (APL Automotive Japan K.K.)

9. Abstract

In outboard engine development, transient response tests and various functional verifications are still mostly conducted on a lake or at sea with the outboard engine mounted on an actual boat or alternatively on a test bench with a large water tank to simulate the conditions which are encountered on an actual boat. In the latter case, APL Automotive has established a front-loading method for outboard engine development and verification. In addition, to make a proposal for the real-world test of outboard engines on a testbench, we would like to connect the simulation environment to a test bench, resulting in Power-Hardware-in-the-Loop testing of outboard engines.

6. Paper No.	NPT2024-010
7. Paper Title	Interconnected Handlebar Ecosystem
8. Authors (Affiliation)	Moritz Schmidt, Thomas Brehmer (Brehmer GmbH & Co. KG)

9. Abstract

In the realm of product innovation, we introduce a cutting-edge integrated unit. This unit comprises several key components: the New Generation handlebar switches, APS (electronic throttle control), electronic brake or clutch (BrakeByWire & ClutchByWire), and an intelligent (heated) grip system (HandsOnDetection). Our primary objective is to enhance the ergonomic design and safety features of two-wheelers by providing seamless control through these handlebar components.

In our pursuit of innovation, we meticulously design and supply each handlebar element to align with the latest two-wheeler technology. Our modular approach consolidates essential functions into a single cohesive unit. This interconnected handlebar ecosystem not only enhances ergonomics but also ensures precise control over functionally safe features. Moreover, it leads to cost savings and heightened reliability.

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Jubilee A
3. Time — 13:00 - 15:00 hrs.
4. Session — Renewable Energy and Alternative Fuels Part 3 of 3
5. Chair (Affiliation), Co-chair (Affiliation) — Yoshimitsu Kobashi (Okayama University); Adrian Irimescu (STEMS-CNR)

6. Paper No. (JSAE/SAE)	20249050/2024-32-0050
7. Paper Title	Experimental Investigation of n-Heptane/Ethanol Blended Fuels on Auto-Ignition and Flame Propagation in High Temperature/Pressure Constant Volume Combustion Vessel
8. Authors (Affiliation)	Tokua Tateishi, Riki Yamaguchi, Daisuke Shimokuri (Hiroshima University), Hiroshi Terashima (Hokkaido University), Takaya Hara, Yuya Honda, Michiharu Kawano (Mazda Motor Corporation)

9. Abstract

This study aims to investigate the effect of ethanol blends on flame propagation and auto-ignition under high pressure and high temperature conditions. Experimental investigations are conducted using n-C7H16 / ethanol blends at various blending ratios (0, 5, 10, 20, 40, 70, and 100 vol%).
The blends are premixed with air at stoichiometric ratios and ignited centrally in a cylindrical constant-volume combustion chamber (20-mm inner diameter, 80-mm long) under elevated temperature (500 K) and pressure (1.0 MPa) conditions. The results show that auto-ignition occurs at an ethanol blend ratio of 10% or less and ceases above 20%.....

6. Paper No. (JSAE/SAE)	20249060/2024-32-0060
7. Paper Title	Experimental Investigation for the Effect of Cavity Geometry on the Flame Propagation and Auto-Ignition in RCM
8. Authors (Affiliation)	Riki Yamaguchi, Daigo Esaki, Tokua Tateishi, Ali Hassan Osaf, Akira Miyoshi, Daisuke Shimokuri (Hiroshima University), Tomoaki Yatsufusa (Hiroshima Institute of Technology), Hiroshi Terashima (Hokkaido University), Takaya Hara, Yuya Honda, Tadashi Tadokoro, Michiharu Kawano (Mazda Motor Corporation)

9. Abstract

In this experiment, we investigated the auto-ignition and flame propagation behavior by using flat piston and cavity pistons which has different geometries, depth, and width of the cavity. In this study, flame behavior inside the cavity is visualized with the ion-probes, which is embedded every 3mm radially from the center of the piston. We also used the pressure sensor in the combustion chamber and high-speed camera through the quartz window near the cylinder wall.
Flame appearance obtained with high-speed camera shows that the flame propagation of the cavity piston is faster than that of flat piston. This is considered because of the outward induced flow in the squish area. That is, the flame propagation inside ...

6. Paper No. (JSAE/SAE)	20249010/2024-32-0010
7. Paper Title	Evaluation and Visualization of Surfactant Effect on Single Emulsified Fuel Droplet for Diesel Engine
8. Authors (Affiliation)	Yuta Kurahashi, Hiromu Katsuki (Graduate School of Kogakuin University), Junya Tanaka (Kogakuin University)

9. Abstract

The emulsified fuel is mixed base fuel with water and stabilized by surfactant. The advantage of emulsified fuel is the improvement of spray and mixture formation by the secondary atomization. The secondary atomization means that the sprayed fuel droplets in cylinder would occur the atomization because of the difference of boiling points between base fuel and water. It is expected improving combustion efficiency and suppressing toxic emissions such as NOx and PM in small diesel engine [1].
The behavior of an emulsified fuel droplet in heating process has 3 types, Namely the micro-explosion, the puffing and only vaporizing without atomization. Their timing and behavior are influenced on the concentration of surfactant within an ...

6. Paper No. (JSAE/SAE)	20249057/2024-32-0057
7. Paper Title	Characterization of Thermo-Catalytically Reformed Diesel Injection and Ignition in Comparison to Conventional Diesel Fuels
8. Authors (Affiliation)	Jan Seeger, Marco Taschek (OTH Amberg-Weiden), Andreas Apfelbacher (Fraunhofer UMSICHT), Lukas Strauss, Sebastian Rieß, Michael Wensing (FAU Erlangen-Nuernberg)

9. Abstract

It is widely known that with decreasing oil reserves on a global scale there is a need for alternative energy sources. Therefore, the introduction of various alternative fuels is of utmost importance. One way of producing alternative fuels is the Thermo-catalytic Reforming (TCR) process which was developed by the Fraunhofer-Institute for Environmental, Safety and Energy Technology (UMSICHT).
For an application in conventional diesel engines, however, it is important to investigate the spray behavior of such TCR Diesel fuels in comparison to conventional Diesel fuels under engine-like operating conditions. Two different batches of TCR Diesel were compared with conventional Diesel fuels. The results show batch-dependent significant differences in the ...

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Jubilee B
3. Time — 13:00 - 15:00 hrs.
4. Session — Measurement and Simulation Part 2 of 4
5. Chair (Affiliation), Co-chair (Affiliation) — Tadao Okazaki (LEMA / KUBOTA Corporation); Stephan Schmidt (Graz University of Technology)

6. Paper No. (JSAE/SAE)	20249017/2024-32-0017
7. Paper Title	A Concept for Functional Modelling of an E-Bike Powertrain
8. Authors (Affiliation)	Yannick Rauch, Maurice Kettner, Reiner Kriesten (Karlsruhe University of Applied Sciences)

9. Abstract

The increasing popularity of e-bikes, especially pedelecs, has led to a growing interest in consideration of e-bike cycling. To achieve a deeper understanding on the process of e-bike cycling and in particular the effects on the rider it can be instrumental to use simulation methods. In this context, the ebike drive system and its function are of central importance for e-bikes. Therefore, this work proposes a functional modeling of the powertrain of an e-bike with a mid-drive motor, considering legal constraints and support functionalities. The model incorporates the mechanical transmission between pedals, motor, and crank shaft, allowing for a detailed analysis of the e-bike's performance.
Additionally, the support mechanism is depicted, where an electric motor amplifies the rider's pedaling torque. The electrical behavior of the motor, energy consumption, and battery state of charge are also integrated into the model. This ...

6. Paper No. (JSAE/SAE)	20249035/2024-32-0035
7. Paper Title	Statistical analysis of data acquired from propagating flames in gasoline engines using a multiple ion probe
8. Authors (Affiliation)	Tomoaki Yatsufusa, Takehiro Okahira, Kohei Nagashige (Hiroshima Institute of Technology)

9. Abstract

Multiple-ion-probe method consists of multiple ion probes placed on the combustion chamber wall, where each individual ion probe detects flame contact and records the time of contact. From the recorded data, it is also possible to indirectly visualize the inside of the combustion chamber, for example, as a motion animation of moving flame front. In this study, a thirty-two ion probes were used to record flames propagating in a two-stroke gasoline engine. The experiment recorded the combustion state in the engine for about 3seconds under full load at about 6500 rpm, and about 300 cycles were recorded in one experiment. Twelve experiments were conducted under the same experimental conditions, and a total of 4,164 cycles of signal data were obtained in the twelve experiments. Two types of analysis were performed on this data: statistical analysis and machine learning analysis using a linear regression model. Statistical analysis calculated the average flame detection time and ...

6. Paper No. (JSAE/SAE)	20249038/2024-32-0038
7. Paper Title	Prediction Method of Strength Robustness Affected by Arc Welding Sectional Dimensions
8. Authors (Affiliation)	Yusuke Hada, Hisayuki Sugita (Suzuki Motor Corporation)

9. Abstract

The arc welding process is essential for motorcycle frames, which are difficult to form in one piece because of their complex shapes, because a single frame has dozens of joints. Many of the damaged parts of the frames under development are from welds. Predicting the strength of welds with high reliability is important to ensure that development proceeds without any rework. In developing frames, CAE is utilized to build up strength before prototyping. Detailed weld shapes are not applicable to FE models of frames because weld shapes vary widely depending on welding conditions. Even if CAE is performed on such an FE model and the evaluation criteria are satisfied, the model may fail in the actual vehicle, possibly due to the difference between CAE and actual weld bead geometry. Therefore, we decided to study the extent to which the stresses in the joint vary with the variation of the weld bead geometry. Morphing, a FE modeling method and design of experiment method, was utilized to ...

6. Paper No. (JSAE/SAE)	20249037/2024-32-0037
7. Paper Title	Mixed Wettability Influence on Water Droplet Behaviour in a PEM Fuel Cell channel
8. Authors (Affiliation)	Simona Silvia Merora, Adrian Irimescu, Chrisian Antetomaso, Bianca Maria Vaglieco (STEMS-CNR), Elio Jannelli (Parthenope University of Naples)

9. Abstract

The utilization of hydrogen in low-temperature Proton Exchange Membrane Fuel Cells (PEMFCs) stands out as a compelling prospect for driving a widespread shift towards green industry practices. Despite significant advancements, a comprehensive understanding of water behaviour and dynamics within PEMFCs remains crucial for their extensive integration in propulsion applications. Striking a delicate balance between flooding and drying conditions poses a challenge for achieving stable and efficient PEMFC operation. In this study, a preliminary experimental investigation was conducted focusing on carbon-paper Gas Diffusion Layer (GDL) and gas channel walls. The static, advancing and receding contact angles were measured and utilized as boundary conditions for simulations. The influence of membrane humidity was also examined during the experimental campaign. 3D CFD simulations were performed on a straight portion of a PEMFC channel with a selected domain length of 5 ...

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Mulberry
3. Time — 13:00 - 15:00 hrs.
4. Session — Emission and Environmental Impacts Part 1 of 2
5. Chair (Affiliation), Co-chair (Affiliation) — Yusuke Suzuki (LEMA / KUBOTA Corporation); Sebastian Schurl (Graz University of Technology)

6. Paper No. (JSAE/SAE)	20249025/2024-32-0025
7. Paper Title	Experimental Study of Port Water Injection System on Single Cylinder Diesel Engine Performance and Exhaust Emission.
8. Authors (Affiliation)	Kaleemuddin Syed, Sandip Chaudhari, Girish Khairnar, Rahul Katariya, Pranjal Jagtap, Vikram Bhoite (Greaves Cotton Limited, Aurangabad)

9. Abstract

Vehicle emission standards have become more and more stringent and have driven the development of advanced engine design with low-cost emission control technologies. For small diesel engine which is used in three-wheel (3W) passenger and load carrying vehicles, it was major task to improve lower engine rpm torque and performance to comply with stringent exhaust emissions standard as well, especially for Oxides of Nitrogen (NOx) and Particulate Matter (PM) emissions. Bharat Stage (BS) VI emission standards for three-wheel vehicles are implemented from April 2020 onwards in India.
Water injection technology has proven advantageous for lowcost solution with Mechanical fuel injection system on small diesel engines, Intake port water injection is the easiest method to introduce water to engine cylinder, which calls for...

6. Paper No. (JSAE/SAE)	20249081/2024-32-0081
7. Paper Title	Visualization of Atomized Droplet Behavior and Distribution under Two-Layer Multiphase Flow in a Urea SCR Systems
8. Authors (Affiliation)	Joe Ono, Tetsuo Nohara, Shotaro Nara, Yuki Kawamoto, Naoya Fukushima, Masayuki Ochiai (Tokai University)

9. Abstract

Urea SCR system, installed in diesel engine vehicles such as trucks and agricultural machinery, is widely used as an exhaust gas aftertreatment system that efficiently purifies NOx, an environmentally harmful substance. Furthermore, the Urea SCR systems may be installed in hydrogen/carbonneutral fuel engines, and biofuel aircraft engines aiming to achieve carbon neutrality. However, an important problem is the degradation of NOx purification performance caused by urea crystallization due to an undesired reaction of urea water solution (UWS) and clogging of the exhaust pipe due to the formation of deposits caused by an unknown number of atomized UWS behaviors, mainly during idling and lowspeed operation when the pipe temperature is relatively low. The problem is that the UWS behavior of the atomized UWS is not well understood. To solve these problems, ...

6. Paper No. (JSAE/SAE)	20249113/2024-32-0113
7. Paper Title	Evaluation of Portable Emission Measurement Systems (PEMS) Accuracy by Simultaneous Measurement of PEMS and Laboratory-Based Analyzers
8. Authors (Affiliation)	Masahiro Matsuoka, Hiroshi Hirai, Takayuki Ito (Japan Automobile Research Institute)

9. Abstract

With growing concern to protect the atmosphere, the stringency of vehicle emission regulations is increasing annually[1,2]. Notably, evaluations of real driving emissions (RDEs) using portable emission measurement systems (PEMS) have been mandated for light duty vehicles (LDVs) in regions, such as the EU, China, India, and Japan[3,4] . Additionally, RDEs have attracted attention in motorcycles and was investigated in the effect study of the environmental step Euro 5 [5]. However, some inherent problems remain with RDE measurements using the PEMS on motorcycles. Due to the smaller engine displacement and fewer cylinders associated with motorcycles, resulting in lower exhaust gas flow rates, the measurement accuracy of the PEMS may be lower than that of the LDVs. Furthermore, exhaust emissions can be affected by the additional weight of the ...

Abstracts of Technical Sessions

1. Date — November 6, 2024
2. Room — Palladium Hall A
3. Time — 13:00 - 15:00 hrs.
4. Session — Vehicle Dynamics and Safety Part 1 of 2
5. Chair (Affiliation), Co-chair (Affiliation) — Shingo Ueda (Honda Motor Co., Ltd.) / Alexander Winkler (University of Applied Sciences Upper Austria)

6. Paper No. (JSAE/SAE)	20249013 / 2024-32-0013
7. Paper Title	Necessity of Body Torsional Rigidity of Personal Mobility Vehicles (PMVs) with an Inward Tilting Mechanism
8. Authors (Affiliation)	Tetsunori Haraguchi (Nagoya University), Tetsuya Kaneko (Osaka Sangyo University)

9. Abstract

In traditional four-wheeled automobiles, the imbalance between the roll moment, which is the product of the centrifugal force during a turn acting on the center of gravity and the height of the center of gravity, and roll stiffness, which is the product of the left-right difference in tire vertical load and the tread width and commonly used among automotive suspension engineers, of the front and rear sections necessitates body torsional rigidity. However, there is a lack of specific cases and guidelines for constructing the body structure of three-wheeled PMVs (Personal Mobility Vehicles) with a tilting mechanism from the perspective of vehicle dynamics characteristics. In this paper, the basic considerations related to the dynamics of such three-wheeled PMVs are investigated. We use the term "torsional rigidity" to refer to the stiffness as the torsional deformation of the body itself, and the term "roll stiffness" to refer to the moment that counteracts the roll moment during a turn and suppresses the vehicle's roll in ...

6. Paper No. (JSAE/SAE)	20249005 / 2024-32-0005
7. Paper Title	Human Model on Multi-Body Dynamics Simulation of Motorcycle
8. Authors (Affiliation)	Motohito Ueki (Yamaha Motor Co., Ltd.), Akihiro Takayama (SOLIZE Corporation), Noboru Yabe (Yamaha Motor Co., Ltd.)

9. Abstract

The possibilities and challenges of adding a rider model to the motorcycle dynamics simulation were investigated for the future planning of a full virtual test.
The human model was added to a multi-body dynamics model that reproduces the equations of motion of a motorcycle, called the 10 degrees of freedom (10-DoF) model. The human model is composed from multiple masses and joints, and the steering angle can be controlled by determining the angle of the arms and shoulder. To study the effect of this model, three distinct simulations were carried out: 'the eigenvalue analysis', 'the steady-state circular test simulation' and 'the slalom running simulation'.
In the eigenvalue analysis, the eigenvalues of the wobble mode shifted to a stable side in the root locus when both hands were fixed on the handlebars. ...

6. Paper No. (JSAE/SAE)	20249028 / 2024-32-0028
7. Paper Title	Study on Motorcycle Rider Model Using Reinforcement Learning -Learning Examples Including Following Target Velocity and Basic Research on Rider Proficiency-
8. Authors (Affiliation)	Yasuhiro Mitsuhashi (InovaLigo LLC), Yoshitaka Momiyama, Noboru Yabe (Yamaha Motor Co., Ltd.)

9. Abstract

In this study, an initial approach using deep reinforcement learning to replicate the complex behaviors of motorcycle riders was presented. Three learning examples were demonstrated: following a target velocity, maintaining stability at low speeds, and following a target trajectory. These examples serve as a starting point for further research. Additionally, the proficiency of the constructed models was examined using rider proficiency evaluation methods developed in previous studies. Initial results indicated that the models have the potential to mimic real rider behaviors; however, challenges such as differences between the model's output and what humans can produce were also identified for future work.

Abstracts of Technical Sessions

1. Date — November 7, 2024
2. Room — Jubilee A
3. Time — 8:30 - 10:00 hrs.
4. Session — NVH Technology
5. Chair (Affiliation), Co-chair (Affiliation) — Gaku Naoe (Honda Motor Co., Ltd.) Maurice Kettner (University of Applied Sciences Karlsruhe)

6. Paper No. (JSAE/SAE)	20249032 / 2024-32-0032
7. Paper Title	Impact of Ordinal Proximity of Frequency Components on the Auditory Perception of Engine Knocking
8. Authors (Affiliation)	Ryuhei Suzuki, Shunsuke Ishimitsu, Misaki Nitta, Mika Sakakibara, Tomoyuki Hakozaki (Hiroshima City University), Satoshi Fujikawa, Kiyoaki Iwata, Mitsunori Matsumoto, Masakazu Kikuchi (Mazuda Motor Corporation)

9. Abstract

This study examines the acoustic properties of engineknocking sounds in gasoline engines, arising from misfires during spark ignition that negatively affect driving performance. The aim was to understand the frequency characteristics of acceleration sounds and their connection to the proximity of the order components. The study also explores "booming," where two different frequencies of sounds occur simultaneously, potentially linked to the unpleasant nature of engine knocking. Using a sinusoidal model, we generated engine acceleration sound models with 5th-, 10th-, and 15th-order components, including engine knocking. Two types of sound stimuli were created: one with the original amplitude (OA) and one with a constant amplitude (CA) for each component order, emphasizing the order-component proximity in CA sounds. Aural experiments with 10 participants in an anechoic room using headphones and the MUSHRA method revealed an inverse relationship between OA and CA ratings as the component order increased. OA typically produced better evaluations, possibly owing to the reduced high-frequency components preventing booming, whereas CA received lower ratings owing to pronounced booming from a constant amplitude. Overall, OA significantly outperformed CA, likely because the reference tone also contained the original amplitude data. This study confirms the significant impact of order-component proximity on auditory perception, such as ...

6. Paper No. (JSAE/SAE)	20249059 / 2024-32-0059
7. Paper Title	Research on Intake Sound Tuning Method by Valve Timing Modification for Enhance Sound Quality in V6 Outboard Engine
8. Authors (Affiliation)	Hideta Muramatsu (Honda R&D Co., Ltd.), Taro Matsumoto, Gaku Naoe (Honda Motor Co., Ltd.), Takashi Kondo (Honda R&D Co., Ltd.)

9. Abstract

This paper explores methods to enhance the sound quality of V6 outboard engines. Previous research in the boat and outboard engine domain has underscored the importance of enhancing sound quality. Specific preferences and desired directions for outboard engine sound quality have been identified. It's been suggested that controlling intake sound and gear noise is important to achieving desired sound quality according to customer preferences. However, there are few examples of methods for achieving this. This study aims to develop methods for enhancing sound quality by emphasizing low-frequency sounds through intake sound. Initially, various methods were evaluated, and intake valve timing modification was chosen. Simple simulations confirmed that delaying valve timing for some cylinders may introduce characteristics that are not present in conventional cases. Subsequent 1D simulations identified optimal intake valve timing, balancing intake pressure characteristics and horsepower reduction. We prototyped this valve timing and recorded outboard engine sound during actual operation. Using recorded sound from multiple outboard engines in the same output range, we conducted subjective evaluations using a paired comparison method. As a result, great sound quality enhancement was achieved through valve timing modification. Based on this, it was confirmed that a method for enhancing sound quality through intake sound modification could be ...

6. Paper No. (JSAE/SAE)	20249015 / 2024-32-0015
7. Paper Title	Identification of Input Force and Contribution for Electric Power Unit Utilizing Virtual Point
8. Authors (Affiliation)	Ryoma Kubo, Kenta Hara, Junji Yoshida (Osaka Institute of Technology)

9. Abstract

In this study, vibration characteristics inside an electric power unit at gravity center where direct measurement is impossible were estimated by using virtual point transformation to consider guideline for effective countermeasures to the structure or generated force characteristics inside the power source. Vibration acceleration, transfer function and the generated force in operation at the gravity center of the electrical power source were obtained by vibration characteristics at around the power source which can be measured directly. In addition, the transfer functions from the gravity center to the power source attachment points on the product were also estimated. And then, the contribution from the gravity center to the power unit attachment point was obtained by multiplying generated force with the transfer function. As results, the obtained total contribution was almost same with the actual measured vibration at the attachment point. Furthermore, the rotational contribution from the gravity center was found to be larger than translational contribution at the attachment point vibration along front-back direction.

Abstracts of Technical Sessions

1. Date — November 7, 2024
2. Room — Jubilee B
3. Time — 8:30 - 10:30 hrs.
4. Session — Measurement and Simulation Part 3 of 4
5. Chair (Affiliation), Co-chair (Affiliation) — Tomoaki Yatsufusa (Hiroshima Institute of Technology); Luca Romani (University of Florence)

6. Paper No. (JSAE/SAE)	20249071/2024-32-0071
7. Paper Title	Fuel Film Measurement in a SI Gasoline Engine Using a Newly Developed MEMS Sensor
8. Authors (Affiliation)	Tatsuya Kuboyama, Yasuo Moriyoshi (Chiba University), Satoshi Takayama (Suzuki Motor Corporation), Osamu Nakabeppu (Meiji University)

9. Abstract

The previously developed capacitance sensor for detecting a liquid fuel film was modified to apply to the in-cylinder measurement. On the developed sensor surface, comb-shaped electrodes were circularly aligned. The capacitance between the electrodes varies with the liquid fuel film adhering. The capacitance variation between the electrodes on the sensor surface was converted to the frequency variation of the oscillation circuit. In the previous study, it was revealed that the frequency of the oscillation circuit varies with the variation of the liquid fuel coverage area on the sensor surface.
The developed sensor was installed in the combustion chamber of the rapid compression and expansion machine, and the performance of the developed sensor was examined. Iso-octane was used as a test fuel to explore the sensor that had been ...

6. Paper No. (JSAE/SAE)	20249073/2024-32-0073
7. Paper Title	RDE Methodology Development for Motorcycle Emissions Assessment
8. Authors (Affiliation)	Sebastian Schurl[1], Stefan Keller[2], Mathias Lankau[2], Christian Hafenmayer[2], Stephan Schmidt[1], Roland Kirchberger[1] 1 Graz University of Technology, 2 AIP Automotive GmbH & Co. KG

9. Abstract

The transfer of conditions and regulations for RDE testing from passenger cars to motorcycles is a non-trivial undertaking. Motorcycles exhibit significant differences in construction and usage compared to cars, necessitating a distinct set of requirements for equipment and methodology. Currently available PEMS are hindered by their relatively large size and weight due to the embedded measurement technology and external power supply. The weight of, at least 50kg, poses a substantial additional load, leading to a deviation and, on average, higher load collective of the engine during RDE measurement rides.
Beyond these structural parameters, the actual propulsion system and subsequent exhaust system introduce another ...

6. Paper No. (JSAE/SAE)	20249083/2024-32-0083
7. Paper Title	Dynamic Analysis of Intake and Exhaust Valve Motion in a High-Performance 4-Stroke Engine. Part1 - Experimental Measurement of Valve Motion Using a High-Frequency Laser Sensor.
8. Authors (Affiliation)	Niccolò Grilli, Luca Romani, Sandro Raspanti, Lorenzo Bosi, Giovanni Ferrara (University of Florence), Paolo Trassi, Jacopo Fiaschi, Edoardo Guarducci (Betamotor S.p.a.)

9. Abstract

The motion of the intake and exhaust valves plays a pivotal role in determining operational efficiency and performance, especially in high-specific power 4-stroke engines. At high rpm levels, the dynamic behavior of the valve may deviate from the kinematic model established during the design phase. This discrepancy arises due to the high accelerations and forces to which the valve and other components of the valvetrain system are subjected. Notably, under such conditions, the valve may detach from the cam profile at the conclusion of the opening stroke and can exhibit a bouncing behavior during the closing stroke. Moreover, the elasticity of all valvetrain system elements introduces additional complexities. Factors such as timing chain elongation, camshaft carrier deformation, and valve stem compression can contribute to a deviation in phase compared to ...

6. Paper No. (JSAE/SAE)	20249084/2024-32-0084
7. Paper Title	Dynamic Analysis of Intake and Exhaust Valve Motion in a High-Performance Four Stroke Engine. Part 2 - Development of a Numerical Model for the Simulation of the Valvetrain.
8. Authors (Affiliation)	Marco Tarchiani, Luca Romani, Sandro Rasapnti, Lorenzo Bosi, Giovanni Ferrara (University of Florence), Paolo Trassi, Jacopo Fiaschi (Betamotor S.p.a.)

9. Abstract

The intake and exhaust valve motion have, as known, a pivotal role in determining engine operation and performances. When dealing with high specific power engines, especially at high rpm, the dynamic behavior of the valve can differ from the kinematic one defined during the design phase. This is related to the high acceleration and forces to which the valve and the other components of the valvetrain system are subjected. In particular, the valve can detach from the cam profile at the end of the opening stroke, and it can show a bouncing behavior during the closing stroke. In addition, all the elements of the valvetrain system are not infinitely rigid and aspects such as the timing chain elongation, the camshaft torsion and the valve stem compression can determine a change in phase with respect to the kinematic one. Since the high complexity level of ...

Abstracts of Technical Sessions

1. Date: November 7, 2024
2. Room: Mulberry
3. Time: 8:30 - 10:30 hrs.
4. Session: Emission and Environmental Impacts Part 2 of 2
5. Chair (Affiliation), Co-chair (Affiliation): Stephan Schmidt (Graz University of Technology), Francesco Balduzzi (University of Florence)

6. Paper No. (JSAE/SAE)	20249004/2024-32-0004
7. Paper Title	Coupled Analysis of First Principle Calculation and Chemical-kinetics Simulation to Predict the Activity of Three Way Catalyst.
8. Authors (Affiliation)	Kazuya Miura (Suzuki Motor Corporation), Hiroki Kusaba, Tomoya Miyoshi (Kumamoto University), Hiroshi Yoshida (Kanazawa University), Hiroyuki Tsuchizaki (Suzuki Motor Corporation), Masato Machida (Kumamoto University)

9. Abstract

This study proposes a technique to predict the catalytic activity of the CO-NO-O2 reaction using the first principle calculations without experiment. The proposed method consists of four steps. (1) Assuming the detailed chemical reactions based on the Langmuir-Hinshelwood mechanism. (2) Estimating the activation energy (Ea) for each detailed chemical reaction using first principle (e.g. Density Functional Theory: DFT) calculations. (3) Defining frequency factors (A) theoretically. (4) Inputting the estimated Ea and A values into simulation software for chemical-kinetics (e.g. exothermia suite) and running the simulation. The validity of the proposed method was evaluated by experiments. This study predicted the catalytic activities of Pt, Pd or ...

6. Paper No. (JSAE/SAE)	20249016/2024-32-0016
7. Paper Title	Investigation on Degradation Process of PdRuIr/CZ “pseudo-Rh” Catalysts Used for Motorcycles
8. Authors (Affiliation)	Takuya Motegi, Shunya Tatara, Shunpei Takamoto, Kosuke Doi (Yamaha Motor Co., Ltd.)

9. Abstract

Platinum (Pt), palladium (Pd), and rhodium (Rh) are used as active substances in exhaust gas purification catalysts for automobiles. Among these, Rh is an essential element because it efficiently promotes a NOx reduction reaction. On the other hand, the price of Rh has been rising in recent years. From the perspective of the supply risk of rare resources, there is an urgent need to develop technologies to replace or reduce the amount of Rh used in catalysts. We focused on the pseudo-rhodium alloy developed by the ACCEL program of the Japan Science and Technology Agency (JST), and then investigated the application of the pseudo-rhodium alloy on the catalysts of our motorcycles and also the degradation process. ...

6. Paper No. (JSAE/SAE)	20249097/2024-32-0097
7. Paper Title	Development of NOx storage catalyst and investigation of deterioration mechanism for small powertrains
8. Authors (Affiliation)	Fumiya Nakano, Yusuke Koito (Umicore Shokubai Japan Co., Ltd.)

9. Abstract

In response to the evolving landscape of exhaust gas regulations for small powertrains, reducing NOx emission is increasingly important. This study deeply investigated the feasibility of a NOx storage catalyst (NSC) containing cerium oxide (CeO2) and barium oxide (BaO) for reducing NOx emission. The key functions, NOx storage and reduction performances were evaluated, and deterioration mechanisms were explored through performance evaluations and physical property analyses. The findings revealed a strong correlation between the size of CeO2 crystals and NOx storage performance at low temperature, such as those encountered during city driving conditions. Conversely, at high temperature, such as those during highway driving ...

6. Paper No. (JSAE/SAE)	20249041/2024-32-0041
7. Paper Title	Estimation Method of Life Cycle Greenhouse Gas Emissions of Motorcycle applicable from Individual Unit to Sales Volume
8. Authors (Affiliation)	Yuichi Mori, Hirotaka Kawatsu, Takumi Yamaguchi, Kazuhiko Tanaka, Toshiki Aoki, Ryuta Niimura (Honda Motor Co., Ltd.)

9. Abstract

To achieve carbon neutrality, manufacturers need to estimate Greenhouse Gas (GHG) emissions generated throughout the life cycle of motorcycles, namely the Carbon Footprint of Product (CFP). We developed a method that allows calculation of the per-unit CFP and the total CFP of sales volume of motorcycles with a common formula, and also enables the estimation of their future values. First, we made it possible to calculate the per-unit CFP of each individual model by setting factors that we quantified the characteristics of motorcycles such as material composition and replacement parts and incorporating them into the calculation formula. Next, we enabled the calculation of the total CFP of sales volume from the present to the future by ...

Abstracts of Technical Sessions

1. Date — November 7, 2024
2. Room — Palladium Hall A
3. Time — 8:00 - 10:35 hrs.
4. Session — Vehicle Dynamics and Safety Part 2 of 2
5. Chair (Affiliation), Co-chair (Affiliation) — Hisayuki Sugita (Suzuki Motor Corporation); Alexander Winkler (University of Applied Sciences Upper Austria)

6. Paper No. (JSAE/SAE)	20249012 / 2024-32-0012
7. Paper Title	Estimation of Loads and Frame Deformation on Motorcycle Handling
8. Authors (Affiliation)	Kazunobu Sakamoto (Yamaha Motor Co., Ltd.)

9. Abstract
Motorcycle frames have been designed based on static stiffness, which are frame characteristics related to stability and maneuverability. With this approach, lightweight frames have been designed, while achieving stability and maneuverability have been an ongoing trial-and-error process.
To further improve them, studies on dynamic frame deformation in motion have already been reported. However, the mechanism that can explain the relationship between frame deformation and motorcycle dynamics has not been clarified yet. It is necessary to clarify the relationship between frame deformation and the change in load acting on the vehicle due to ...

6. Paper No. (JSAE/SAE)	20249080 / 2024-32-0080
7. Paper Title	Dynamic Modeling of an Off-Road Vehicle with Whoops Behavior
8. Authors (Affiliation)	Tsuyoshi Inoue, Haruto Ejiri, Akira Heya (Nagoya University), Masahiro Yoshida (Yamaha Motor Co., Ltd.)

9. Abstract
Off-road vehicle demand is on the rise, particularly in North America. In connection with this trend, there is a demand for dynamic modeling to describe the behavior of off-road vehicles when driving terrains surfaces with successive bumps. However, conventional dynamic models has been insufficient in representing the situation where the tireground contact and detachment states switch successively during whoops behavior. Therefore, in this study, rigid-body multibody dynamics methodology was employed to model the vehicle and conduct numerical simulations. Numerical simulations were conducted using the constructed vehicle model, demonstrating that the behavior of off-road vehicles in whoops closely resembles the actual ...

6. Paper No. (JSAE/SAE)	20249034 / 2024-32-0034
7. Paper Title	Analysis of Lane Departure Caused by Inadequate Motorcycle Driving Maneuvers Due to Road Alignment
8. Authors (Affiliation)	Hiroshi Kuniyuki, So Takechi (Suwa University of Science)

9. Abstract
There are many riders who drive motorcycles on winding mountain roads and caused single motorcycle traffic accidents on curved roads by lane departure. Driving a motorcycle requires subtle balancing and maneuvering. In this study, in order to clarify the influence of lane departure caused by inadequate driving maneuvers against road alignment, the authors analyzed the required curve initial operation and driving maneuvers in curves depending on the traveling speed using a kinematics simulation for motorcycle dynamics. In addition, it was analyzed how inadequate driving maneuvers for curved roads can easily cause lane departure. As a result, it shows that the steering maneuvers and the lean of motorcycle body during the curves ...

6. Paper No. (JSAE/SAE)	20249043 / 2024-32-0043
7. Paper Title	A Two-step Approach for Tire Lateral Force Observation for Motorcycles
8. Authors (Affiliation)	Alexander Winkler, Gernot Grabmair (University of Applied Sciences Upper Austria), Johann Reger (Technische Universitat Ilmenau)

9. Abstract
This study presents a two-step method for estimating motorcycle tire lateral forces, which are critical to the safety of driver assistance systems. In the pre-filtering stage, a partial attitude of the motorcycle is estimated using a Kalman filter and a kinematic model. In the observation stage, the side slip angle and subsequently the tire lateral forces are provided by a sliding mode observer. It extends previous research by incorporating both out-of-plane and in-plane dynamics. The paper also proposes an approach for selecting the Kalman filter parameters. An approach to identify the stochastic sensor errors of the inertial measurement unit is presented. The identified parameters are used as a basis for the selection of the covariances. ...

6. Paper No. (JSAE/SAE)	20249049 / 2024-32-0049
7. Paper Title	Analysis of the Effect of Combination Frame Flexibility on Weave Modes
8. Authors (Affiliation)	Reiya Haraoka, Tsuyoshi Katayama, Takahiko Yoshino (Kurume institute of technology)

9. Abstract
The weave mode of a motorcycle is known to be affected by the flexibility of the vehicle frame. The weave mode has been shown to be more unstable in the 10-DOF model than in the 4-DOF model. However, it is not clear why the weave mode would be unstable, given the six different frame flexibilities. In this study, the authors analyzed the stability of the weave mode in a 4-DOF model when the same was integrated with two types of frame flexibilities. In the vehicle specifications used in the analysis, the combination of the bending flexibility of the front forks and the torsional flexibility of the main frame destabilizes the ...

Abstracts of Technical Sessions

1. Date — November 7, 2024
2. Room — Jubilee A
3. Time — 11:30 - 12:30 hrs.
4. Session — Engine Components and Fuel Supply System
5. Chair (Affiliation), Co-chair (Affiliation) — Wataru Yamamoto (Kawasaki Motors, Ltd.), Francesco Balduzzi (University of Florence)

6. Paper No. (JSAE/SAE)	20249105 / 2024-32-0105
7. Paper Title	Virtual Encoder for Achieving Crank Angle Resolution Measurements of In-Cylinder Pressure in Small Engines by Using Time Based Data Acquisition
8. Authors (Affiliation)	Adrian Irimescu, Giovanni Cecere, Simona Silvia Merola, Bianca Maria Vaglieco (STEMS-CNR)

9. Abstract

Small size engines feature several peculiarities that render them a challenge with respect to implementing measurements required for characterizing specific phenomena such as combustion evolution. Measuring in-cylinder pressure is well established as standard procedure for determining combustion characteristics, but in the case of small size units actually applying it can require alternative approaches. Fitting a crank angle encoder may be extremely difficult, as a consequence of the actual size of the power unit. Cost is another essential driver for small engine development that also influences how measurements are implemented. Within this context, the present work describes the development and implementation of a method that employs an algorithm that practically generates a 'virtual' encoder. Only a basic phasing signal is required, such as an inductive crankshaft position sensor output or that of an ignition pulser. The software was developed on an experimental engine with a crank angle encoder, that provided the reference case. Several configurations were under scrutiny, so as to identify the minimum requirements able to fulfill the intended task. Afterwards, it was tested for achieving crank angle resolution in-cylinder pressure measurements by applying time based data acquisition on up to 8 high speed channels (with a maximum sampling rate equivalent to 0.5 crank angle resolution at 6000 rpm). Measurements showed that the proposed method successfully fulfilled both requirements, i.e. high accuracy and cost effective data acquisition on two small size engines (one single cylinder 50 cc and the other 3 inline cylinders 600 cc). Simulations performed using the 0D/1D approach also confirmed the validity of the results. The only major drawback that was identified at this stage is that the proposed method requires the acquisition of data on one or two additional channels (for crank shaft position/ignition pulser signals) for ensuring correct implementation. Nonetheless, the benefits can be considered as more than sufficient for minimizing the effects of this shortcoming.

6. Paper No. (JSAE/SAE)	20249109 / 2024-32-0109
7. Paper Title	CFD Analysis of Pintle-Nozzle Spray for Swirl Chamber Type Small Diesel Engine -Application of Hole-Nozzle Atomization Model to Pintle-Nozzle-
8. Authors (Affiliation)	Tadao Okazaki, Tsukasa Fujiwara (KUBOTA Corporation)

9. Abstract

Swirl chamber combustion system is commonly used for IDI (In-Direct Injection) diesel engine. It is characterized by swirl combustion chamber arranged in cylinder head, main combustion chamber with shallow piston recess and connecting throat where fuel spray and flame mixture is ejected out from the swirl chamber to the main chamber [1]. Fuel is supplied in the swirl chamber and a pintle type nozzle is often used in this type engine as its simple structure and robustness for operating condition.

In this paper, numerical simulation of a pintle nozzle spray was focused on and simulated results were compared with high speed photo data obtained in a constant volume vessel (CVV). Spray angle and tip penetration were mainly evaluated, but simulated angle and penetration could not be matched simultaneously to these characteristics of the pintle nozzle spray when conventional spray models were used for the simulation. To overcome this mismatch, "Multi-hole replacement model" was newly introduced. In this model, annular liquid sheet was treated as a circular bundle of liquid columns and hole-nozzle breakup model is applied to each liquid column. Fundamental concept of "Multi-hole replacement model" and practical application procedure were explained here. This proposed spray model will be applied actual engine model for the next step and contribute to expand the scope of application of IDI engines.

Abstracts of Technical Sessions

1. Date — November 7, 2024
2. Room — Jubilee B
3. Time — 11:00 - 12:30 hrs.
4. Session — Measurement and Simulation Part 4 of 4
5. Chair (Affiliation), Co-chair (Affiliation) — Takashi Mitome (Suzuki Motor Corporation), Giovanni Ferrara (University of Florence)

6. Paper No. (JSAE/SAE)	20249055/2024-32-0055
7. Paper Title	Pursuit of Realistic Vehicle Acceleration Sounds Based on Discomfort Index
8. Authors (Affiliation)	Misaki Nitta, Shunsuke Ishimitsu (Hiroshima City University), Satoshi Fujikawa, Kiyoaki Iwata, Mayuko Niimi, Masakazu Kikuchi, Mitsunori Matsumoto (Mazda Motor Corporation)

9. Abstract

Contemporary Japanese society relies heavily on vehicles for transportation and leisure. This has led to environmental concerns owing to vehicle emissions, prompting a shift toward environmentally friendly alternatives, such as clean diesel and electric vehicles. Clean diesel vehicles aim to reduce harmful emissions, whereas electric vehicles are favored because of their minimal emissions and quiet operation. However, the lack of engine noise in electric vehicles can make it difficult for drivers to perceive speed changes, potentially increasing the risk of accidents, and simply amplifying all sounds is not viable because it may cause discomfort. Therefore, this study explored how deviations from expected engine sounds affect the perceived sound quality and vehicle performance assessment. Unlike traditional gasoline-powered and clean diesel vehicles, electric vehicles produce very little running noise, which makes road surface noise more prominent. Given the novelty of electric vehicles and the challenges associated with their driving noises, this study focused on acceleration sounds, analyzing whether incorporating typical engine noises, such as rumbling and humming, could enhance realism. The comfort levels of the participants with various acceleration sounds were examined based on their driving experience, highlighting the complex relationship between sound expectations ...

6. Paper No. (JSAE/SAE)	20249074/2024-32-0074
7. Paper Title	3D-CFD Simulations of H2 ICEs: a Preliminary Evaluation of a Laminar Flame Speed Correction for Thermo-Diffusive Instability
8. Authors (Affiliation)	Stefano Sfriso, Fabio Berni, Sebastiano Breda, Stefano Fontanesi, Ilario Cordisco (The University of Modena and Reggio Emilia), Caio Ramalho Leite, Pierre Brequigny, Fabrice Foucher (The University of Orléans)

9. Abstract

In recent years, climate change and geopolitical instability have intensified the focus on sustainable power generation.
This shift seeks alternatives that balance environmental impact, cost-effectiveness, and practicality. Specifically, in transportation and power generation, electric motors face challenges against internal combustion engines due to the high cost and mass of batteries required for energy storage. This makes electric solutions less favorable for these sectors. Conversely, internal combustion engines, when properly fueled, offer cost-effectiveness and a quasi-environmentallyneutral option. To address these challenges, researchers have explored e-fuels derived from renewable sources as a carbonneutral supply for internal combustion engines. Among these, hydrogen is particularly promising. In hydrogen-powered internal combustion engines, 3D-CFD (Computational Fluid Dynamics) in-cylinder models are crucial. Once validated, these models can speed up the design process. A key challenge in simulating H2 combustion is accurately representing flame thermo-diffusive instabilities in lean mixtures, which are vital for peak engine efficiency. Accurate representation of the combustion process under lean conditions is thus mandatory in 3D-CFD models. This study represents a preliminary effort to incorporate thermodiffusive ...

6. Paper No. (JSAE/SAE)	20249115/2024-32-0115
7. Paper Title	A Methodical Concept Study and Optimization of the Drivetrain for Light Commercial Vehicle Applications
8. Authors (Affiliation)	Thomas Stephan Königshofer, Jürgen Tromayer, Hans Jürgen Schacht (Graz University of Technology), Eric Wang (Inmotive Inc.)

9. Abstract

The EU currently has very ambitious plans for the electrification of vehicles, particularly in the field of urban logistics. For example, the so-called "Transport White Paper" [1] aims to achieve essentially CO2-free logistics in major urban centers by 2030, while "Europe on the move" [2] has presented a series of legislative initiatives. The Strategic Research and Innovation Agenda for Transport proposes research priorities and actions to deploy innovative solutions, with a particular focus on the electrification of transport. Numerous advancements in electromobility have led to a growing number of vehicles available in various areas, particularly in urban logistics. New concepts like cargo bikes and micro-vehicles are being developed, but they cannot fully replace traditional light commercial vehicles. While some electrified options exist, they are often modified versions of existing platforms with internal combustion engines swapped for electric drives.
The research work in this paper deals with the basic considerations and the interaction between vehicle and drivetrain with the ulterior motive of laying the foundation for the development of a possible application-oriented concept for inner-city and suburban goods delivery. In particular, the advantages of a two-speed transmission solution for this vehicle category will be ...

Abstracts of Technical Sessions

1. Date — November 7, 2024
2. Room — Mulberry
3. Time — 11:00 - 12:30 hrs.
4. Session — Two Stroke Engine
5. Chair (Affiliation), Co-chair (Affiliation) — Akira Iijima (Nihon University), Roland Kirchberger (Graz University of Technology)

6. Paper No. (JSAE/SAE)	20249039/2024-32-0039
7. Paper Title	Basic Investigation of Thermodynamic Effects on a Hydrogen Two-stroke Engine
8. Authors (Affiliation)	Terutaka Yasuda (Maruyama Mfg. Co., Inc.), Roland Oswald, Roland Kirchberger (Graz University of Technology)

9. Abstract

The spark ignited two-stroke engine, as a cost-efficient power unit with low maintenance demand, are used millionfold for the propulsion of hand-held application, motorcycles, scooters, boats and others. The outstanding power to weight ratio is the key advantage for two-stroke engines. On the other hand, poor exhaust emissions, caused by high scavenge losses, especially on port controlled two-stroke engine, and a low efficiency are disadvantages of this combustion process. Under the aspect of increasing environment- and health awareness, the two-stroke technology driven with fossil resources, shows no future advantage. The anthropogenic climate change force for sustainable development of combustion engines whereby reduction of fuel consumption or usage of alternative fuels is an important factor. Best way of a decarbonisation to fulfil future climate goals is the utilisation of non-carbon fuels. In this field of fuels, hydrogen, with its high energy content and close inexhaustible availability, shows a good solution.
Four-stroke gasoline engines are developed since many years for the use of hydrogen. Different strategies of mixture preparation, like port- or direct injection with low- or high injection pressure are available and well known. Compared with two-stroke engines, the usage of hydrogen and, therefore, the knowledge about thermodynamic effects, is still at the beginning. Challenges, such as inhomogeneous air-fuel mixture within the cylinder at high speed, short-circuiting of fuel to the exhaust, ...

6. Paper No. (JSAE/SAE)	20249054/2024-32-0054
7. Paper Title	DoE-based Numerical Optimization of Intake and Exhaust Port Geometry of a Small Opposed-Piston 2-Stroke (OP2S) Hydrogen Engine
8. Authors (Affiliation)	Saurabh Singh, Prasad Boggavarapu, Himabindu M., R. V. Ravikrishna (Indian Institute of Science, Bengaluru)

9. Abstract

The future potential of an opposed-piston two-stroke (OP2S) engine has attracted the attention of researchers worldwide as it offers a high thermal efficiency and power-to-weight ratio with a simple engine configuration. This engine can be used with low-carbon fuels and hydrogen to reduce green-house gas emissions. However, the two-stroke operation has always been limited by its low scavenging efficiency and shortcircuit of fresh charge. The current work is focused on optimizing scavenging efficiency and short-circuit in a small 200 cc single-cylinder OP2S SI engine using 3-D computational fluid dynamic (CFD) simulations. The effect of four parameters, namely, area of intake ports, area of exhaust ports, and angular orientations of intake ports (swirl and tilt) on scavenging efficiency and short-circuit, has been assessed and optimized. A Latin-hypercube based Design of Experiments (DoE) methodology is used to sample the design space spanning over a range of four parameters. A response surface is generated using the Kriging method, and the geometry of intake and exhaust ports have been optimized for maximum scavenging efficiency and minimum short-circuit using a genetic algorithm on the response surface. The results show that the scavenging efficiency improves with the increase in exhaust port area, but it also increases the short circuit of fresh air. The Intake port swirl angle significantly impacts scavenging efficiency and short-circuit. The current optimization process achieved a scavenging efficiency of 85% (percentage of the total mass in the cylinder) and a short circuit of 12% ...

6. Paper No. (JSAE/SAE)	20249112/2024-32-0112
7. Paper Title	Research on Basic Characteristics of a Two-Stroke Opposed Piston Engine
8. Authors (Affiliation)	Shumpei Fukushima, Ryota Uehara, Yoshiaki Hayashi, Ryo Igarashi, Kazuho Tokita, Akira Iijima (Nihon University)

9. Abstract

This study investigated the performance characteristics of a two-stroke opposed piston engine that is capable of constantly operating with high power output and high efficiency. An investigation was also made of the performance obtained by applying a pseudo uniflow condition as a measure against large hydrocarbon (HC) emissions owing to blow-by of unburned mixture, which is an issue of two-stroke engines. The test engine had a displacement of 127 cm3 and a bore and stroke of 48 x 70 mm. One-point and dual-point ignition systems were used, and regular gasoline was supplied as the test fuel using a carburetor-based fueling system. Experiments were conducted at engine speeds of 1500 and 3000 rpm at ignition timings of 45 deg. and 35 deg. before top dead center. The results showed that large quantities of HC emissions were emitted because stable combustion was not achieved. This revealed that a stronger uniflow condition must be applied as a countermeasure rather than a simple pseudo uniflow.

Abstracts of Technical Sessions

1. Date — November 7, 2024
2. Room — Palladium Hall A
3. Time — 11:30 - 12:00 hrs.
4. Session — Data Driven Digitalization
5. Chair (Affiliation), Co-chair (Affiliation) — Nuksit Noomwong (Chulalongkorn University), Stephan Schmidt (Graz University of Technology)

6. Paper No. (JSAE/SAE)	20249121 / 2024-32-0121
7. Paper Title	Accelerating Battery Thermal Analysis by Integrating CFD Simulation and Machine Learning Techniques
8. Authors (Affiliation)	Gurudevan Devarajan, Ganesh Vaidyanathan, Ajinkya Bhave, Lichao Ji, Jiao Wang (Siemens Industry Software), Wei Zhou, Jiguang He, Pengfei Shi (BMW Brilliance Automotive Ltd.)

9. Abstract

The growing demand for sustainable transportation solutions and renewable energy storage systems has heightened the necessity for precise and effective prediction of battery thermal performance. However, achieving both precision and efficiency poses a challenge, necessitating exploration into diverse methodologies. The conventional use of Computational Fluid Dynamics (CFD) offers a comprehensive insight into thermal dynamics but prioritizes precision over efficiency. To enhance the efficiency of this traditional approach, numerous reduced-order modeling techniques have emerged, and the concept of Machine Learning (ML) presents a distinct avenue for enhancing simulation capabilities, particularly in the context of mobility solutions. This paper presents a novel approach to accelerate battery thermal analysis by integrating CFD and ML. The CFD simulations provide an intricate understanding of the thermal dynamics within batteries, encompassing fluid flow and temperature distributions. Building upon this physical understanding, ML models are trained using the CFD data to capture complex relationships and patterns within the thermal behavior to develop a framework capable of efficient prediction of thermal responses under diverse operating conditions. To validate the effectiveness of the proposed methodology, a case study is presented in the paper, comparing the results of the ML approach with CFD results. The findings demonstrate that the proposed methodology significantly reduces computational time while maintaining a high level of accuracy in prediction of battery thermal behavior. This innovative approach represents a promising step towards expediting the design and optimization of battery systems, contributing to faster development cycle of sustainable energy technologies.

Abstract of Organized Session

1. Date — November 7, 2024
2. Room — Palladium Hall A
3. Time — 12:00 - 12:30 hrs.
4. Session — Organized Session
5. Chair (Affiliation), Co-chair (Affiliation) — Nuksit Noomwong (Chulalongkorn University), Stephan Schmidt (Graz University of Technology)

6. Paper No.	Oral Only
7. Paper Title	Factors Contributing to the Severity of Motorcycle Rear-End Crashes in Thailand
8. Authors (Affiliation)	Kunnawee Kanitpong (Asian Institute of Technology)

9. Abstract

Objective: Motorcycle (MC) rear-end collisions cause many serious injuries and deaths for MC riders. In Thailand, the MC crash investigation data revealed that 18 percent of all MC crashes were rear-end collisions, which accounted for 18 percent of all fatalities as well. The aim of this study was to investigate the causes of injuries and deaths from MC rear-end collisions and factors that contribute to their severity level. Between 2016 and 2020, 141 MC rear-end crashes were thoroughly investigated throughout Thailand. Method: The ordinal logistic analysis was conducted to analyze factors contributing to severe injuries. The analysis to rear-end collision models comprised four categories: M1(n=141) is all types of rear-end collisions to MC, and M2(n=114) is the rear-end collision due to other vehicles(OV) collided by MC, M3(n=72) is the rear-end collisions for traveling OV collided by MC, and M4(n=42) is the rear-end collision for MC hitting the parked OV. The outcomes are verified by the likelihood and Pseudo R 2 . Result: When a MC collides with the rear of another vehicle, there are more fatalities than when other vehicles collide with the rear of a MC. Furthermore, the probability of death is higher if MCs collide with the rear-end of parking vehicles. As for the primary crash contributing factor, motorcyclists' perception failure was the most frequent. Experience, license status, driving conditions, speed, the time of the crash, the areas of the crash, and types of other vehicles involved significantly influence the severity of rear-end crashes. Conclusion: In severe crashes, riders with perception failure are more likely to be involved. Based on the findings of this study, some policies and countermeasures can be drawn to prevent MC rear-end crashes and reduce their severity.