BOOK OF ABSTRACTS

The 2nd TSME International Conference on Mechanical Engineering (TSME-ICoME 2011)

Sheraton Krabi Beach Resort, Krabi, Thailand

October 19-21, 2011

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The Thai Society of Mechanical Engineers

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The 2nd TSME International Conference on Mechanical Engineering

October 19th – 21st, 2011 Sheraton Krabi Beach Resort,

Krabi, Thailand

Book of Abstracts

Editor

Professor Dr. Phadungsak Rattanadecho

PREFACE

It is my great pleasure to present this formal collection of the Proceedings of the 2nd TSME International Conference on Mechanical Engineering (TSME-ICoME 2011) which is held in Sheraton Krabi Resort Beach, Krabi, Thailand during October 19-21, 2011. The TSME-ICoME 2011 was the second in the well-established series of conferences held every year since 2010 which sponsored by the Thai Society of Mechanical Engineers (TSME) with the collaborations from ASME, IMechE, and JSME (Thailand Chapters). It brought together leading national and international experts presenting papers on state-of-the-art research associated with the theoretical, experimental, and applied aspects of the main and related disciplines of mechanical engineering. The topic areas cover the whole spectrum of mechanical engineering, which include, but are not limited to: Aerospace and Marine Engineering, Applied Mechanics, Materials and Manufacturing, Dynamic System, Robotics and Control, Energy Technology and Management, Thermal Systems and Fluid Mechanics and Biomechanics.

I am pleased to note, however, that TSME-ICoME 2011 has succeeded in attracting the most papers and the most participants despite the formidable competition! With the initial number of submitted abstracts of around 260, close to 170 full papers were reviewed. A preprint volume of all manuscripts was prepared on CD-ROM and distributed to participants at the conference. Information on TSME-ICoME 2011 is available at the Conference website: http://rcme.engr.tu.ac.th

As the Chair of the TSME-ICoME 2011 and on behalf of the organizing committee, I wish to express my sincere thanks to the distinguished keynote speaker, the contributing authors, all the session chairs and the participants. I would also like to thank all members of the International Organizing Committee, Conference Program Committee and all members of Mechanical Engineering Department, Kasetsart University and King Mongkut's University of Technology Thonburi. My thanks are also due to a number of reviewers who helped tirelessly with the abstract and manuscript review processes. This form of assistance is indeed heavily responsible for the technical success of TSME-ICoME 2011. I am grateful to our sponsors, including National Science and Technology Development Agency (NSTDA), Alpine Electronic Air Filter, Kinetics Corporation Limited Thailand and Metal Work S.p.a. My appreciation also goes to a number of graduate students of Research Center of Microwave Utilization in Engineering (RCME), Mechanical Engineering Department, Thammasat University for their continuing help and hard work to organize the event.

P. Rattanadecho

Professor Dr. Phadungsak Rattanadecho
Chair of the TSME-ICoME 2011

Letter from TSME President

On behalf of Thai Society of Mechanical Engineers (TSME), I am grateful to the Department of Mechanical Engineering, Kasetsart University for their dedication to make the 25th ME-NETT conferences successful. We appreciate the support from our partner organizations; The Japan Society of Mechanical Engineers (JSME), the Institute of Mechanical Engineers (IMechE) , and the American Society of Mechanical Engineers (ASME). Also,thank to the sponsors for financial support our conference. Finally, my gratitude also goes to all the committee especially the chairman, Prof. Dr. Phadungsak Ratanadecho, and his staff for all the hard work for the international conference TSME-IcoME 2011.

Additionally, I would like to extend a warm welcome to all the authors and participants of this 2nd TSME-ICoME. We hope that this conference will be useful to the research and development in the field of mechanical engineering and all of you will have a wonderful experience with this fruitful conference, and at the same time enjoy the sights of Krabi in Thailand.

Sincerely,

Withaya Yongchareon

Withaya Yongchareon, Ph.D.
TSME President
Associate Professor
Department of Mechanical Engineering
Chulalongkorn University

Letter from JSME President

On behalf of the Japan Society of Mechanical Engineers (JSME), I would like to celebrate the opening of the 2nd TSME International Conference on Mechanical Engineering organized by TSME and in cooperation with ASME, IMechE and JSME. Furthermore I cannot help expressing my deepest gratitude for kind support and encouraging message given from all over the world to Japan facing with the historical disaster that occurred on 11th March of this year. We have still been in the great difficulties but I believe that we can overcome with the support from people around the world in not the distant future.

After the disaster happened we immediately launched committees working on investigation of the damage and making proposals for the future in order to fulfill our responsibility as a group of professional mechanical engineers. We keep doing our best in order to make our activities to be help to revival of Japan and respond to international accountabilities.

Not only activities in Japan but also publicizing information globally are our significant duty. I would like to emphasize the importance of international cooperation among academic societies. Since 2009 when the JSME International Chapter Thai Section was launched, JSME and TSME have kept good relationship with each other. Last year at the opening ceremony of 1st TSME-ICoME, Prof. Yoichiro Matsumoto, former president of JSME, gave speech to congratulate TSME on the opening of the conference. I hope to keep the tie with TSME and develop it into stronger one.

It is my great pleasure to present at this successful conference and to communicate with many of participants gathered globally. Thank you for inviting us to and hosting this great conference. I wish that all the participants will enjoy joining and fruitful success will be provided through 2nd TSME-ICoME.

Jun Sato

Jun'ichi Sato
President
The Japan Society of Mechanical Engineers

Letter from the IMechE

Ir. P.E. Chong
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Dr. Satesh Namasivayam
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Mr. Wynand Wessels
Corresponding Member
IMechE Thailand

Dr. Paul Bland
Member
IMechE Thailand

The Institution of Mechanical Engineers (IMechE), Thailand Group, on behalf of the Regional Chairman and the Young Members Representative of the IMechE of South East.Asia Region, wishes to reaffirm our support of the continuing development of this conference and look forward to enhancing our co-operation with all parties involved.

This year IMechE reorganised its international structure into seven regions worldwide and South East Asia is one of the Regional Group, Chaired by Ir P.E. Chong and Dr. Satesh Namasivayam as the Regional Young Members Representative. This emphasises the growing importance of the region, and a commitment to supporting the conference as part of the IMechE's activities in the region.

This last year has seen some horrific natural disasters and tragedy underscoring the need for global co-operation and the important role that Professional Engineers can play. We would like to offer our deepest sympathies to all those affected.

Dr. Satesh and Dr. Paul Bland will be representing IMechE at the conference and both of them will look forward to meeting you all.

Finally, we wish to thank TSME, Kasetsart University and all the organising team for their hard work.

Yours faithfully,

Wynand Wessels

Corresponding Member, IMechE Thailand.

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Keynote Lecture

The Second TSME International Conference on Mechanical Engineering
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What's Happened in Fukushima Nuclear Power Plant
- Heat and Fluid Flow in Reactors at Severe Accident-

By Professor Shigenao Maruyama

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Abstract

The authors has analyzed several thermal-hydraulic phenomena in the nuclear power plant after the severe accident at Fukushima Daiichi Nuclear Power Plant in order to understand what happens inside and make proposals for early restoration of the plant. In this lecture, the outline of the accident is overviewed. Then, Heat and fluid flow in the reactors are analyzed to estimate the damage of each reactor. We presumed one scenario of broken process of the reactor pressure vessels (RPV) and containment vessels by examining the measurement data provided by Tokyo Electric Power Company.

Keyword: Thermal-Hydraulic Phenomena, Fukushima Nuclear Power Plant, Reactors at Severe Accident

Alternative Energy and Combustion

(AEC)

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Nanostructures and Oxidation Kinetics of Diesel Particulate Matters

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Abstract

Diesel particulate matters (PMs) must be removed from the exhaust gas emitted from diesel engines to protect the environment and human health; therefore, regulation of vehicle emissions has become increasingly strict. The nanostructures of diesel particulate matters emitted from an actual diesel engine and a diffusion flame burner were investigated by using a transmission electron microscopy (TEM) for better understanding. The single particulate's sizes of both engine and burner were approximately 20-80 nm. The various size of particulate might be strongly related to drag and shear forces of fluid flow, Brownian motion force of gases molecules and electrostatic forces of charges carbon elements, even though such forces is the order of Pico-Newton. Thermo-gravimetric analysis (TGA) was used to investigate chemical kinetics of PM oxidation. The apparent activation energies of engine's PM oxidation were approximately 105kJ/mol and 248kJ/mol for hydrocarbon and carbon zones, respectively. On the other hand, the apparent activation energies of lamp's PM oxidation were approximately 139kJ/mol and 218kJ/mol, respectively. Consequently, much amount of soluble organic fraction (SOF) emitted from an actual engine may be strongly affected to the low apparent activation energy at the low temperature oxidation zone. Similarly, an internal combustion engine operates with very high temperature and pressure. Structure of soot emitted from diesel engine may be strong carbon bonding resulting in increasing of the apparent activation energy of carbon oxidation.

Keywords*:* Diesel particulate matter, Diesel particulate filter, Hydrocarbon, Apparent activation energy.

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Biodiesel Contamination in Engine Lube Oil

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Abstract

Recently, there have been increasing interests in using biodiesel as an alternative fuel for commercial vehicles, particularly in agriculture-based countries. Many research efforts have been focusing on proving that biodiesel is able to blend with conventional diesel and that its blend performance is similar to pure diesel. However, engine robustness has still been a concern in long-term biodiesel usage. Therefore, this research aimed to study the contamination of biodiesel in engine lube oil and its effects on the oil's properties. The selected fuels in the study consisted of biodiesel derived from palm-olein, jatropha, and used cooking oil, as well as commercial diesel as a reference. To simulate the contamination, engine oils were blended with biodiesel fuels of 5%, 10%, 15% and 20% (wt), respectively. The engine oil's properties, in terms of engine wear protection, were focused in this research, including the physical, chemical properties and selected wear protection performance. The results showed that the biodiesel contamination caused the reduction in viscosity of the engine oil, which is generally considered a serious negative effect. Nonetheless, the contamination also resulted in the increase in lubricity, which constitutes to wear protection. Moreover, different types of biodiesel showed different impacts on the engine oil's properties.

Keywords: Engine oil, Biodiesel, Density, Viscosity and Acid Value.

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Numerical modeling of NOx by using micro combustor

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Abstract

The present study focused on numerical modelling on flame temperature and pollutant emissions of H2-air mixture combustion in a series of chambers with same shape and various diameters under adiabatic wall condition. The simulation results indicate that increasing the flame temperature and the combustion efficiency by increasing diameter, decreasing the NOx emission by depleting chamber size and the zero emission of the prompt NOx emission by using hydrogen as fuel in micro combustors. Also the best chamber size of reducing NOx emission and high efficiency was achieved at chamber diameter about 5 to 70 mm.

Keywords*:* Micro combustion; Hydrogen; Premixed mixture; Numerical model; NOx emission

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Tar Removal Performance of Vegetable Oil Scrubber with Turbulent Effect and Its Combination with Rice Husk Char Adsorption

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Abstract

Biomass gasification has been considered as attractive and successful waste-to-energy technology. Nevertheless many troubles still occur. For advanced applications, which use producer gas as fuel for gas engines with power generators, the gas needs to be clean enough and tar should extensively be removed. Otherwise, tar in the producer gas will condense at reduced temperature and will cause blocking and fouling of engines. Therefore, one of the key problems to deal with is tar removal. The physical tar removal is proven to be technically and economically attractive approach for gas cleaning. Vegetable oil is one of the most effective scrubbers. In this paper, two topics were investigated; 1) the turbulent effect of vegetable oil scrubber and 2) the combination of vegetable oil scrubber with rice husk char as adsorbent. The temperature of the tar decomposition process was set at 800°C. The results showed that 63.6% of gravimetric tar was removed by vegetable oil scrubber with no mixing and 89.8% of gravimetric tar was removed at mixing of 1000 rpm. Once combining 1000 rpm mixing vegetable oil scrubber with rice husk char adsorption bed, 95.4% of gravimetric tar was removed. Therefore, it is found that the combination of vegetable oil scrubber at 1000 rpm mixing with rice husk char adsorption bed showed the best result for tar removal in gasification systems.

Keywords: biomass gasification, vegetable oil scrubber, rice husk char and tar removal.

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Oxidation Behaviors of Gasohol Deposit

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Abstract

Nowadays, the costs of the fossil fuel have continuously increased. To survive from this problem, we need to find the new alternative energy sources to replace the fossil fuel. Ethanol fuel is focused. The side effect when using gasoline or blended ethanol fuel is the adhesion of carbonaceous deposits on the intake port wall will directly result to performance engine because they restrict air flow. Intake deposits have also been shown to affect exhaust emissions, particularly volatile organic compounds (VOCs) and oxide of nitrogen (NO_x). In order to investigate the chemical composition of deposit, scanning electron microscope with energy dispersive spectrometry (SEM-EDS) is used to study. The carbonaceous species of deposit may be in the form of C_xH_y for gasoline fuel, whereas the carbonaceous species may be C_xH_yO for blended ethanol fuel. The oxidation kinetics of deposit formed gasoline and blended ethanol fuel are studied by thermo-gravimetric analysis (TGA) and it can be also determined the activation energy for the reaction between deposit and oxygen. The apparent activation energy of deposit formed gasoline and E20 (gasoline 80% + ethanol 20%) fuel are 156 and 149 kJ/mol, respectively. As a result, the lower apparent activation energy of E20 deposit may be expected that there is oxygen molecular inside the deposit.

Keywords*:* Deposit, Thermo-gravimetric analysis, Activation energy.

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Comparative Studies on Combustion of Peanut and Tamarind Shells in a Bubbling Fluidized Bed: Fluidization Characteristics of Binary Alumina–Biomass Mixtures

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Abstract

Hydrodynamic regimes and characteristics of a gas–solid bed were experimentally studied in the conical section of a bubbling fluidized-bed combustor (FBC). Prior to tests, alumina sand of 0.3–0.5 mm particle sizes used as the inert bed material in the FBC was premixed with shredded peanut/tamarind shells in different mass fractions (MF): 0%, 2.5%, 5%, 7.5% and 10% (by wt.). Ambient air used as the fluidizing agent was injected into the conical alumina–biomass bed through a 13-bubble-cap air distributor. For each biomass fraction in the binary mixture, the pressure drop across the bed (Δp) was measured versus superficial velocity at the distributor exit (u) for three static bed heights (BH): 20 cm, 30 cm and 40 cm. The Δp-u diagrams were plotted for variable MF and BH and compared between the two biomass fuel options. Three sequent hydrodynamic regimes of the bed were found to occur in all test runs when increasing u from 0 to 4–5 m/s. With higher MF, main hydrodynamic characteristics of the bed – the minimum fluidization velocity (u_{mf}) and corresponding pressure drop (Δp_{mf}) – were found to be increased. The bed height showed apparent effects on these hydrodynamic characteristics, particularly on Δp_{mf}, for any arbitrary MF. Static bed heights of 30 cm seem to be an optimal range as ensuring stable fluidization of alumina–biomass mixtures and reasonable values of u_{mf} and Δp_{mf}. For the two biomass fuels, dimensionless dependencies of $\Delta p/\Delta p_{mf}$ on u/u_{mf} showed a similarity when ranging MF at fixed BH.

Keywords*:* Bubbling fluidized bed; Binary mixtures**;** Hydrodynamic regimes and characteristics.

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Comparative Studies on Combustion of Peanut and Tamarind Shells in a Bubbling Fluidized Bed: Combustion and Emission Characteristics

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Abstract

This paper presents the experimental results from a study of burning shredded peanut/tamarind shells in a bubbling fluidized-bed combustor with a cone-shape bed using alumina sand as the inert bed material. For both fuel options, the combustion tests were performed at the fuel feedrate of about 60 kg/h, when ranging excess air from about 20% to 80%. During each test run, temperature and concentrations of O_2, CO, C_xH_y (as CH_4) and NO were measured along the axial direction in the reactor as well as at stack. The axial temperature profiles in the reactor were found to be rather uniform and weakly affected by the fuel type and excess air. However, the axial profiles of distinct gaseous species showed similar trends for the two fuels with substantial effects from the fuel properties and operating conditions. The CO and C_xH_y emissions of the combustor can be effectively controlled via maintaining excess air. With increasing excess air, the NO emission was found to be increased remaining, nevertheless, at a level below the national NO emission limit. For the range of operating conditions, the combustion efficiency was found to be high, 97.6%–99.8%, when burning peanut/tamarind shells as shredded fuels in this conical fluidized-bed combustor.

Keywords*:* Peanut/tamarind shells; Conical fluidized-bed combustor; Emissions; Combustion efficiency.

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Prediction of Total Equivalence Ratio for a Self-Aspirating Burner

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Abstract

A total air entrainment affects the burner performance in terms of completeness of combustion. In recent years, the prediction of a value of the air entrainment for a self-aspirating burner deals only with the primary air, and is also limited to the without preheat case. This study provides a combined theoretical and experimental investigation into the prediction of the total air entrainment for a self-aspirating burner, which is corresponding to the total equivalence ratio. Both with and without preheat of combustion air cases are carried out the primary air entrainment. The oxygen concentration in the mixture is measured by the oxygen sensor. It reveals the level of primary air within this mixture. Calculation method for predicting the total equivalence ratio was developed by using the momentum and energy conservation principles. It is observed that the levels of both primary and secondary air entrainment are increased with increasing the heat input due to the high momentum jet. The preheated case yields a lower primary and secondary air entrainment because of the preheating effect, the fluid in the mixing tube has more viscosity. The levels of total equivalence ratio are in the range of 0.5 to 6. The rich condition is occurred at lower heat input because of the low total air entrainment. At higher heat input, the high momentum jet entrains an excess air. Therefore, the total equivalence ratio becomes very low under lean conditions. The optimum operation of this burner occurs at heat input equals to 7.5 kW, in which the stoichiometric combustion is achieved. As a result, it may be helpful in predicting the thermal efficiency in the future especially in combustion with preheated air.

Keywords*:* Self-aspirating burner, total equivalence ratio, preheating effect, air entrainment

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Thermo-gravimetric Analysis of Biodiesel Diffusion Flame's Particulate Matter

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Abstract

The problem of particulate emissions from diesel engine can be reduced in many ways, for example: engine design, development of fuel additives and using the diesel particulate filter (DPF). This research has two parts. First is studied about the physical properties of diesel (B0) and bio-diesel (B100) particulate matter (PM), such as nanostructure, microstructure and size distribution by using a scanning electron microscope (SEM) and transmission electron microscope (TEM). The primary and agglomerated size distribution of each particulate matter can be estimated by using the image of TEM and SEM. The primary sizes of diesel and biodiesel particulate matter are approximately 50-60 nm and 40-50 nm, respectively. Oxygen content inside bio-fuel may be affected to biodiesel particulate combustion. Second, chemical kinetics of particulate matter oxidation are studied by using Thermo-gravimetric analysis (TGA). The apparent activation energies of diesel and biodiesel PM oxidation in the first stage (hydrocarbon) are approximately 133 and 96 kJ/mol. In the second stage (carbon), apparent activation energies of diesel and biodiesel PM are approximately 176 and 158 kJ/mol, respectively. Because of oxygen content inside unburned fuel and nanostructure may be affected to biodiesel particulate combustion, resulting in low apparent activation energy.

Key words: Emissions, Particulate matter, Apparent Activation Energy, Thermo-gravimetric analysis

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The study of combustion and heat transfer performance of porous combustor-heater with in-bed heat extraction

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Abstract

Porous combustor-heater (PCH) with in-bed heat extraction is a combined combustion and heat transfer device in which heat transfer surfaces are embedded directly within packed bed of porous medium wherein premixed gaseous fuel is burned. During past decade, the PCH has received more attention by many researchers. However, none of the literature works illustrates flame zone and thermal structure by a direct measurement of temperature along the PCH axis, and discloses the complex heat transfer phenomena of the PCH. In order to broaden the knowledge, this work conducts an experimental study on 21 kW PCH with three rows of staggered tube bank to clarify the thermal structure, heat transfer performance and emission characteristic. In addition, the simplify calculation method is presented to reveal the heat transfer contributions (conduction, convection and radiation) to the tube bank with the purpose of exploring the complex heat transfer phenomena of the PCH. The results show that flame zone can be located and stabilized within the tube bank yielding highest heat transfer rate of 274 kW/m^2 with extremely low CO and NO_x emission (i.e. 14 ppm and 24 ppm, respectively) at optimum operating equivalence ratio of 0.64. Furthermore, the study of heat transfer contributions reveals that both convection and radiation play an important role for transferring combustion heat to the tube bank. Radiative contribution is enhanced when operated at rich condition (up to 58% of the total rate). In contrast, convective contribution is enhanced when operated at lean condition (up to 50% of the total rate). As expected, conduction, which results only about 10% of total rate, is not significant contribution for enhancing heat transfer to the tube bank.

Keywords: combustion, porous medium, premixed gaseous fuel, combustor-heater, in-bed heat extraction, heat transfer contributions.

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Spray Characteristics of Ethanol and Gasoline in a High-Pressure Chamber by Schlieren Photography Technique

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Abstract

The present research attempted to characterize fuel spray pattern, such as spray angle, spray penetration and their mixture formation by recourse to images analysis. Ethanol and gasoline were used to investigate a direct-injection stratified charge phenomenon carried out in a constant volume high-pressure chamber. A high pressure of swirl type injector was selected for this study. In this experimental study, the spray characteristics of gasoline and ethanol fuel were comparatively evaluated. With the initial ambient temperatures of 50^0C and 100^0C, initial ambient pressures varied from 0.0 to 5.0 bar, injection durations varied from 1 to 5 ms at constant injection pressure of 45 bar. The series of images were captured by high speed mono chrome video camera with resolution of 6,000 frames per second for schlieren photography and shutter speed of 1/10,000 sec. The result showed the mixture formation of ethanol spray penetration and spray angle were lower than that of the gasoline. From the results, can be concluded that the higher the density and viscosity of ethanol, the stronger the effect on the mixture formation.

Keywords: Spray characteristics, Ethanol, Gasoline, Schlieren photography technique.

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Biodiesel Usage in a Common Rail Vehicle – Performance and Emission Characteristics after 60,000km

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Abstract

The effects of biodiesel on on-road fuel use experience have been investigated in this study. With a common rail fuel injection system, an unmodified van TOYOTA HIACE 2,494 CC engine was selected to run as a modern diesel engine. The vehicle fueled with neat palm biodiesel operated continuously on regular on-road conditions and accumulated mileages to achieve 60,000 kilometers. The engine performance, fuel consumption and exhaust gas emissions were measured periodically on a chassis dynamometer and compared with the reference value recorded at the start of biodiesel usage. In addition, commercial diesel fuels were fueled for comparison during the dynamometer test. Although biodiesel exhibited lower power and higher fuel consumption than those of diesel, their use could lead to substantially lower particulate matter. For a long term test result, the vehicle has been successful to complete the test with no problems of any consequence. Engine performance and fuel consumption has not been influenced by engine deterioration when using biodiesel. However, there are some effects on exhaust emissions at 60,000-km.

Key words: Biodiesel, common rail, engine performance, emissions

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Effect of Diesel Injection Parameters on Diesel Dual Fuel Engine Operations with Charge Preheating under Part Load Conditions

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Abstract

Diesel Dual Fuel (DDF) is an alternative operating mode for conventional diesel engines. DDF engines provide a potential alternative solution for PM and NO_X emissions reduction from typical diesel engine operations. However, DDF engine operations suffer from high HC emissions and poor operation characteristics under part load conditions. The current study investigated the effects of diesel injection parameters and charge temperature on DDF combustion and emission characteristics in a common-rail direct injection, single-cylinder research engine. The natural gas was supplied at 9.5 mg/cycle. The diesel fuel injection timings were varied under injection pressures of 200 and 500 bar. The diesel injection duration was tuned to obtain the injected mass of 3.25 mg/cycle. This corresponded to 70% energy ratio of natural gas to the total fuel energy supplied to the engine for all engine conditions. The intake port temperature was controlled at 45ºC, 60ºC, and 80ºC. All experiments were tested under steady state engine operations at 1600 rpm. Our data indicated that using high intake charge temperature has potential to reduce HC emissions. However, the higher charge temperature resulted in increase of NO_x emissions and the rate of pressure rise. To achieve good DDF operation, which produce lowest HC emissions possible; the injection parameters should be tuned. Increasing the injection pressure promoted the mixing shifted the optimum injection timing later towards TDC. Use of the injection timing at later crank angles would help lessen the amount of fuel impinged on to the cylinder liner. The findings from this research provide a guideline for optimizations of injection parameters and intake charge temperature for improvement of DDF engine operations.

Keywords*:* DDF, PCCI, Diesel Dual Fuel, Injection Pressure, Injection Parameters, Charge Temperature

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Effects of Exhaust Valve Timing on Diesel Dual Fuel Engine Operations under Part Load Conditions

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Abstract

A natural gas engine with direct diesel injection has shown potential as an alternative combustion mode. Many research studies have reported poor diesel dual fuel (DDF) operation characteristics under part load conditions. Under these conditions, the engine can suffer from high HC emissions, mostly methane. In the current study, a four-cylinder turbocharged diesel engine has been converted into a dual-fuel engine operating under premixed natural gas and common-rail direct diesel injections. Experiments were performed to investigate use of different exhaust valve timings for improvement of low-load DDF operation. For all engine conditions, the flow rate of natural gas was maintained, on average, approximately 70% by energy of the total fuel supplied. Results showed that different exhaust valve timings changed the fractions of EGR and the charge temperature. Advancing the exhaust valve timing was most beneficial for low-load DDF operations. Under these operations, HC and CO were significantly reduced. As the engine load increased, the exhaust timing advance might lead to excessive combustion rates and high NOx emissions. Under these operations, the suitable exhaust valve timing should be shifted to towards the original setting for conventional diesel operations. The findings from the current work offered a possibility for expanding the DDF operating range.

Keywords*:* Diesel Dual Fuel, Premixed charge compression ignition, Natural gas, Exhaust valve timing.

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In-situ Monitoring of Carbon dioxide Emission from Combustion of Jatropha Oil by Infrared Emission Spectroscopy

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Abstract

In this research, *in-situ* monitoring of CO_2 emission of jatropha oil was performed by using infrared (IR) emission spectroscopy. The presence of CO, H_2O and NO were also investigated in this research. Moreover, 2D distribution of CO_2 emission intensity was visualized for this oil using an IR camera. A conventional burner from Indonesia, with a preheating system which is required for viscous vegetable oil combustion, called *semawar*, was adopted.

Key words: Jatropha Oil, Infrared Spectroscopy, Carbon dioxide

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Insight into Emissions and Combustion Efficiency of Hydrogen-Diesel Dual Fuel Engine with Exhaust Gas Recirculation Using Chemical Equilibrium Analysis

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Abstract

This paper presents theoretical analysis of the hydrogen-diesel dual fuel combustion with exhaust gas recirculation. A chemical equilibrium method is employed to estimate exhaust gas products from diesel and hydrogen-diesel mode combustion in a presence of exhaust gas portion. The combustion products, e.g. unburned hydrocarbons (in terms of methane, CH_4), hydrogen (H_2), carbon dioxide (CO_2), carbon monoxide (CO), etc. from those are comparatively investigated, based upon equivalent specific energy input. Subsequently, those products are subsequently used to calculate combustion efficiency, based upon chemical energy left in the waste exhaust gases. The main findings are associated with the reduction in CH_4, CO_2, and CO corresponding to the increase in combustion efficiency in hydrogen-diesel combustion mode. Meanwhile, hydrogen content in flue gas may increase in some operating conditions.

Keywords*:* equilibrium analysis, hydrogen, dual fuel, diesel engine, emissions, combustion efficiency, exhaust gas recirculation.

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Preliminary Design of 1.5-MW Modular Wind Turbine Tower

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Abstract

This research aims to obtain a novel modular wind turbine tower design for a 1.5-MW wind turbine to be installed in Thailand. The tower is designed for an IEC Class III wind turbine corresponding to low speed wind region. The new design is economically superior to existing models due to its more flexible transportation options. The feasibility of manufacturing and the availability of materials in the country are considered. The steel structure is 76.9 m high and has a tapered tubular shape with variable wall thicknesses along its height. The tower consists of six longitudinal sections which are further divided into several curved panels. Finite element method simulations are used to conduct stress analyses and to optimise the tower geometry. Linear elastic analysis is performed in all FE models. The structures are analysed for static loads representing the effects of gravity, the operational and survival aerodynamic conditions according to IEC 61400-1 and Eurocode 1. Design constraints on shell buckling and local buckling of the tower are taken into account conforming to Euler and Brazier theory. It has been found that the optimised modular tower with 5.59 meter base diameter and the shell thickness ranging from 8 mm at the base to 16 mm at the top enables the tower to be built with less steel, lowering raw material costs significantly. Increased base diameter allows for thinner tower wall thicknesses, not only resulting in a tower mass reduction of up to 24% but also improvement in structural stabilities with 12% higher tower natural frequencies and 13% lower maximum tip deflection. The result indicates that this modular wind turbine tower design has potential to be economically attractive and the manufacturing is also technically feasible. However, further work to investigate the effects of tower connections should also be conducted.

Keywords*:* Wind turbine tower, Modular tower, Finite element analysis, Structural optimisation.

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A Quasi One-dimensional Simulation of a Combustor for Micro Gas Turbine Engine Using different NGV-Ethanol Fuelled Modes

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Abstract

This work is to numerically study combustion in silo combustor type of micro gas turbine engine using different NGV-Ethanol fuelled modes. The simulation applied chemical equilibrium method where the fuel mixture is specified by the way of its C-H-O-N values and curve-fit coefficients are employed to simulate air and fuel data along with frozen composition. The study described performance parameters, pressure and temperature profile data on the effect of mole ratio of the NGV-Ethanol-mixture (100:0, 90:10, 80:20, 70:30), equivalence ratio (0.6-1.0), pressure ratio (3.0-4.0), and engine speed (40000-120000 RPM).In this study, the silo combustor was simulated on the variation of the ignition length (premixed zone) 0.10, 0.15 m and burning length (primary zone) 0.10, 0.15 m. The calculated data is then showed to plot the changing performances and pressure-temperature profile.

Keywords*:* NGV-Ethanol, equilibrium, Simulation, Thermodynamic Modeling and Olikara and Borman.

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Visualization of LPG-PME Dual Fuel Combustion in an IDI CI Engine

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Abstract

This study is aimed to investigate and to identify the effect of biodiesel as the pilot injection in dual fuelled engine. Firstly, images of spray and combustion characteristics of liquefied petroleum gas (LPG) premixed charge-diesel dual fuelled engine was studied. Next, the investigation continued with the pilot injection changed to palm biodiesel (PME). Lastly, it finished with varied injection timing for neat liquid as well as dual fuelling to fulfill a comparison. Test bench experiments (steady state) were conducted with a 4-cylinder IDI CI engine, at selected fixed load, high probability operating points corresponding to the ECE15+EUDC cycle. The engine ran as LPG-air premixed mixture was maintained at four fixed values by an electronic controlling system. The acquired data included basic parameters and accessed combustion chamber visualization. The comparative analysis deal with: energy efficiencies, liquid fuel substitution, combustion chamber phenomena including spray, combustion, flame probability distribution, flame temperature, and soot concentration (two color method). With LPG-PME, the flame probability distribution and the area of high flame temperature was smaller, due to the PME properties: lower heating value, lower adiabatic flame temperature, and heavier. This was also thought due to the limit of the two color method when applied for gaseous and oxygenated fuel combustion. Concentration of soot in flame was observed to be lower with higher LPG and was much lower in LPG-PME cases. The 1.2-degree-advanced injection timing gave better LPG-diesel combustion while the OEM setting was suitable for LPG-biodiesel combustion.

Keywords : Dual Fuel, LPG, biodiesel, combustion, visualization

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Thermal efficiency of self-aspirating porous medium burner for Small and Medium Scale Enterprises (SMEs)

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Abstract

A self-aspirating conventional burner, CB, is widely used for heating process of small and medium scale enterprises, SMEs, in Thailand but it has a relatively low thermal efficiency (<30%). This study is made to improve a thermal efficiency of self-aspirating burner by porous medium technology. A self-aspirating porous medium burner, SPMB, was already designed and constructed from my previous work. This experimental study is carried out to investigate the effect of firing rate, *CL*, and distance between the burner top and the bottom of the loading vessel, *H*, of the SPMB and CB on the thermal efficiency, η_{th}, and emission levels. Method of experiment and data result is based on European standard with the operating conditions of *CL* = 21-44 kW, *H* = 75-125 mm and LPG used as gas fuel. The thermal efficiency of the CB and SPMB were increased with the decreasing *CL* and *H*. An average of η_{th} of the SPMB is higher than the CB about of 4.58%, yielding a relatively high of energy saving of about 10.19% in average over the operating range. The SPMB emitted a relatively low average NO_x emission level of less than 59 ppm (corrected to 0% of O_2). But the CO emission levels of SPMB were relatively high as compared with the CB because of a lack of secondary air entrainment and incomplete combustion. Despite its relatively high CO emission of SPMB, the level was still lower than value of the industry standard in Thailand.

Key words: Self-aspirating burner; Porous medium burner; Thermal efficiency; Premixed flame; SMEs.

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The Effect of Porous Emitter on the Combustion of Diesel Oil Porous Burner

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Abstract

The combustion of diesel oil in the porous burner (PB) installed the porous emitter (PE) was experimented to investigate evaporation mechanism, combustion behavior. The pebbles carefully chosen in the same size like the solid sphere homogeneously had been adopted as the porous media. The tested apparatus was divided into 4 sections. The first section is fuel injection chamber. PB or porous absorber having porosity (ϕ) of 0.45 is the second section. The combustion or flame position is located in the third one which three ways swirling air (Q_A) is supplied in this section. The final one is defined as PE section. The PE with different two porosities of 0.45 and 0.52 were examined by installing below PB with distance of 20 cm. The fuel was supplied dropwise from the top through the PB and evaporated in the porous media followed by the combustion on the bottom side. Axial profiles of temperature along the burner length were measured to clarify the evaporation and combustion phenomena. The pollutant emission characteristics were monitored at the burner exit. From the experiment, it was found that the temperature profiles decreased with the three ways swirling air flows (Q_A) increasing. On the other hand, the temperature profiles increased with fuel heat input (Q_F). Remarkably, a better combustion and higher temperature profiles were achieved by PE having porosity of 0.52.

Keywords*:* Diesel oil, Porous burner, Temperature profile

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Physical Characterization of Biodiesel Particulate Matter by SEM

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Abstract

A diesel engine is a principle choice in transportation, because of its high thermal efficiency, durability and low maintenance. However, in-use diesel engines produce high concentration of particulate matter (PM) which affects air pollution and human health. This paper describes a part of an ongoing research project in diesel particulate matter reduction as emitted from diesel engines. In order to achieve the particulate matter reduction, physical structure and aggregation behavior should be investigated for better understanding. The physical characteristics such as micro- and nano- structure of particulate matter were studied by a scanning electron microscope (SEM) and a scanning transmission electron microscope (TEM). The primary and accumulate size distributions as well as particulate structures were presented by means of scanning images. From this study, the primary particle size of biodiesel was found that smaller than that of diesel because the oxygen content in biodiesel might have effects on particle combustion. Therefore, the biodiesel particulate removing is necessary to study in detail in an actual engine for more understanding. The particulate matter generation is based on the application of on-road conventional diesel vehicles. Particulate matter emitted from biodiesel combustion was compared with the results of diesel. Finally, the expected results will be used to design and develop a diesel particulate filter (DPF) which is proper for in-use diesel engines for using in both diesel and biodiesel fuels.

Keywords*:* diesel engine, biodiesel, particulate matter, diesel particulate filter

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Investigation of Effects of Ignition Improver on Ignition Delay Time of Ethanol Combustion with Rapid Compression-Expansion Machine

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Abstract

This work presents the effect of ignition improvers, i.e. 5% glycerol ethoxylate and additive ED95, on the hydrous ethanol 95% (Eh95) under simulated diesel engine conditions using the rapid compression-expansion machine (RCEM). The results show that Eh95 without ignition improver shows longest ignition delay and highest the peak rate-of-pressure-rise, while 5% glycerol ethoxylate and additive ED95 as ignition improvers have similar peaks rate-of-pressure-rise, but 5% glycerol ethoxylate shows slightly shorter ignition delay. The highest NO_x and lowest soot occurred in case of 5% glycerol ethoxylate related to the shortest ignition. In addition, the flame of Eh95 with 5% glycerol ethoxylate also shows the brightest apparent flame. The flame of Eh95 without ignition improver is brighter than that of ED95.

Keywords: Ethanol, Ignition improver, Rapid compression-expansion machine and Compression ignition engine.

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Experimental Study of RDF-Gasification for Power Generation : University's RDF Model

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Abstract

Waste is the discard matters which is coming out from human activity and needed a proper disposal in order to avoid the harmful to environment. However, there is still the hidden energy inside the throw-away waste and one need to recover that system since it is considered a green and clean renewable energy which can reduce the emission of green house gas and mitigate the global warming effect. In case of community which has the amount of waste less than 100 Tons per day, the prominent Waste-To-Energy technology is the using Refused Derived Fuel (RDF) and Gasification for power generation. Advantage is the only technology that can dispose waste properly, by reducing mass and volume, and at the same time, can generate the green energy in the form of electricity with no harmful to environment. Experimental study has been carried out to study the possibility of using RDF-Gasification technology for power generation by using waste generated within University as Model. Waste has been sorted out of non-combustible materials, as well as recyclable material from source separation. The rest paper and plastic are used to prepare RDF. Gasification by using RDF as feedstock has been performed in a laboratory scale downdraft gasifier which has a capacity of 10 kg/hr. The experimental parameters include the variation of air flow rate that fed into reactor, as well as RDF's compositions. The measured parameters include temperature distribution along the height of reactor, producer gas compositions. The potential of RDF-Gasification for power generation is judged by the cold gas efficiency which is high enough to feed into the engine-generator for electricity generation.

Keywords*:* Refused Derived Fuel, Gasification, Electricity Generation, Waste-To-Energy

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Effects of incompletely converted palm oil on biodiesel quality and engine performance

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Abstract

This study investigates how an incomplete conversion of methyl ester influences the parameters of quality standards and engine performance. The parameters evaluated include viscosity, cloud point, acid number and heating value. Biodiesel oil produced from palm oil is examined. In terms of engine performance, the 3-liter engine with a 4 cylinders 4 strokes, are used. The proportion of methyl ester in biodiesel is varied by adding an appropriate amount of triglyceride. Properties of biodiesel with the methyl ester between 75% and 96.8% by mass are tested against the standard diesel. The engine performance and efficiency with biodiesel of different qualities are determined under the operating engine speed. It was found that the incompletely converted palm oil considerably affected the quality of biodiesel. The biodiesel of all proportions of methyl ester generally gave lower engine performance than that given by the standard diesel. Among the biodiesel fuels, biodiesel with higher portion of methyl ester provided better engine performance.

Keywords: Biodiesel; Palm oil; Methyl ester; Triglycerides; Transesterification; Engine performance

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Design and Manufacture of a Rhombic-Drive Stirling Engine

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Abstract

This paper presents design, manufacture and test of a rhombic-drive Stirling engine. The engine is a Beta-type configuration. The two dynamic pistons called displacer and power piston reciprocate in the in-line concentric cylinder arrangement. Rhombic drive mechanism is designed for engine balance of a single acting engine. The displacer rod is assembled concentrically inside the power piston rod. The sliding of both piston rods is controlled by a matched pair of gearwheels. The prototype has swept volume of 110 cm^3. In the proof-of-concept device, the hot end of the displacer cylinder was heated by a LPG burner and the power piston cylinder was cooled by water. Air is used as the working gas at atmospheric pressure for initial charging of the engine. The experiments were set up and conducted to investigate the engine performance at variation of the heater temperature of the heat source. The testing results showed that the unpressurized engine started operation in only about 100 seconds at the heater temperature of 460 $^{\circ}$C with 312 rpm. At the heater temperature of 540 $^{\circ}$C, the engine speed was 680 rpm. At the engine speed of 280 rpm, the maximum torque was 0.245 Nm while the maximum power was 7.85 watts at 360 rpm. Engine speed increases with the flame temperature inclement. The prototype with initial atmospheric air filling gave the promising power.

Keywords*:* Stirling engine, Beta type, Rhombic drive, unpressurized, flame temperature

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Economic Performance of Solar Panel Installations with Heat Gain Reduction Benefit

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Abstract

The feasibility of solar panel wall and roof installations in building is investigated. Without considering reduced heat gain benefit, it has been widely shown that solar panels remain prohibitively expensive. With the benefit, however, certain building configurations become attractive candidates. This research explores the combinations of building shapes and panel locations leading to economically viable installations using a building energy simulation program called eQuest. Employing Bangkok weather data, the results show that roof installations have the highest rate of return for tall and slim buildings, while west and south wall installations gives the highest return for short and wide buildings.

Keywords**:** Building-integrated photovoltaics, economic performance, heat gain reduction

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Purification of Glycerin By-product from Biodiesel Production Using Electrolysis Process

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Abstract

High-purity glycerin is one of the most important industrial feedstocks. Its applications are found in food, pharmaceuticals, cosmetics, oleochemicals and tobacco industries. With increasing popularity of biodiesel, the amount of crude glycerin by-product has dramatically increased. The oversupply of glycerin has flooded the market and driven the prices of crude and refined glycerins down. Hence, the margin of refined glycerin depends largely on the purification cost. Therefore, this study proposes a cost-effective alternative to purify crude glycerin by using electrolysis, as well as obtaining the technical and economical feasibility. We found that, by using five pretreatment steps together with the electrolysis process, the glycerin content has increased from 75-80% up to meet pharmaceutical grade (> 95 %) without using the expensive vacuum distillation. This is because the electrolysis process could remove inorganic salts and other contaminants by electrolysis and electro-coagulation reaction.

Keywords*:* Refined Glycerin, Electrolysis, Purification, Biodiesel

Aerospace and Marine Engineering

(AME)

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A Comparative Study on 6-DOF Trajectory Simulation of a Short Range Rocket using Aerodynamic Coefficients from Experiments and Missile DATCOM

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Abstract

A comparative study was carried out to investigate the trajectory simulation of a short range solid propellant rocket using aerodynamic coefficients determined by different methods. The first set of aerodynamic coefficients was estimated using an aerodynamic prediction code, Missile DATCOM. It was found that the accuracy of the predicted coefficients was limited due to the limitation of Missile DATCOM and model simplification. The second coefficient set was obtained from published experimental data and employed as a benchmark. Then these two sets of coefficients were applied to a 6-DOF rigid body model for trajectory simulation. The result parameters, such as spin rate, angle of attack, and impact point, were compared. The comparison suggested that the less accurate coefficients predicted by Missile DATCOM could be used for predicting velocity and impact point of the selected rocket with moderate errors. However, significant error was found in the spin rate and angle of attack prediction.

Keywords: Trajectory Simulation, Aerodynamic Coefficients, 6-DOF, Rocket, Missile DATCOM.

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The Wing Twist Maximization of Aeroelastic Car-Spoiler

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Abstract

The rear spoiler of car is employed to control lift of car with producing the negative lift or downforce. This effect makes the driving safer. The conventional spoiler is designed to be stiff and strong to reduce structural deformation and aeroelastic problem. The angle of attack of such a spoiler is set to a high angle to get more downforce at the high speed. However, the downforce at the low speed is still created and it is not needed. This paper presents a new idea to take advantage of wing twist at the high speed whilst there is smaller angle of attack at the low speed. The technology of Multidisciplinary Design Optimization applied to the airfoil spoiler with one fixed spar to allow the structural deformation whereas the structural and aeroelastic failures were avoided. The optimization problem was set up to maximize the wing twist angle of the spoiler with varying the thickness of spoiler skin and spar, the height of a trapezoid spar subject to structural and aeroelastic constraints such as deflection, stress, divergence and flutter. Population Based Incremental Learning (PBIL) was selected to solve such a problem. The structural and aeroelastic analysis are performed in MATLAB program with developing Finite Element and PBIL algorithm. The results are compared with a general spoiler using a flat plate. The outcomes demonstrated that the airfoil spoiler provided the higher angle of attack at high speed and the lower angle of attack at low speed whilst its deflection was small when their results were compared with the results of the flat plate spoiler. Therefore, this paper shows the success of employing MDO to search for the maximum twist angle of aeroelastic spoiler so that the spoiler wing deformation is taken in a positive way.

Keywords: Car Spoiler, Aeroelastic Wing, Optimization

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Developing Firing Table Software for Artillery Projectiles using Iterative Search and 6-DOF Trajectory Model

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Abstract

This paper presents the development of the firing table software for computing firing solutions for an artillery projectile. Unlike traditional tabular firing tables, in which the firing solution is determined by interpolating standard condition data then applying correction factors, the iterative search approach employed in this study uses a trajectory model to predict the point of impact in the non-standard conditions and uses search algorithms to converge to the firing solution. The concept and method used in the firing table software are explained and applied to the 155-mm HE M107 projectile. The demonstration program was tested with test cases in non-standard conditions. The results are presented and discussed.

Keywords*:* Firing Tables, Artillery, Trajectory Simulation, Projectiles.

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Importance of Wind Tunnel Test in Design Process of Micro Air Vehicles

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Abstract

Micro Air Vehicles (MAVs) have been studied and researched for a ten year. Many platforms have been developed and numerous MAVs have been successfully flown. Due to their small size, there are a lot of challenges for engineers such as selection of materials, control system, and components. Aerodynamic is another issue which is most attractive for design of MAVs as well. Since they have very small size and fly at low speed, their low Reynolds number and laminar separation bubble result in very poor aerodynamic performance. In addition, due to limitation of size, fixed-wing MAVs are usually designed by very low aspect ratio wing. High completed 3D flow problem induces more difficulty for determination of aerodynamic characteristics. Moreover, aerodynamic-structure and aerodynamic-propulsion interactions strongly present in the design of fixed-wing MAVs. Most numerical simulations still cannot well determine a good result. Therefore wind tunnel and experimental tests are necessary for a good design process of MAVs.

Keywords*:* Aerodynamic of Micro Air Vehicle, Design Process, Wind Tunnel Test

Applied Mechanics, Materials and Manufacturing (AMM)

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DATCOM CURVO ROPEWAY FOR URBAN COMMUTATION

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Abstract

Years of design efforts and simulation, a special non-linear CURVO ropeway system, operating over arterial metro city roads, has been developed, with specific aim to contain emission, road causalities, health hazards and huge fuel subsidy. The paper presents a noble application of the aerial system, named “CURVO ROPEWAY” to highlight its huge potential in future years.

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A New Device for Accuracy Measurements of Multi-axis NC Machines

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Abstract

In this paper, a new device is proposed for accuracy measurement of multi-axis machines. The proposed new device is designed such that to overcome all the drawbacks that are with ball bar and R-test measuring instruments, low cost and easy usage. In this paper the design of the new device, applications and comparison of measurement results of three devices are discussed.

Keywords*:* Five-axis, NC machines, Accuracy, Measurement.

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Influence of Non-Linear Stress-Strain Curve on Elastic Response of Cantilever

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Abstract

Influence of non-linearity of a stress-strain curve on the elastic response of a cantilever was investigated theoretically and the validity was checked by experiment. Two types of non-linearity were taken into consideration; difference in Young's modulus between the tension and compression sides and the non-linearity of the stress-strain curve. The theory was extended to predict the response of a sheet coated with a thin hard layer. Specimens sectioned from a cold-rolled steel sheet were subjected to tension and compression tests to measure the non-linearity. For the validity check bending tests were carried out.

Keywords*:* Cantilever, Non-Linear, Stress-Strain curve, Bending Test.

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3D Finite Element Analysis of Configurational Forces in Surface Coating

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Abstract

This paper aims to study failures at the interface of a surface coating with perfect bonding subjected to thermal loads. The finite element method with elastoplastic constitutive relations is employed in order to simulate the interfacial characteristics of a film/substrate system. In addition, the configurational (or inhomogeneity) force based on the concepts of Eshelby's energy momentum tensor is also introduced and numerically evaluated by the finite elements. In context of the variation and magnitude of the inhomogeneity forces at the interface, effects of small interfacial roughness, crystal morphology, and temperature gradient are examined and discussed as a cause to generate a driving force of delamination.

Keywords*:* Debonding, Inhomogeneity force, Thermal stress, Finite element analysis.

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A Study of Surface Roughness Affected by Radial and Axial Depth of Cut in Side Milling Operation

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Abstract

In the process of metal cutting operations, unstable cutting condition causes many effects on surface quality of finished products. In addition to size of cutter, clamping system and hardness of the work-piece, forces exert on cutting tools dramatically change quality of surface. In this paper, experiments were conducted by two cases: Case (I) with large radial depth of cut, RDC and small axial depth of cut, ADC and Case (II) with small RDC and large ADC. In experiments 91 HRB Mild steel plates were used as test pieces and two 16 mm diameter solid carbide flat end mill cut them for two cases. Surface roughness analysis was carried out by making test cut with eight side milling operations, four for Case (I) and the others for Case (II). To show the greater performance, the cutting speeds of Case (II) are set to two times of Case (I) and higher machining parameters were used for every operations of each case. By analyzing roughness data of each operation, it has been observed that large radial depth of cut and small axial depth of cut caused higher surface roughness Ra than that of small RDC and large ADC.

Keywords*:* Axial depth of cut, radial depth of cut, side milling, surface roughness

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An Approximate Analytical Modeling of Honeycomb Sandwich Structure Including the Effects of Imperfection, Core Thickness and Impact Damage

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Abstract

In this study an approximate buckling model for a sandwich structure consisting of a honeycomb core sandwiched between two layers is developed considering the geometric imperfection in the hexagonal structure core, core thickness and impact damage. These factors are important to be modeled for better overall design. Buckling stress with imperfection characteristics and impact damage are introduced by appropriate formulations. Core thickness affects the shear and normal stresses in honeycomb structures; the experimental data relating stresses to thickness is employed to form a relation. These terms is then integrated into the governing equation obtained from energy technique to improve the accuracy of the approximate analytical model. The results obtained are compared without these effects, and shows that the present model produces extremely accurate results.

Keywords: Modeling, honeycomb sandwich structure, imperfection, thickness, impact, energy principle

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Carbon nanotube growth directly on nickel substrate using alcohol

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Abstract

Chemical vapor deposition (CVD), having ethanol vapor as carbon source, is used to synthesize carbon nanotubes on 99.9 wt%Ni polycrystalline materials acting as catalyst bulk metals. At different reacting temperature of 600, 700 and 800°C, synthesized CNTs on 400x400 and single hole Ni grids are visually investigated by a field-emission scanning electron microscope. With 20 minutes feeding time of ethanol under 1000 sccm Ar carrier gas, densely packed CNTs on the substrate are best found at 600 °C. Abundant nanofibers occur at 700 °C while Ni grids are oxidized and broken in small chips at 800°C and it becomes difficult to spot CNTs. Nucleation site of CNTs has been noticed to be at circumferential surface of nanofibers. In addition, CNTs on stainless steel rings that hold the Ni grids in place are found. This indicates the potential application of the CNT growth process on other metals in the near future.

Keywords*:* Carbon nanotube, CVD growth, Nickel substrate, ethanol.

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Time to Seizure Comparisons between Different Plain Journal Bearings

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Abstract

This paper is a continuation of the research which was presented at last year's TSME conference. In that paper [1], two new concepts for plain journal bearings were presented. Their design takes advantage of the fact that the coefficient of friction is not just a function of the specific materials sliding together but also a function of time, load and environment. The coefficient of friction will increase with time until a steady state value is reached, where the rate of particle generation matches the rate at which particles are removed. The new designs took advantage of this information by incorporating particle traps and compliant surfaces to reduce friction. Since then an experiment has been designed and built to test both of the new design concepts against a regular plain journal bearing. The experimental data did not produce absolute data on the friction coefficient but it did allow a relative comparison between the different bearings. A time to seizure was produced in every case. The new concepts produced time to seizures ranging from 3 times greater than the regular bearing to over 5 times greater.

Keywords*:* Journal Bearings, Low Friction, Low Wear, Seizure Times

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A Study of Hardness Change on 25 HRBW Reference Blocks due to the Number of Indentations

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Abstract

Hardness reference blocks may have a measurement uncertainty as low as 0.45 Rockwell units. However, in the case of Rockwell scale B hardness blocks, changes in hardness over the test surface caused by indentations could be as high as 2 HRBW or more which exceed its measurement uncertainty and thus directly affect the accuracy of hardness measurements. To study the behavior of hardness change due to indentations, two groups of 25 HRBW test specimens of reference hardness blocks were studied: one group in the spread pattern and the other in the huddle pattern, respectively. Each group of the test specimens consists of 3 sets of reference hardness blocks of 6, 8.5, 10.5 and 11 mm thickness in order to match the 60, 12 and 6 mm anvil diameters. The results of the study showed that indentations caused bending deflections of the reference blocks. The bending deflection was inversely proportional to the diameter of the used anvil and the thickness of the reference block. When using a 60 mm diameter anvil, for every thickness of reference block, the hardness values always increased over 1 HRBW. On the other hand, anvils having 12 mm and 6 mm diameter produced positive hardness changes. The hardness change tended to decrease when the diameter of the anvil was increased and increased when the thickness of the reference block is decreased. Especially, for the 6 mm thickness block, the hardness change was in the negative direction. Moreover, tests carried out in the huddle pattern gave more stable results than the tests carried out in the spread pattern. From the results, it cold be concluded that the hardness change could be minimized by selecting an appropriate thickness of the reference block, diameter of the anvil used, and indenting pattern. However, those factors influence the bending of the reference block. Therefore, the maximum number of indentations should be carefully considered by taking into account not only the distance between the indentations but also the tolerance of the surface flatness of the reference block.

Keywords*:* Reference block, hardness change, bending.

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A Localized Defect Detection of Rolling Element Bearing Using A New Indicator for Morlet Wavelet Filter Adjustment

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Abstract

Failures of rolling element bearing can cause serious downtime. Early stage bearing defects require a special detection method. When localized defect occurs, the periodic impulse which relates to bearing defect location appears in machinery vibration signal. High frequency resonance technique (HFRT) or envelope analysis is used in conjunction with complex Morlet wavelet because it resembles to mechanical impulse. This detection method demodulates defect-related low frequency part from system-natural-frequency-related high frequency part. However a proper indicator for optimal center frequency and bandwidth is needed to obtain promising detection result.

This study proposes an indicator that picks optimal Morlet wavelet that gives the highest ratio of the sum of harmonics family that has maximum value to the arithmetic mean of envelope spectrum in a specified range. In simulation study, it is shown that the proposed parameter can detect bearing defect not less than 97% from signal of various natural frequencies and damping ratios up to signal to noise ratio of -15 dB. The real bearing experiment was conducted with outer race defect under various defect sizes, radial loads and shaft speeds. It is shown that the indicator can successfully detect all cases of defect on outer race if line resolution in envelope spectrum is chosen properly.

Keywords*:* Rolling Element Bearing Defect Detection, Wavelet Filtering, Envelope Spectrum, Morlet Wavelet, Optimal Wavelet Indicator.

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Development Drying of Cashew Kernel with Microwave by using a Continuous Belt

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Abstract

This research aims to develop microwave based dryer with continuous conveyor for cashew kernel. Stoves together with 8 magnetrons(100-1000w/unit) installed in zigzag pattern are employed in the experiments based on a variety of factors to be considered. The stove has dimension of 336x2000x350 mm.[3]. The power of 1000 watts for 11 minutes gives cashew kernel containing 2.4194% dry basis and causes the seed color to be dark and not look appetizing. Moreover, the taste is quite bitter. However, the power of 1000 watts for 10 minutes can result in 4.5799 % dry basis, which is not far from that generally found in the market (3.7787 % dry basis), and lead to the maximum production of 14.400 kg/hr. The corresponding seed color is light brown and looks delicious. In addition, the other physical appearances look similar to those found in the market.

Keywords: **:**, Microwave drying, cashew kernel, Anacardium Occidentale Of Fumigato

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The Influence of K-dominance Zone on Brittle Fracture

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Abstract

This paper presents a review of works in relation to the studies of K-dominance zone on brittle materials. It is commonly believed that stress intensity factor alone can characterize brittle fracture behavior. Researchers show that apparent fracture toughness under different specimen configurations and loading conditions is not constant due to the degree of K-dominance zone. It is found that the non-singular stress term combining with the stress singularity can be used to compute critical stress intensity factor effectively. The constant stress term acting ahead of the crack tip is represented by the positive or negative slope of the normalized opening stress. It is shown that the results obtained from the two-parameter model are in good agreement with the experiments.

Keywords*:* K-dominance zone, Non-singular stress term and Stress intensity factor

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Parametric Study of Food Can Corrugation Geometry by using Finite Element Method

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Abstract

Food cans are usually manufactured as a cylindrical thin shell because the shape is easy to form and the material cost is economized. However, the performance of thin circular shells under combined loading is not high especially when subjected to bending stresses. Corrugated can wall is designed to stiffen the can body such that it can endure loadings occurring in the manufacturing process. On the other hand, the corrugation causes decrease in the axial load capacity of the can. A proper design and dimensions of food can corrugation to minimize the material cost whereas the structural performances of the can are not compromised is necessary. In the present work, Finite Element Method (FEM) is employed to study the effects of corrugation geometries to a commercial food can. The 603x700 commercial food can is examined. The parameters of interest include the radius, spacing, number and depth of corrugation. The effects of changing each geometric parameter to the loading capacity of the can are investigated. Two-level full factorial design is employed to analyze the effects of all variables on vacuum pressure and axial load. It was found that the key parameters to the structural performances of the container for both loadings are the corrugation depth, spacing and radius. The corrugation depth has the most effect for both loadings while the number of corrugations is shown to be an insignificant factor.

Keywords*:* Corrugation, Cylindrical shell, Food container, Finite Element Method, Buckling load.

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Heat and Time Effect on Properties of Polycarbonate Composites

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Abstract

Composite of polycarbonate is widely used in various applications as parts and products, such as parts in electronics industries. It is know that heat usually affects in deterioration trend to polycarbonate composite properties. The deterioration may be resulted from changing of its structure and yield to shorter life time. However, mechanism of heat effect to life time of part or product is still unclear. Therefore, aim of this study was to study effect of temperature and time to properties of polycarbonate composite. Polycarbonate composite specimen was annealed at 75 90 105 120 degree Celsius for 1/4 3/4 4 8 12 and 24 hours. It was found that increasing of treatment time and temperature results to changing of the polycarbonate composite from ductile to brittle material. From thermal analysis, it was found that treatment time and temperature seem to be not affecting to the polycarbonate structure and composition change. It was proposed that heat may result the interdiffusion of polymer matrix and lead to more order of its structure.

Keywords: Polycarbonate, Composite Material, Heat & Time effect, Elongation, Glass transition Temperature

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Prevention of adhesion in forming of stainless steel by using surface coatings

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Abstracts

This research is aimed to study the prevention of adhesion during ironing operation by utilizing surface coatings. Since adhesion is a cause of galling or scratch on the product surfaces; to remove scratches additional cost and time are necessary. In this work, three types of hard-thin surface coatings, i.e. TiCN-CVD, TiCN-PVD and AlCrN are selected. Firstly, Ball-on-Disk typed tribology tests are performed. The balls are made of high strength steel (SKH51) which is the same grade as die materials, while the disks are made of stainless steel (SUS304). Next, strip ironing tests are carried out to study the effectiveness of surface coatings under high contact pressure. From the results of both tests, all surface coating used can reduce adhesion between the workpiece and die surfaces. From ball-on-disk test, AlCrN-PVD provides the lowest coefficient of friction between the contact surfaces. However, the results of strip ironing tests reveal that TiCN-CVD provides the deformed workpieces with the best surface quality, i.e., minimum surface roughness and least number of scratches found on the ironed surface.

Keyword: Strip Ironing/ Tribology Test/ Adhesion/ Surface Coatings/ Stainless steel

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Influence of bottoming-bead geometry in wipe bending process

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Abstract

Wipe bending process is widely used in the hard disk drive industry. The major problem in this process is a springback. The springback can be reduced by using a bottoming technique. In this paper, the influences of bottoming-bead geometry on springback were investigated by using finite element method (FEM) and the FEM simulation results were validated by laboratory experiments. Workpiece material used in this research is a low-carbon steel, SPCC (JIS G 3141). The commercial code, DEFORM-2D, was used. The mechanism of springback when the bottoming technique applied was clearly identified based on the stress distribution. The influences of bottoming-bead geometry on springback were also clearly identified. The FEM simulation results showed a good agreement with the experimental results.

Keywords*:* Wipe Bending / Bottoming / FEM / Springback

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A Prototype of a Stair-Climbing System for a Wheelchair

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Abstract

In general, lower limb disabled people do their daily activities on wheelchairs. The disabled people encounter difficulties when they have to ascend or descend the stairs. For example, enter or exit buildings that have no ramps, go up or down in buildings that have no elevators or cross pedestrian bridges. For these situations, many assistants are required to carry a lower limb disabled person and a wheelchair. This leads to a risk of injury for both the disabled person and the assistants. Therefore, this research presented a prototype of a stair-climbing system for a wheelchair. This research was aimed to enhance the quality of life for the lower limb disabled people by enabling the wheelchair to climb the stairs with only one assistant to control the wheelchair. The designed stair-climbing system consisted of two 5-spokes wheels and the slot plates. The 5-spokes wheels were used for climbing the stairs. The slot plates were used for sliding the rear wheels of the wheelchair. The 5-spokes wheels were installed at the rear of the wheelchair and were driven by power from an electric motor. When climbing the stair, the rear wheels were slid to the front of the wheelchair. To move on the floor, the rear wheels were slid back to the rear of the wheelchair. From test results, the wheelchair with the stair-climbing system could ascend and descend the stairs with the maximum riser height of 200 mm. The maximum payload was 80 kg. The stair-climbing system could reduce the number of the assistants to only one person and the wheelchair could still move on the floor as a general wheelchair.

Key words: Wheelchair, Stair-climbing system, Lower limb, Disability, Mechanical design

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Investigation of Materials for Liners of Shaped Charge Warhead and Their Optimum Standoff Distances

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Abstract

Each specific shaped charge has its own optimum standoff distance. However, there is no solid research which reports on the analysis of this distance. This research attempts to determine the optimum standoff for a common shaped charge warhead so that the maximum jet penetration can be obtained. In addition, a series of numerical analyses varying materials for liners, i.e. copper, tantalum and tungsten, were conducted using an explicit finite element (FE) code, AUTODYN. The optimum standoff distance for each liner can be determined from the standoff-penetration chart presented in this paper. This study reveals that the optimum standoff distances for copper, tungsten and tantalum are 3.63D, 3.89D and 4.46D, respectively, where D is a cone diameter of shaped charge. The penetration depth for each standoff distance is in the same trend with the corresponding jet momentum except the copper liner detonated at 5D standoff where the high jet momentum leads to high radius of penetration.

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The Effect of Pivot Bearing Assembly Process on Natural Frequency of Actuator Arm

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Abstract

The hard disk drive manufacturers are now very concerning of the vibration in each element of the HDD, especially, the resonance in the actuator arm. The resonance in the actuator arm could lead to the read-write error or media's surface damaging, which effect directly to the efficiency of the HDD and its reliability. To control the natural frequency of the actuator arm, various parameters are concerned. The components are made very precisely. The parameters of the manufacturing process are strictly controlled. The very little non-conformance parameters could lead to the quality problems of finished goods.

The pivot bearing assembly process is considered as an important factor of the variation of the actuator arm's natural frequency. To withhold the pivot bearing and the ACA (Arm Coil Assembly) together, the most common methods used by the HDD manufactures are tolerance ring insertion and glue injection. The tolerance ring, which is acting like a group of compressed springs, creates friction between the bearing and the actuator arm. With the created friction, the pivot bearing and the ACA can be fixed together during the operation. The tolerance ring compressive forces react directly on the inner surface of the actuator arm. To control the friction and the compressive forces, HDD manufacturers have to control many parameters e.g. dimension of the tolerance ring, bore diameter of the ACA, and the insertion force. This paper presents the study of vibration in each element of HDD, especially the resonance in the actuator arm. The experiment results show the relationship of variation of the pivot bearing assembly in relation to parameters that affect the modal frequency of the actuator arm.

Keywords: Pivot Bearing, Actuator Arm, Tolerance Ring

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Influence of heating temperature fluctuation on flying height under EAMR conditions

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Abstract

This paper investigates the influence of heating temperature fluctuation on flying height under Energy Assisted Magnetic Recording (EAMR) conditions. During the read/write process, the effects of high temperature on the flying height have been studied under steady state condition. The modified Reynolds equation was formulated included the temperature effect on both air viscosity and density. Numerical scheme based on the finite difference method and Newton-Raphson method with multi-grid multilevel technique were implemented to obtain the flying characteristics of the slider in steady state. Under high temperature condition, the pressure gradient and flying height were calculated with varying temperature and disk velocity. The simulation results show that temperature change and disk velocity change have significant effect on the flying characteristics of the head slider in EAMR conditions.

Keywords*:* Energy Assisted Magnetic Recording, Temperature effect, Finite difference method with Multi-grid multilevel technique, Flying characteristics under steady state condition.

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SAE Student Formula Space Frame Design and Fabrication

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Abstract

The purpose of this research is to design and manufacture a space frame for Chulalongkorn University FSAE team in “The FSAE Student Formula 2011 Competition”. The requirements for the frame are mass less than 30kg and torsional stiffness of the whole car more than 1200Nm/deg, which are important values that determine the frame performance level. The design is generated using the computer aided program, CATIA, and then the finite element analysis (FEM) is performed in order to determine the mass and torsional stiffness of the frame. After analysis, the frame is constructed and the torsional test is performed to determine the torsional stiffness of the frame. The results are compared and the 2011 frame is decided. The 2011 frame has torsional stiffness of 1030Nm/deg and with the mass of 29.8kg which accomplish the requirements of the frame.

Keywords*:* Space frame, SAE student formula, Torsional stiffness.

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A Development on Design of the Multi Cavity Injection Moulds with a Cold Runner System for Rubber Seal Manufacturing

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Abstract

In general, rubber seals are manufactured using compression moulding which results in long period of cycle time, excessive flashes and nonuniform part thickness. In this research work, a design of the multi cavity injection moulding with a cold runner system for Nitrile Butadiene Rubber (NBR) seal production is proposed to replace the compressing moulding process.The injection parameters including gate position, runner pattern and balancing, material flow rate, injection time, injection speed, injection pressure, injection temperature, shear rate, as well as viscosity were investigated. A numerical simulation was performed to predict the flow characteristics and then to design the cold runner system. In addition, the part injection experiment using the developed mould design was conducted for simulated result verification.The results show that the cold runner system with equivalent distance and four pin gate type selection as well as the flow rates of 51, 58 and 66 cm_3/s and the injection speeds of 51, 54 and 57 % for the injection temperatures of 70, 80, and 90 °C, respectively, leads to the optimized operating condition of part injection process. Consequently, it can be seen that the multi cavity injection mould with a cold runner system was successfully developed to reduce product cycle time and to provide less waste materials leading to higher production cost.

Keywords*:* Multi Cavity Injection, Mould, Cold Runner, Seal, Nitrile Butadiene Rubber.

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Influences of Reduction Ratio on Mechanical Properties and Transformation Temperature of NiTi Drawn Wires.

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Abstracts

NiTi alloy wires are widely used in many applications for examples, orthodontic arch wires, mini screw implant, sensors, etc. Usually, wire drawing process is chosen to produce arch wires because of its high productivity as well as superior surface quality of the drawn wire surface. In the case of NITI arch wire, the cold work occurred during wire drawing operation also plays important role to control mechanical properties and transformation behavior of the wires. Thus, the purpose of this work is to study the influences of reduction ratio of cross sectional area and annealing temperature on transformation and mechanical behavior of the drawn wires. The wire materials used in the experiment are $Ni_{51.4}Ti_{48.6}$ (atomic percentage) with initial wire diameter of 0.64 mm. The die tip is made of tungsten carbide which is inserted into the steel case made of tool steel. The reduction ratios of cross sectional area (%Re) are varied at three different levels, i.e., 10, 20 and 30%, respectively. In order to study the influences of post heat treatment temperature, the drawn wires are annealed for 3,600 sec at two different levels; 400 and 600^{o}C. The lubricant used in the experiments is sodium stearate powder. From the results, drawing force and surface roughness of the drawn wire strongly depend on %Re. in addition; tensile properties and phase transformation temperature noticeably depend on heat treatment temperature.

Keyword: NiTi arch wire, Wire drawing, Reduction ratio, Heat treatment temperature, Phase Transformation temperature, Shape memory alloy

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ANALYTICAL STUDY ON THE UNCERTAINTY OF LOAD CELLS CALIBRATED WITH DEADWEIGHT-FORCE-STANDARD MACHINE AND FORCE-COMPARATOR MACHINE

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Abstract

In Thailand, there are two important types of force calibration machines; deadweight force standard machine and force comparator machine. The first machine provides more accurate results, but requires high investment when compared to the force comparator machine that is widely used. However, the quality of calibration from force comparator machine is still questionable due to many factors, such as alignment and loading method.

The purpose of this study was to evaluate the uncertainties of load cells calibrated with deadweight force standard, in comparison to force comparator machines. The calibration results were compared in term of sources of uncertainties, i.e., reproducibility, repeatability, stability of the standard and hysteresis to understand the behavior of both machines.

The results showed that the maximum relative reproducibility errors from the deadweight force standard and force comparator machine are 0.006% and 0.05%, respectively. The relative instability of the deadweight machine (at 10 kN) is less than 0.003% while the comparator machine is 0.07%. Therefore, these data strongly demonstrate that load cell calibration with deadweight force standard machine is better than that of force comparator machine. Moreover, the 0.07% relative instability of the force comparator machine is more than the reported uncertainty (0.0529%), indicating that, the machine requires more realistic evaluation on the uncertainty of the applied forces.

Keywords*:* force calibration, uncertainty of force measurement, deadweight machine, load cell

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Sidewall-curl prediction in U-bending process of advanced high strength steel

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Abstract

Currently Advanced High Strength Steel (AHSS) has been extensively use in automotive industry for the purposed of reduction in weight and therefore in fuel consumption. However, increasing the strength of material leads to the reduction in formability and high degree of springback. Moreover, sidewall-curl has been detected from bending operation of AHSS which caused problem in assembly line. Therefore this work is aimed to explore the side wall curl phenomenon of AHSS grade SPFC 980Y. The die designed parameters of die radius and the process parameters of blank holder pressures are studied to reduce sidewall-curl problem using finite element simulation code AutoForm. U-bending experimental has also been conducted to verify the analytical model.

Keywords*:* sidewall-curl, springback, U-bending, AHSS

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Development of Ion-Selective Electrode Fabrication Process Based-on Drop-On-Demand Printing Technique

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Abstract

Ion-selective electrodes (ISEs) have been applied across many fields. The typical fabrication often offers large size and expensive electrode. We develop a fabrication process using drop-on-demand (DOD) printing technique to produce a smaller sensor. The DOD printer utilizes a pneumatic-base print-head as drop generator of a polymer ink. Several groups of photopolymer are specifically formulated to use with our DOD printer. The polymer ink is printed to form a thin membrane that is the important part in the ISE. Operating parameters in printing process are identified to achieve good forming of the final film.

Keywords*:* Drop-on-demand, Ion-selective electrode, Photopolymer

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Drop-On-Demand Printing System with Pneumatic-based Drop-Ejector

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Abstract

Drop-On-Demand printing technology has been applied across various fields. The key component to ensure success printing system is the print-head that produces small droplets of printing medium at desired spatial location. We present a low cost and easy to operate print-head that is already integrated to our printer for fabricating three-dimensional objects. The pneumatic-based print-head is our recent developed prototype that utilizes two LPG injector-valves. The features of these valves are low cost, durable and fast turn-on/turn-off response. The print-head set is designed to achieve quick assembly and nozzle interchangeable. In this paper, we illustrate main components of the print-head. Furthermore, we conduct experiments to demonstrate workability of the whole systems by printing straight lines from photo-polymer ink.

Keywords*:* Drop-on-demand, rapid prototype, 3D printer, photo-curable.

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Product Development Process Improvement by Using Finite Element Simulation

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Abstract

The designing, manufacturing and testing steps are the important steps in product design and development processes. It begins with a design that searches for required dimensions and shape that conform to its applications. Then, parts are manufactured and tested for performance evaluation and making of corrective design. These steps generally consume long time and high expense. It should be more advantage, if these steps could be carried out by computer simulation. Therefore, this research aims to use a finite element method to simulate and analyze failure of the polycarbonate product. Fixtures are designed and constructed for tensile testing of the current product. The result comparison between simulation and testing shows approximately 90% of accuracy. It implies that simulation model and software are verified. The results from this research were used to improve the current design. It is expected that using simulation techniques could significantly reduce development time and expense.

Keywords: failure analysis, computer simulation, polycarbonate, product development

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Influence of Co Addition on Mechanical Behavior of TiNi for Orthodontic Applications

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Abstract

The purpose of this study was to investigate the mechanical behaviors of TiNi and TiNiCo shape memory alloys in order to obtain optimum fabricating conditions for using in orthodontic application. TiNi binary alloys with Ni-content 50.6 at%, TiNiCo alloys with Co-content ranges from 1 to 3 at%. The alloys were melted by electrical arc-melting method, and then the ingots obtained were homogenized at 800°C for 3600 s. Next, they were sliced into thin plates (1.5 mm) by EDM wire cutting machine in order to evaluate mechanical properties. The sliced specimens were cold-rolled with 10, 20 and 30% reduction, and then underwent heat treatment at 400°C for 3600 s, respectively. A Differential Scanning Calorimeter was used to detect transformation temperatures. Mechanical properties were evaluated by micro hardness and three-point bending tests. The results show that Co addition can increase the stress plateau, increase critical stress in superelastic curve and develop austenitic transformation temperature near the oral temperature. Transformation temperatures markedly decrease with increasing percentage of cold work. Superelastic behavior can be found in specimens having high dislocation or those having undergone cold rolling operation at a high percentage of cold work (30%) followed by heat treatment at 400°C. The data obtained can be used to determine optimum fabrication conditions of the materials used for orthodontic application.

Keyword: Shape memory alloys, TiNiCo, Mechanical behavior, Orthodontics.

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Microwave-accelerated curing with low-pressure of Portland cement paste at very early stage

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Abstract

The microstructure characteristic of microwave-accelerated curing of the paste which had a 0.38 water-to-cement mass ratio (w/c) under low pressure level of cavity was investigated experimentally. The microwave power levels of 390, 811, and 1231 watt for 45 minutes were taken into account. The results indicated that the increased temperature consistently related to an increasing microwave power level. Microwave-cured pastes consisted of hydrated phases and pores, $Ca(OH)_2$ dendrite crystals, C–S–H, and granular structure. The range of the Si/Ca ratios was 0.147 to 0.263, while the that of the Al/Ca ratios was 0.029 to 0.061. At elevated temperatures, the sample subjected to a high microwave power level of 1231 watt was suddenly burnt and exposed.

Keywords*:* Microwave-accelerated curing; Portland cement paste; Low pressure; Cavity

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Evaluation of Young's modulus of thin coated layer on cold-rolled steel sheet

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Abstract

Tremendous number of research works has been carried out on the strengthening of material surface such as those on the coating of titanium nitride in order to improve the wear resistance. However little has been investigated clearly on the high performance of the modified surface, because elastic moduli of coated surface and substrate are necessary to evaluate the wear response of the coated surface.

Present study is a trial for measuring Young's moduli of cold-rolled steel sheet of 0.8 mm in thickness and of a thin coated layer of titanium nitride of 2 □m in thickness. After predicting the response of cantilevers sectioned from these sheets with and without a coated layer simple bending test was carried out to check the validity. The results are as follows:

(1) The Young's modulus of cold-rolled steel sheet of 0.8 mm in thickness was 192 GPa on the tension side but the estimated Young's modulus on the compression side was 162 GPa.

(2) The Young's modulus of the coated TiN layer was estimated to lie between 1009 and 1063 GPa on the basis such that the Young's modulus of substrates was 201 GPa after a simple tension test.

(3) If the Young's modulus of substrate on the compression side is lower than that on the tension side the Young's modulus of coated layer of TiN is estimated to lie between 400 and 700 GPa.

Keywords*:* Cantilever, Tension test, Bending test, Coated layer, TiN

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Applications of Casting Process Simulation in Tooling and Process Design for Squeeze Casting Processes

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Abstract

To achieve the laminar flow filling pattern in squeeze casting processes, many literatures [1,2,3,4] have reported that ideal velocity of liquid metal passing through the ingate should be between 0.1 – 0.5 m/sec. Campbell [1] reported that melt front speed should be less than 0.4 m/sec in order to achieve the laminar flow and minimize gas porosities. However, such slow speed requires the higher temperature of liquid metal and die. This results in not only the longer cycle time but also a coarser microstructure of the casting. In addition, the sample castings used in the literature are simple form castings which do not reflect the real castings used in daily life.

In this study, the indirect squeeze casting processes is adopted to cast a motorcycle's component originally produced by a high pressure die casting process. Based on shape and dimensions of the casting to get the real casting out for the mass production, melt's speed must be higher than the level reported by the literatures. As a result, a full laminar flow may not be achievable. Casting process simulation software is used to verify the design of die's gating system and process parameters. Results from simulation are used to evaluate the possibility of defects and minimize them.

Keywords*:* squeeze casting, high pressure die casting, laminar flow, casting simulation, gas porosity

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The Effect of Substrate Surface Roughness on the Mechanical Properties of DLC Film Deposited by RF Magnetron Sputter Ion Plating from Woodceramic as Target

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Abstract

Diamond-like carbon (DLC) film was produced onto stainless steel (SUS304) surface by radio frequency (RF) reactive magnetron sputtering technique with argon as source gas and woodceramics as a target.Surface roughness of the substrate four kinds were prepared by mechanical polishing, sand blasting and electro chemical polishing. Structural evolutions of DLC films were investigated by Raman and XPS spectroscopies. The mechanical properties such as hardness and elastic modulus of films were measured by nano-indentation hardness testing. Contact angle and surface energy of the films were measured by contact angle measurement. Tribological performances of the films were characterized using a ball-on-disk friction tester. The aim study was to compare and study the effects of diamond-like carbon (DLC) films deposition and tribological properties of the films.

Keywords*:* Diamond-like carbon; Wood ceramics material; Surface roughness; Tribological Properties; Mechanical Properties.

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High Strength Dual Phase Steels and Flow Curve Modeling Approach

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Abstract

Dual Phase (DP) steels are an important advanced high strength steel, which have been widely used in the automotive industry for vehicle components requiring light weight and safety. A microstructure of DP steel generally consists of martensitic islands embedded in ferritic matrix. DP steel in this investigation was produced by using two commercial hot-rolled strips as the raw material. Different intercritical temperatures were considered during annealing process in order to generate different martensite phase fractions. Initially, Thermo-Calc calculation was performed to find a proper temperature range of the austenite-ferrite two-phase region for the intercritical annealing process. After the annealing, microstructures of the produced DP steels were characterized by Light Optical Microscope (LOM) and Scanning Electron Microscope (SEM). It was found that the microstructures of the DP steels contain globular and irregular martensite surrounded by ferritic matrix. Ferrite-martensite morphology and martensite phase fraction (MPF) play the most significant role on the mechanical properties of DP steel. Obviously, yield and ultimate tensile strength of DP steel were increased with increasing MPF, but the elongation was reduced. Additionally, micromechanical FE modeling was carried out for predicting flow curves of both DP steels. 2D Representative Volume Element (RVE) was prepared based on micrographs of real dual phase microstructures. A physically based model was applied to describe the stress-strain behaviour of individual phases in DP steel. The model also takes the grain boundary dislocation (GBD) density into account, which has contribution to both an increase in forest dislocations and a building up of back stresses. Finally, calculated stress-strain curves were compared with experimental stress-strain curves determined from tensile test.

Keywords: Dual Phase Steel, Intercritical Annealing, Flow curve, Microstructure

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Fabrication of paper-based lab-on-a-chip by printing SU-8 polymer

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Abstract

Nowadays, lab-on-a-chip which integrates the functions of laboratory into a compact chip is attracting a lot of interest from scientific community, since it can perform chemical detection or disease diagnostics at the point of care. Generally, it consists of several micro-channels and wells that contain detection agents such as chemicals or biological molecules (i.e. protein and DNA). When the fluid sample flows into micro-channels, the target substance mixes with the detection agents causing some physical changes, for instance, color change. Therefore, type of the target substance (i.e. chemical or disease) can be identified. Generally, lab-on-a-chip is often fabricated on glass or plastic templates. Recently, filter paper has been employed as the template for reducing cost resulting in a more widespread usage of the lab-on-a-chip especially in developing countries. Previously, several methods have been proposed to fabricate the micro-channels and wells in the production of the paper-based lab-on-a-chip such as photolithography using SU-8 polymer [1], wax printing in a laser printer [2], polydimethylsiloxane (PDMS) printing in a modified plotter [3], inkjet printing of hydrophobization agent [4] etc. In this work, we studied the fabrication process of paper-based lab-on-a-chip using the inkjet printing technology of SU-8 polymer. The advantages of the proposed method are inexpensive equipment and its simple procedures. This study aims to determine the suitable conditions in the fabrication process and test the developed prototypes.

In the fabrication process, a piezoelectric inkjet printer (Epson, T13) was used to print the pattern of micro-channels and wells on a filter paper (Whatman, Grade 1) using SU-8 (Microchem, SU-8 2010) as ink. SU-8 is a polymer that can be hardened when exposed to UV light. In this work, three key conditions in the fabrication process: the concentration of SU-8 in cyclopentanone solvent, the width of the micro-channel wall and the printing time, are determined in order to fabricate micro-channels and wells that can prevent the water leakage. According to the experimental results, the three suitable conditions are as follows; the concentration of SU-8 in solvent: 1 to 10, the width of the micro-channel wall: at least 3 mm and the printing time: 3 times and more. The micro-channels and wells fabricated with these conditions were found to transport the water without leakage. This proposed scheme provides an alternative to low cost and simple manufacturing of the paper-based lab-on-a-chip.

Keywords*:* lab-on-a-chip, micro-channel, inkjet printer, SU-8

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Effect of Projectile Geometry on Impact Response and Regime Characterisation

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Abstract

Previous studies on the response of a flat plate to impact from a free flying projectile have identified response regimes, with boundaries and transitions defined by projectile mass and velocity, and broadly characterised as ranging from quasi-static to highly transient and localised responses. The objective of this work was to investigate the effect of projectile geometry, specifically the shaft length of a circular cross sectioned projectile with a hemispherical nose, on generating atypical responses that did not fit the regime boundary locations identified in the earlier work. Simulations with LS-DYNA included a damage mechanics model using element deletion based on reaching a critical strain, allowing for the case of perforation and continued contact forces between the projectile shaft and target during perforation. Cases with three different critical failure strains used in the damage mechanics model, as well as varying the projectile shaft length were considered, for a range of initial impact regime conditions determined by projectile mass and velocity.

For a given initial impact condition, defined by projectile velocity and mass, the type of response of the plate is strongly affected by shaft length if perforation occurs, and the longer the shaft, the greater the shift of the response from a highly transient and localised response to a quasi-static type of response. In the case of rebound, the shaft length has negligible effect on the type of plate response. This is further confirmed by observing the time evolution development of stress waves and stress profiles across the plate span, including the timing of the stress profile switching between a characteristic highly transient response type profile to a profile typical of a quasi static response. All three critical failure strain values gave the same qualitative results, with the middle value being considered to be the most realistic.

Keywords*:* Impact regimes, response, stress profiles

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Non-linear Modal Behaviour in Cantilever Beam Structures

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Abstract

Modal analysis theory is based on linear assumptions, yet even relatively simple real structures exhibit non-linear (NL) behaviour. The objective of this work was to excite and detect NL modal behaviour in simple single and sandwich cantilevered beam structures composed of aluminium and rubber layers.

Standard modal testing and analysis was performed on all beam configurations using the impulse hammer excitation method, using a range of excitation force levels. The resulting Frequency Response Functions (FRF) were compared, as the main indicator of NL behaviour, most importantly by looking for changes in the peak amplitude and frequency for a given mode. A linear Finite Element (FE) model was used to give a baseline validation against static tests and modal test data using cases with the least evidence of NL behaviour, allowing the rubber layer properties to be modelled, at least for linear behaviour assumptions. All remaining beam configurations were then modelled using these material properties, and compared to test results in order to further identify NL behaviour.

The FE model showed no shift in peak amplitude or frequency for any mode for changes in the excitation force level, as expected for a linear model. All beam configurations showed evidence of NL behaviour from the modal tests, with the FRF modes peak amplitudes and frequencies shifting for changes in the excitation force level. All modes for all sandwich beam configurations showed decreasing peak amplitude and frequency, for increasing excitation force. The peak amplitude and frequencies for single beam configurations showed a mix response to increasing the excitation force, with some modes increasing, some remaining unchanged, some decreasing and some not showing any clear trend.

Key words: Modal analysis, non-linear, beams

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An Investigation of a Helical Gear Crack Used in a Crop Shear

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Abstract

This paper reports the results of an investigation into the crack of a helical gear used in a crop shear. Standard investigative procedures were employed in the analysis. It was found that the longitudinal running through the bore gear face width after quenching process. The chemical compositions indicated that the failed gear was made from low alloy Cr-Mo steel to AISI 4140 standard. The microstructure near the crack zone was a martensite phase. The micro-hardness values measured from the crack surface region to inside decreased from 729 HV to 489 HV at the depth of 2.5 millimeters respectively. And it was found that the hardness of inside the gear was almost the same at 486 HV.

It was, therefore, concluded that the cracks were caused by the casting process. The lesson learned from this case is that one must inspect the casting defect before machining station.

Keywords*:* Helical gear, Helical gear cracks, Longitudinal crack, Casting defect

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Design, Modeling and Analysis of Low Earth Orbit Satellite

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Abstract

This paper presents design, modeling and analysis of engineering qualified satellite model used for remote sensing. Detailed study is carried out for the design and modeling of the satellite structure focusing on the factors such as the selection of material, optimization of shape and geometry, accommodation of different sub-systems and payload. The center of mass is required to keep within the range of (1–2)cm from its geometric center, and that needs to be calculated theoretically as well as through Pro-E. Once the model is finalized it is required to be analyzed by the use of *Ansys*, a tool for finite element analysis under given loading and boundary conditions. Static, modal and harmonic analyses in *Ansys* are performed at the time of ground testing and launching phase. The finite element analysis results are also validated and compared with the theoretical predictions. These analyses are quite helpful and suggest that the satellite structure doesn't fail and retain its structural integrity during launch environment.

Keywords*:* Satellite, Design, Modeling, Analysis, Pro-E, *Ansys*, Static, Dynamic, Harmonic.

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Development of High-Durability and High-Sensitivity Glass Disk for Flying Height Measurement Process

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Abstract

In hard disks, flying height or the spacing between the read/write head and the magnetic disk has been greatly decreased to less than 10 nm to achieve high-density magnetic storage. Generally, the flying height is characterized in a flying height tester by measuring the interfered light from the head/disk interface whereas a transparent glass disk is employed instead of the magnetic disk. This characterization process easily causes the scratches on the glass disk resulting in a limited lifetime of the glass disk. Therefore, the first objective of this work is to improve the disk durability by employing a hard coating material of diamond-like-carbon (DLC) to increase its wear resistance resulting in lifetime improvement [1]. In the wear test, the wear depth on the disk coated with 3-nm thick silicon and 15-nm thick DLC was reduced by 92% as compared to that on the glass disk. In the disk lifetime measurement, the lifetime of the DLC coated disk can be significantly improved by at least 30 times as compared to that of the glass disk [1]. Furthermore, the sensitivity of the flying height measurement can be significantly improved by optimizing the configuration and the thicknesses of the overcoat layers. We demonstrated that the disk coated with 4 layers (silicon1: 1 nm, DLC1: 55 nm, silicon2: 3 nm and DLC2: 25 nm) has drastically increased the sensitivity in the flying height measurement at near contact (flying height: 0-20 nm) by 85% as compared to the measurement result using a commercial glass disk.

Keywords*:* Glass Disk, Flying Height, Flying Height Tester, Hard Coating, Diamond-like-Carbon

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Development of Durian Fiber-based Composite Material

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Abstract

This paper presents investigation on the development of durian (*Durio zibethinus*) fiber-based construction materials incorporating rice husk ash (RHA) as a supplementary cementing material. Investigation on the RHA included oxide analysis, X-Ray diffraction, surface area, fineness and particle size distribution measurements. In addition, scanning electron microscopy (SEM) of the rice husk ash was conducted. The bulk density, compressive strength and thermal conductivity of the composites at various conditions were determined. The experimental investigation reveals that the replacement of ordinary Portland cement with ground RHA of 10-30% could improve the compressive strength of the durian fiber-based construction material.

Keywords*:* Rice Husk Ash (RHA), compressive strength, thermal conductivity

Biomechanics

(BME)

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Injection Characteristics of Liquid Jet from a Needle Free Injection Device in the Tissue Simulant

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Abstract

This study aims to investigate the dynamics characteristics of liquid jet injected from a needle-free injection device by analyzing the the flow visualization from the high-speed video camera and the CFD calculation. This is to investigate the jet flow phenomena (e.g. penetration, dispersion, velocity) in the quiescent air and in the tissue simulant (20% polyacrylamide gel) as the further information to apply in the real tissues. The jet injection parameters, which are jet velocity, piston movement, and jet penetration in the tissue simulant, for the needle-free jet injection, are thoroughly investigated by using the high-speed video camera and CFD simulation. In the experimental visualization, a high-speed video camera was used to capture the jet flow phenomena in the medium which are the quiescent air and the 20% polyacrylamide gel used as tissue simulant. Jet injection into the air, both in an experimental and numerical visualization, it is found that when the liquid volume ejected is decreased, the jet velocity slightly increases, and the average velocity of piston movement during jet injection process is found to be steadily decay over remaining 0.15 – 0. 2 m/s after the high velocity pulse during the first 1-10 ms. The CFD results show good agreement to results from experiments both quantitatively and qualitatively. Injecting into 20% polyacrylamide, the jet can be captured by the high speed video camera. The penetration process which consists of three stages which are the threshold stage, the penetrative stage, and the dispersion stage can be revealed.

Key words: needle – free jet injection, CFD, tissue simulant

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Biomechanical Study of Thai Femoral Bone Fracture with Gamma 3 Long Nail: Finite Element Analysis

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Abstract

This study was aimed to evaluate the mechanical performance of Gamma 3 Long Nail in Thai femoral bone. A Three-dimensional CAD model of the nail was created from Computed Tomography (CT) scan, and then the nail was inserted in to the bone, by Virtual Simulation, into the intramedullary canal. Then the geometric mismatch between the nail and intramedullary canal were measured. Finally, the mesh model of the bone and the devices was created for finite elements analysis. The fracture zone was on the Mid-third region of femoral shaft. The strain on the femur and the stress distributed on the screw and nails were observed under walking conditions.

Keywords*:* Femur; Gamma 3 Long Nail; Healing; Stress distribution; Strain.

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Biomechanical Effect of Fin on Hip Prosthesis to Thai Femoral Bone

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Abstract

Cementless hip stem prosthesis was used to restore the femoral head. It can be divided into 2 model types: the hip stem with fin and without fin. The femoral bone model was reconstructed from a computed tomography and the hip modal was carefully created from CAD software by comparing with real shape. Hip prosthesis was inserted by virtual simulation into the femoral bone for the characteristics of actual surgery. Finite element analysis was used to determine the stress distribution on hip prosthesis and strain distribution on femoral bone under walking and stair-climbing condition. The results showed that the model with fin had less stress distribution than one without fin.

Keywords*:* Hip stem with fin, Hip prosthesis, Finite element analysis, Stress distribution.

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The Shape Analysis of Hip Prosthesis Inserted in Thai Femoral Bone: Finite Element Analysis

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Abstract

Hip prosthesis was used for the patients who has the hip fracture and unable to recover naturally. This study aims to analyses the six shapes different of hip prosthesis by finite element analysis. All model is cementless hip stem which were used to analyses simulating two of the most common physiological activities – walking and stair-climbing. The design of a hip prosthesis involves parameters which include neck size and lateral shape with the same size of ball diameters. The results showed that the neck size and lateral shape affected the stress distribution on hip prosthesis when inserted in the femoral bone. The maximum von Mises stress at the neck of model 1-3 were 260, 155 and 93 Mpa respectively and maximum von Mises stress at the lateral shape of model 3-6 were 29, 25, 20 and 22.5 MPa respectively. The large neck had less maximum von Mises stress than the small one. The lateral shape with a curved surface had a better stress distribution than the edge shape.

Keywords*:* Hip prosthesis, Finite element analysis, Shape of hip prosthesis.

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Development of Wear Test Machine for Dental Crown

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Abstract

Dental crown is a replacement materials used to repair the damage on human teeth which has been developed continuously. The wear resistance of the surface is one of the most important features. The resistance depends on the type of materials, the usage, and the environment which change constantly.

This research was aimed to study and develop wear testing machine of dental crown by simulating the oral motion, the load in the process of chewing, and the oral environment. By applying the method of pin on flat test with AC Servo Motor and microcontroller, the load control system was stable and responsive to where it can adjust the load accurately during the test. The machine was designed to test the surface that resembles the curve of the crown. The two axes were moved, mimicking the movement of the teeth in the oral cavity, which was moving one way and reciprocating by controlling oscillator movement of cyclic loading between 16 to 36 N, characterizing a sine curve with a load cell measured force and friction at 37^{o} C, pH = 7 and frequency of 0.5 and 1 Hz.

Wear testing machine for dental crown can be used to test the synthetic materials in dentistry for the suitable use at present and in the future.

Keywords: Dental crown, Wear test machine, Pin on flat.

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The Effect of Distal Femur after Replace with Biomaterials: Finite Element Analysis

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Abstract

Giant cell tumors are frequently detected at the lower end of thighbones (femurs). Surgery is the most effective treatment for these tumors. However, it is based on surgeons' experiences to remove the area of bones containing the giant cell tumors (excision) and then replace them with biomaterials. Finite elements analysis was employed in this study to analyze the maximum von Mises stress on different biomaterials at distal Thai femurs. The distal femoral bone models were divided into ten parts and then the different parts of the bones were replaced with biomaterials, namely Polymethylmethacrylate (PMMA) and Hydroxyapatite (HA). The stresses caused from the biomaterial replacements were analysed under walking and stair climbing conditions. In all conditions, the maximum von Mises stress of PMMA increased as the number of replacement increased while the maximum von Mises of HA gradually increased to the highest level in four parts replacement; then dramatically decreased in the latter five parts replacement; and became relatively stable in further replacement. Although the von Mises stress of HA reduced after five parts replacement, it was still higher than the maximum von Mises stress of PMMA. Therefore, HA might be better than PMMA in bone replacement since it could resist to higher force. Using HA could also minimize the bone excision which corresponds to the surgeons' decision. In addition, finite elements analysis seems to be a useful tool combining with surgeons' experience to validate a suitable biomaterial or an appropriate procedure for a better result in bone surgery.

Keywords: Distal Femur, Biomaterials, Finite Element Analysis.

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Biomechanical Effect of Nail Length to Thai Femoral Shaft Fracture

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Abstract

The intramedullary (IM) nail has been most frequently used to stabilize the surgical treatment of dia- and metaphyseal fracture. This study was aimed to use the IM nail to fix the femoral shaft fracture and conduct finite element analysis to determine the stress distribution on the IM nail and strain distribution on the fracture gap under walking condition. The IM nail was varied in 3 different lengths; 360, 380, and 400 mm from the proximal part. The result showed that the maximum von Mises stress on the IM nail was 480, 400, and 350 MPa. respectively. The longest nail showed the least stress distribution comparing to the others.

Keywords*:* Femoral shaft fracture, IM Nail, Biomechanics.

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Influence of Blending Carboxymethylcellulose with Gelatin Scaffold on Mechanical Properties

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Abstract

Biopolymer scaffolds fabricated by freeze drying process have been widely used for tissue engineering applications. We took the interest in using gelatin scaffold blended with carboxymethylcellulose (CMC) to improve the mechanical properties of the scaffolds. The CMC solutions were blended with gelatin solutions of 5 ratios and fabricated to porous structure via freeze drying process. The thermal crosslinking technique was used to induce conjugation of free amide and carboxyl groups in protein structures of the scaffolds. The swelling and mechanical properties of the scaffolds were characterized. Adding of CMC in gelatin scaffolds effected in both physical and mechanical properties. The scaffold which used gelatin and CMC in the ratio of 80 and 20, respectively occurred in the highest level of water absorption with the ratio of 44.67 ± 3.86. The result from mechanical test showed that GC82T scaffold dramatically increased in compressive modulus of the scaffolds (0.70 ± 0.07 kPa) with significant different compared to pure gelatin scaffold. The high level in swelling ratio of the scaffold can help the scaffold to maintain a porous network during *in vitro* cell culture because they have to immerse in surrounding media. The high value in compressive modulus of the scaffold can also help the scaffold to provide 3D structure while implanting in the body. This results suggested that the blending gelatin and CMC scaffold in the ratio of 80:20 (gelatin:CMC) had tendency to improve in mechanical properties of the scaffolds for applying in tissue engineering applications.

Keywords*:* carboxymethylcellulose; gelatin; scaffold; swelling; compressive modulus

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Hip Protectors: Comparative Study of FEM Simulation and Testing

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Abstract

The hip fracture is a serious problem especially for elderly. However, it can be prevented by using a hip protector. The purpose of this work was to compare the impact force reduction of four different cases of a bare femur (A), a femur covered with a soft tissue (B), and a femur covered with the tissue and a hip protector type I (C) and type II (D). The results were analyzed with the FEM. The impact test was performed by dropping a weight of 4.75 kilograms from a height of 52 cm on to a pelvis. The measured impact force was measured and readout directly from a load cell. It was found that the measured impact forces from A, B, C and D systems were 7,797, 5,561, 1,546 and 1,177 N, respectively. It can be compared with the force analyzed from the FEM of 7,535, 5,228, 1,927 and 1,424 N, respectively. Both results differ in a range of 200-400 N. Thus, the FEM was assured to use as a tool for a successful design of a high-perform hip protector.

Keywords*:* Hip, Hip fracture, Hip protector, femur, bone.

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Biomechanical Study of Proximal Femoral Fractures with Jensen's Classification under Walking Condition

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Abstract

The implant failure is the main cause of unsuccessful bone healing process which, has been commonly found in the patients who had applied weight bearing on their fractured bone before the healing process completed. The objective of this study was to determine the stress distribution on the Trochanteric Gamma Nail (TGN), when inserted in the femoral bone fractures according to the Jensen's Classification under walking condition. The result could be divided into 2 groups; stable (Jensen type 1 and 2) and unstable (Jensen type 3, 4 and 5). It showed the maximum von Mises stress at 294 and 298 MPa in Jensen type 1 and 2 and at 1,910, 1,050 and 3,000 MPa in Jensen type 3, 4 and 5 respectively. The proximal femoral fracture in unstable group should not receive the full load for a good clinical result.

Keywords: Jensen's Classification, Biomechanical, Proximal femoral fracture.

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Vaccine Storage Temperature Monitoring and Alert System

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Abstract

This paper describes the development of a low cost vaccine storage temperature monitoring and alert system. The system has to be cheap and can alert assigned personnel in the case of power failure or malfunctions especially during the off-hours. The first prototype of the vaccine storage temperature monitoring and alert system was built from off-the-shelf components to prove that the system concept can work successfully. The prototype consists of a digital thermostat for a sensor which is connected to a microcontroller board that sends a short telephone massage to responsible personnel via a general packet radio service (GPRS) module when the storage temperature is out of safe range. The system is powered by an uninterruptible power supply (UPS) and plugged in to the power grid. The first prototype is too expensive for remote hospitals (12,000 Thai Baht or 400 US dollar) but proves that the concept can work. The final system uses high-precision digital thermometer integrated circuit (Dallas Semiconductor DS18S20) as the temperature probe and then weather proofed with plastic tubing and acetic silicone sealant. The probe is read by an 8-bit microcontroller that can use wide tolerance power supply (Atmel AT89LP4052) and the microcontroller is used to drive four small relays (Fujitsu FTR-C1CA003G-01) through darlington drivers (Toshiba ULN2803AP-G). The relay contacts are then wired directly to the keyboard contact of a low cost cellular telephone (Nokia 1208). The power supply of the whole system is a telephone battery plugged in to a wall charger. The system can send a SMS to a telephone when the storage temperature is getting out of safe range, when the power grid fails or when the temperature probe did not response to the controller read command. The firmware for the controller is written in assembly language for compactness and is 1,047 byte long. In this configuration, the user needs to store the destination phone number and the massage in the telephone before operation. The system cost including assembly is 2,500 Thai Baht or less than 100 US dollar. With appropriate sensors and firmware programs, this type of system can be used to monitor many kinds of mechanical systems or processes at a very low cost.

Key words: Vaccines, Temperature, Microcontroller, Cellular Telephone

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Feasibility study on Lab-on-a-chip fabrication in Kasetsart University, Chalermphrakiat Sakon Nakhon Province Campus

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Abstract

This study presents problems and results in fabricating microfluidic devices for biological sample manipulation at Kasetsart University, Chalermphrakiat Sakon Nakhon Province Campus. Electrodes obtained from sputtering technique are used to produce dielectrophoretic force on the devices. The electrodes were fabricated with three different current conditions. The polydimethylsiloxane (PDMS) lab-on-a-chip (LOC) design from a literature was considered specifically as a microfluidic device prototype. The PDMS LOCs were fabricated manually at Chalermphrakiat Sakon Nakhon Province Campus but all components were prepared and fabricated at Nanoelectronics and MEMS Laboratory, National Electronics and Computer Technology Center. The PDMS LOC was aimed to use with biological samples and different frequencies of AC electric fields. From the LOC fabrication results, the higher current in electroplating process, the coarser electrode surfaces, the finished LOC with these electrodes showed problems in channels. The LOC fabricated locally and manually without using plasma cleaners is reassembly, considered as the main advantage. However, it is required skills and techniques to arrange all components to be on exact positions. This feasibility study shows that there is possibility to develop the LOC technology locally with helps from Nanoelectronics and MEMS Laboratory. The LOCs were also examined with two sets of biological samples, from the results, the different samples reacted differently with the electric field on the workable LOCs.

Keywords*:* polydimethylsiloxane, PDMS, lab-on-a-chip, LOC

Computation and Simulation Technique (CST)

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Element Adjustment for Crossover in Evolutionary Algorithm to Solve Continuum Topology Optimization

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Abstract

This paper presents element adjustment in crossover to prevent exchange between effective and useless bits in continuum topology optimization problems. The proposed idea is embedded into a selected multi-objective evolutionary algorithm, the improved strength Pareto evolutionary algorithm (SPEA-II). This idea can also be embedded any types of crossover, it is considerably used in one-point and uniform crossover in this paper. The tested problem is a heat conduction continuum topology optimization problem with 2-3 objectives. The proposed idea is investigated by comparing solutions of any crossover type from with and without the element adjustment. The performance criterion used in this paper is hyper volume (HV), which is a maximum criterion of multi-objective optimization. After simulation runs, by HV results, crossovers with the element adjustment are better than the normal crossovers in any crossover types. Especially, for uniform crossover, the element adjustment much improves performance of the crossover such as it can gain more average HV 2.90% and 23.15% for the problem with 2 and 3 objectives respectively. In addition, the element adjustment can enhance performances of crossover in the problem with 3 objectives more obviously than the problem with 2 objectives. In addition, this idea can also be applied to single-objective continuum topology optimization problems.

Keywords: Element Adjustment Crossover, Evolutionary Algorithm, Multi-objective Optimization, Continuum Topology Optimization.

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Implementation and Validation of Finite Volume C++ Codes for Plane Stress Analysis

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Abstract

The interaction between solid and fluid is an important and interesting subject for the present. In general, to simulate the interaction between solid and fluid, finite element method (FEM) and finite volume method (FVM) are used for analysis of solid and fluid respectively. The transformation of results between FVM and FEM has a disadvantage since it takes time to transfer data between FEM and FVM. The individual using FVM for analysis of solid and fluid can avoid transferring data and it is more stable when simulating complicated problems. This research presented the FVM codes using C++ to perform a plane stress analysis. The code was implemented using Open Source Software that was OpenFOAM. The written code was validated with plane stress problems as the test cases, which comprised the tension of thin rectangular plate with and without a circular hole at the center. The results of FVM were compared with the analytical solutions. From the results, the average difference between the FVM results and analytical solutions was less than 1.68%. These results suggested the potential of using FVM for stress analysis and it will be used for analyzing solid-fluid interaction.

Keywords*:* Finite volume method, Finite element method, C++, Stress analysis, OpenFOAM

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The Effect of Baffles on Fluid Sloshing inside the Moving Rectangular Tanks

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Abstract

Sloshing of fluid inside a container such as tanker trucks is the important phenomenon that develops pressure on tank wall which can cause structural damage or loss of the maneuvering stability. Decreasing the severe sloshing, the baffles are required to be included into the tank at appropriate locations. The FVM (Finite Volume Method) is the favorite method for analyzing the fluid sloshing. The effect of baffles on the fluid sloshing can be investigated using the computational models. This research improved C++ code of the fluid sloshing inside the movable tanks with and without baffles. These codes were implemented in the Open Source software that was the OpenFOAM. The computational results were validated with the experiment results which had a good correlation. The different results between simulation and experiment were digitized using the image processing techniques and had the average error less than 3.73%. This error can be proved that the computational method can be used to evaluate the effects of the baffles to control the sloshing of fluid inside the tanker trucks.

Keywords*:* Sloshing, Tank, FVM, Baffles, OpenFOAM.

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Placement Angle Optimization in Physical Vapor Deposition Process

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Abstract

To significantly improve the lifespan of tools, manufacturers have widely used many surface coating processes. By creating high-energy beam of coating particles or plasma ions, Physical Vapor Deposition (PVD) process yields hard coating film due to high adhesion. However, the good property of coat can be achieved only with uniform coat thickness. Coating companies rely on their experience in performing the coating process to get the even coat, which may not be enough when dealing with unfamiliar or large work piece. To address the problem, a computer simulation is used to determine the optimal placement angle of the work piece that yields the most uniform coat. The 3D model of PVD process with multiaxial substrate rotation is developed to predict the thickness of coat with parameters found from experimental coating data. Parameters are found to be dependent of oven and setup, the number of rotation axes, and distance from self-rotation axis. The genetic algorithm is used to perform the optimization with the range and the standard deviation of coat thickness as objective functions. Simulation results show that when compared to a common-practice placement, optimal placement angles can improve the range and the standard deviation of coat thickness by up to 66.9% and 51.7%, respectively.

Keywords*:* Physical Vapor Deposition (PVD) Simulation, Optimization, Genetic Algorithm

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Numerical Heat Transfer Study in a Square Channel with Zigzag-Angled Baffles

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Abstract

The article presents a numerical investigation on laminar periodic flow and heat transfer behaviors in a three-dimensional isothermal-wall square-channel fitted with zigzag-inline angled baffles having a constant length equal to channel height, (H) for six flow blockage ratios, (BR=b/H), and a pitch spacing ratio, *s*=L/H=2 and an attack angle, α=45°. The inline angled baffles are mounted repeatedly on the upper and lower channel walls to create longitudinal vortex flows throughout the test channel. The computations based on the finite volume method with the SIMPLE algorithm have been conducted for the airflow in the form of Reynolds numbers ranging from 100 to 1000. Effects of six different baffle heights on heat transfer and flow behaviors in the channel are examined. The computational results reveal that the maximum heat transfer is at *BR* = 0.30. For the given conditions, the maximum thermal performance enhancement factor (*TEF*) of the zigzag-angled baffle is found to be about 2.7 at *BR*=0.15 and Re=1000.

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Simulation and Test on Braking Performance of Electric Vehicle with Retrofit Solution of the Mechanical Braking System

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Abstract

In this study, a systematic procedure for mechanical braking system design is developed for the prototype of the electric vehicle which is modified from commercial car by replacing internal combustion engine with electric motor. A retrofit solution of mechanical braking system is designed as prototype to modify the conventional mechanical brake equipped with brake booster by adding the vacuum-assisted system consisting of vacuum pump, reservoir, relay switch, pressure sensor, and check valve to substitute the vacuum source from the internal combustion engine. To predict the braking performance represented by braking distance as well as deceleration, a vehicle model is developed in MATLAB. By means of a novel simulation method, the braking procedure of an electric vehicle with a retrofit kit of mechanical braking system can be simulated. Consequently, the braking distance and the deceleration depending on design parameters of an electric vehicle which affects the braking performance such as the change in weight distribution, the effect of ABS and EBD or road conditions can be estimated. To validate the simulation model and to ensure the reliability of the retrofit solution, several field tests based on the ECE 13 regulation is performed. This paper can be used as a guideline for one to develop an electric vehicle when considering about the braking system design. The results show that by using employed simulation model, the prediction of braking performance can be achieved. Nevertheless, the accuracy is to be improved.

Keywords: Braking Performance Prediction; Braking System Simulation; Vacuum-assisted Braking System (VBS); stopping distance; deceleration; ECE 13; Pedal effort; Brake force; Weight distribution; ABS

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Cavitations Analysis on Impeller Blades of Thai-made Irrigation Pump by Computational Fluid Dynamic technique

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Abstract

This research aims to study the cavitations on impeller blades of Thai-made Irrigation Pump. The diameter of mixed - flow impeller is 234 mm, tests at 900 rpm. Computational Fluid Dynamic technique (CFD) is used to predict the behaviors of the internal flow, the causes of cavitations and the area of cavitations occurrence on impeller blade. The cavitations occurrence is explain in terms of head at the exit, Net Positive Suction Head (NPSH), total head pump, pressure distribution and rate of vaporization at the different NPSH. Volume of Fluid (VOF) is the cavitations model which used to analyze and the Stepanoff's design parameters is used for the flow and in pump and on impeller blades. Boundary condition of total pressure is reduced until the cavitations occur. The result from CFD analysis shows that the cavitations occur in low pressure area, which causes high speed. The cavitations area starts from leading edge along to the tip. When NPSH is reduced, the cavitations area moves from leading edge to the trailing edge. The NPSH curve is lowered when cavitations number is more than maximum chord of impeller.

Key words: Thai-made irrigation pump, Cavitations, CFD.

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Combined Natural Convection of a Drink Can using Three-Dimensional Simulation

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Abstract

A drink can placed in a refrigerator is cooled by natural convection is investigated. In this study the full combined boundary layer system on the can wall is simulated. The cylindrical can filled with water (Pr=7.0) at temperature T_o=20^{o}C is located within a larger cylindrical container filled with air (Pr=0.7) at temperature T_a=5^{o}C. The container and can have the height-width ratio of 1 and 2, respectively. The walls of the can are very thin, hence, the assumption of zero thermal resistance at walls is used and the heat capacity in the walls is neglected. The outer container walls are maintained at constant temperature T_w=5^{o}C. The development of the flow and cool down of the fluid in the can is simulated by solving the governing Navier-Strokes and temperature transport equations using the commercial solver FLUENT. The study examines the placement of the inner can in two configurations. The first case has the inner can placed vertically and the second case has the inner can placed horizontally. Both of the cans placed in the middle of the outer container. The flow behavior of both cases will be presented. The numerical results show that the second case has a rate of cooling around 4.25% faster than the first case.

Keywords*:* Natural convection cooling, full combined boundary layer system, cooling rate.

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Energy Absorption Analysis of Various Vehicles under Crash Test Simulation

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Abstract

The analysis of energy absorption behavior under crash test simulation is presented as the initial part of the second weight reduction analysis project. The demonstrative crash tests cover the existing front and side impacts with three different segments of the public vehicle models. The objective of the vehicle crash simulation is to investigate the energy absorption in crash tests under the European New Car Assessment Programme (Euro NCAP) criteria. The energy absorption is a critical factor to estimate a safety level of passenger, therefore, the crash performance of three public FE-models of Ford Taurus, Chrysler Neon and Geo Metro is determined using LS-DYNA simulations. Obtained results from the simulations suggest that the segment of the vehicle model has a significant effect not only on the energy absorption but also intrusion of occupant cell.

Keywords*:* analysis of the energy absorption, energy absorption behavior, vehicle crash simulation

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A Numerical and Experimental Measurement in a Dynamic Strain Response of an Electric Bus Body Structure

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Abstract

In this paper, a structural analysis of a medium-sized electric (EV) bus is proposed. Due to an increasing demand of bus transport in Thailand, a numerical technique called Computer-Aided Engineering (CAE) has now become a necessary tool in a bus analysis for verifying the strength of a structure and predicting any potential problems. Generally, computational modeling of a bus is often investigated via the use of finite element analysis in comparison with strain responses that are experimentally measured by strain gauges at various locations during a test run. In this study, a numerical analysis was carried out on both chassis and body structure of an 8m-bus prototype which was purely powered by electricity. A computational model of the bus structure was consisted of shell and beam elements for chassis and body structure respectively. Linear springs were applied on the chassis model to represent actual suspension components such as leaf spring and air bellows in order to give the computational model a dynamic response in various driving conditions. A bumping test where the bus was driving pass a single speed bump with a front axle followed by a rear axle was considered in this study. A maximum stress of 10.97 MPa and a maximum deviation of 17.35% compared to experimental results were calculated to occur at a front section of the chassis where front chassis side-rail members and battery compartment were connected. Furthermore, the results from this study could be used as a guideline to an EV bus design in Thailand by giving approximated solutions to examine strength of the bus body structure.

Keywords: Electric bus, Computer-Aided Engineering, Linear spring, Dynamic response, Speed bump

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AFM-Based Manufacturing for Nano-fabrication Processes: Molecular Dynamics Simulation and AFM Experimental Verification

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Abstract

Recent developments in science and engineering have advanced the fabrication techniques for nanodevices, including the use of atomic force microscope (AFM) for nanomachining and nano-fabrication of nano-structures. AFM-based manufacturing generally involves nanoindentation and nanoscratching processes. This paper describes the development and validation of computational models for the AFM-based manufacturing for nano-fabrication processes. The Molecular Dynamics (MD) technique is used to model and simulate mechanical indentation at the nanoscale. MD simulation represents itself as a viable alternative to the expensive traditional experimental approach, which can be used to study the effects of various indentation variables including tool shape, indentation conditions, and material properties in a much more cost effective way. The simulation allows for prediction of the indentation forces at the interface between an indenter and a substrate. Also, the MD simulation is used to study the effects of speed on the indentation force. The material deformation and indentation geometry are extracted based on the final locations of atoms, which are displaced by the rigid indenter. In addition to modeling, an AFM was used to conduct actual indentation at the nanoscale, and provide measurements to validate the predictions from the MD simulation. It can be observed from the MD simulation results that the indentation force increases as the depth of indentation and tip radius increase, but decreases as the tip speed increases.

Keywords*:* Molecular Dynamics, MD Simulation, AFM-based Manufacturing, Nanoindentation.

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Computational Analysis of SAR and Temperature Distributions in Human Body Exposed to Microwave

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Abstract

The utilizations of microwave are used in many industrial and household applications because of the several advantages of the microwave heating source. There is concern about the human health from the leakage microwave because the high power in range several MW of industrial microwave can damage some tissues in human body. For many years, hyperthermia and the related radiometry have been a major subject of interest in investigating biological effects of microwave. The 2-D computational analysis is used to study the distributions of SAR and temperature increase on tissue organs in human body using the Finite Element Method (FEM), the SAR and temperature distributions of nine organs in human trunk are calculated. The influence of frequency, electromagnetic mode of propagation, power of heating source and time exposure are investigated. It is found that the maximum SARs and temperature increases are proportional to the power of heating sources. The low frequency of microwave can penetrates through the human body deeper than that of the high frequency. The microwave which is propagated different electromagnetic mode of propagation, TE and TM mode, cause the different SAR and temperature increase in human body at each frequency and power of heating source.

Keywords*:* computation, TE and TM mode, SAR, temperature increase, microwave

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Study on an Ideal Elastic Deformation of Flapping Wing Due to Some Ribs by Finite Element Method

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Abstract

In this paper, we present the structural deformations, which will be highlight the information of an ideal elastic deformation for development the fluid applications in future. The flying insects, birds, and aquatic animals fly and swim skillfully by controlling a flow field around their body using their wings or tail flukes of complex shape and their elastic deformation. Since. the insect have been evolved and perfected their flight, making them the most agile and maneuverable creatures for their size today. Hence, many researchers attempt to mimic these characteristics of the insect flight, and construct a small flapping robot or MAVs for performing the special missions. However, the flow field around the moving elastic body is treated as a coupled problem of fluids and structures (Fluid Structure Interaction Problem, FSI). Furthermore, there are a variety of the phenomena with applications in many areas. The flying robot is only one of the applications on the fluid-structure combination working. For solving FSI problems, 3-D structural deformations largely and complexly have been very difficult to resolving these deformation with making the structural function deforming. Hence, We were going to carry out the elastic deformations of the wing structures by the finite element method (FEM). In addition, we varied a simple wing structures with three cases of the wing structures. In the analysis of the flow around flapping rigid wing, we found, that the butterfly robot obtain lift by flapping wings, caused to making vortices also, and a pair of large-scale vortices is formed on the wing tip. Lift and Drag are changed with the flapping wing position very well. Moreover, in the case of structural analysis, some ribs included with main spar on the wing structures could control the wing deformation. In particular, the maximum deformation occurs at the trailing edge on the membrane.

Keywords*:* Finite Element Method, Flapping Elastic Wing, Structural Flexibility, Wing Deformations

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Novel Boundary Conditions for turbulent flows enclosed by porous media

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Abstract

In this paper we present the new boundary conditions for the turbulent flows enclosed by porous medium. Such flows play a crucial role in many areas such as filters, oil wells, heat exchangers, catalytic reactors, ground water pollution, scouring and deposition of pollutions at river bed. Since the porous media always consist of multi-scale structures starting from the dimension of the porous medium itself down to pore scale. Resolving all of these structures is too expensive considering the uncertainty of the porous media geometry representation. Under certain conditions, the effects of the porous media to the turbulent flows can be modeled as boundary conditions. However, the approach adopted in [1], [2] and [3] lacks some physical property of the flow at the porous media interface because in those works, either the slip velocity or the interface-normal velocity is assumed zero. The boundary conditions proposed in this work, are validated against the pore scaled simulation in which the whole porous media are resolved. The proposed boundary conditions deliver excellent normalized mean velocity and fluctuations. The numerical simulation using boundary conditions only uses 0.92 Million grid cells and it is computed on a simple workstation compared to 230 Million grid cells of the pore scaled simulation which is computed on a cluster with 512 nodes. The proposed boundary conditions allow accurate predictions of such flows to be accessible by the computing resources available in Thailand.

Keywords*:* boundary conditions, turbulent flows, direct numerical simulations, flow over porous interface, multi-physics

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Modeling of Human Sensation and Prediction of Passenger Ride Comfort

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Abstract

This article presents a systematic procedure and Artificial Neural Networks (ANN) based tool for passenger ride comfort objectification, to support vehicle developer during the product development process. In this case, the term “comfort objectification” can be clarified as reproduction of subjectively sensed convenience of a passenger through objectively measurable values. Many factors, such as noise, vibration, physical or psychological condition of a passenger generally influence the ride comfort. The main purpose of this project is to develop vehicle assemblies which can sustain customer demand of vibration comfort. The presented methods and tools enable the identification and the evaluation of vehicle dynamic properties from the passenger point of view during vehicle travel in the early stage of the product development process. To estimate the subjective passenger sensation, the new driver modeling tool based on ANN is developed from the way individual drivers make their assessment. This paper presents a user-friendly interface which allows both experts and users who are short of experience in the ANN field, to create different network architectures depending on given task. By means of this tool, the modeling process can be effectively simplified and shortened. As a result, the objective values captured from experiments are efficiently correlated with the subjective sensation. Consequently, the high performance of comfort prediction can be achieved.

According to the approach of virtual drive train development, in this study, the transmission test bench is primarily used to generate several virtual operating situations. This enables the determination of NVH properties of the future product, such as a transmission, and allows the developer to investigate the effect of vibration like on the degree of ride comfort. By applying objective data from the experiment, a prediction of comfort assessment using the presented tools can be executed. In the long run, costly field tests and cost-intensive prototypes can be partially replaced.

Keywords: Passenger Ride Comfort, Comfort Objectification, Vehicle development, Virtual Drive Train, NVH, Artificial Neural Networks

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Design and Analysis of Clutch Housing Prototype for One Cylinder Diesel Engine Direct Clutch System

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Abstract

In this work, a design of clutch housing for one cylinder diesel engine in an agricultural truck or E-TAND using CAD and CAE was carried out. A CAD model was analyzed by using finite element method ANSYS® software. The analyses were consisted of structural stress and fatigue life analysis by converting vibration profile into corresponding forces which were used as a load parameter. In order to collect relevant load profiles, an experiment was set up to measure vibration amplitude by the engine using accelerometers. Moreover, an optimization technique was used to find an optimum design of a clutch housing suitable for one cylinder diesel engine application. Overall design frame work, concerning design problem, load collecting experiment, and computational analysis results were reported and discussed. After achieving the goal of design, all parts will be ready for prototype manufacturing and assembly for a direct clutch system in an agricultural truck.

Key words: Finite element analysis, Stress analysis, Design optimization

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The effect of blood flow past a stenotic carotid artery by using Computational Fluid Dynamics

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Abstract

This research presents the analysis of blood flow passed vessels that are clogged with fat**.** Blood flow unsteadiness is due to the heart-imposed temporal variations which occur during cardiac cycle. This study focused on the effects of the Newtonian and Non-Newtonian blood's flow behavior that computed by using both Laminar and Turbulence (k-Ɛ model) flow. The results can show the effects from various blood's flow analyses that provide the different wall shear stresses. Consequentially, the tendency of potential risks that caused by the plaque rapture can be predicted more accurately and used as a supportive tool for the artery stenosis diagnosis as well.

Keyword: Blood Flow, Stenotic Sarotid Artery, Analysis of Blood Flow

Dynamic System, Robotics and Control (DRC)

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H∞ Robust Control via Singular Value Decomposition as a Design Tool for Continuous Dynamic Systems

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Abstract

We present a novel generic tool to design the shape and location of an actuator for continuous elastic dynamic systems, i.e. essential properties of the actuators in order to generate a desired state profile. The main idea of the research is to generate an approximation via reduction of the number of actuators by using the singular value decomposition (SVD). SVD is a powerful and elegant method for data analysis aimed at obtaining low-dimensional approximation of high-dimensional data. We implement our work on the structural dynamics of a clamped elastic beam. By the use of Finite Difference Method (FDM), we divide the beam into discrete elements. Each element has the ability to translate and rotate with respect to the surrounding elements. By implementing the theory of robust H∞ control, we obtain the optimal control law with respect to the worst exogenous input. This and the use of SVD enable us to approximate efficiently the number of actuators needed. Thus enabling us to reduce the number of actuators that are necessary in order to obtain a desirable state profile with a robust control law.

Keywords: Finite Difference Method, Singular Value Decomposition, H∞ control

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INTELLIGENT TRACTION CONTROL SYSTEM OF AN ELECTRIC GOLF CAR: Nonlinear Dynamics Investigation

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Abstract

Intelligent traction control system of an electric golf car has been developed by using the experience of the traction in order to maintain the golf car traction as required with utilizing optimum power. Compared with conventional control approach, fuzzy logic approach is more efficient for nonlinear dynamic systems and embedding existing structured human knowledge into workable mathematics. The purpose of this study is to investigate the relationship between vehicle's input parameters of power supply (PI) and moisture content (MC) and output parameter of traction force (TF) and Power Consumption (P). Experiment has been conducted in the field to investigate the vehicle traction and the result has been compared with the developed fuzzy logic system (FLS) based on Mamdani approach. Results show that the mean relative error of actual and predicted values from the FLS model on TF is found as 7.68 %, which is less than the acceptable limit of 10%. The goodness of fit of the prediction value from FLS is found close to 1.0 as expected and hence shows the good performance of the developed system.

Keywords*:* Golf car; Nonlinear intelligent traction system; Fuzzy logic system; power strategy

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Design and Development of a Remotely Operated Vehicle

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Abstract

This paper describes basic design and development of a mini remotely operated vehicle. It is a custom designed and built vehicle, measures 320mm wide, 500 mm long, 250mm high and it weighs approximately 15kg in air. This underwater vehicle will be used for surveillance and maintenance application. The cylindrical pressure hull with clear acrylic nose has been designed and fabricated, creating efficient use of space to fit electronics unit alongside the camera. Four thrusters for the propulsion system are newly designed and layout, providing surge, heave and yaw motions. Various controls have been built; the 8 bits microcontroller, supplemented with custom power management PCB. Sensing is undertaken through the use of a colour camera, an electronics compass, a pressure sensor and off-the-shelf inertial measurement unit. Two 12 Volt 7.2Ahr lead-acid batteries make up the power for entire system to extend the working range to approximately 1 hour. Implementations of basic movements were done in the pool and at sea.

Keywords*:* ROV, Underwater, Applications

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Robust Controller Design for an Autonomous Underwater Vehicle

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Abstract

This paper presents a robust sliding mode control technique applied to an autonomous underwater vehicle. The sliding mode control is one of the most common nonlinear feedback controller design based on the Lyapunov analysis. Two common decoupled subsystems of an autonomous underwater vehicle are detailed. The role of the sliding mode control for the decoupled systems is to drive the system towards the designed slide surface and keep it on it. Therefore it is able to improve a capability to track the desired state of the proposed autonomous underwater model. Simulations of the heading and depth controls are demonstrated in this paper. The results have shown that the sliding mode control is able to provide accurate control for the system with small steady state errors.

Keywords*:* Robust control, Sliding mode, Autonomous Underwater Vehicles

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Design and Analysis of a Two-Degree of Freedom Cable Driven Compound Joint System

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Abstract

A prototypical two-degree of freedom compound joint system has been designed to imitate the pitch and yaw motion of a human shoulder. Several design criteria are listed. One of them is to achieve the clean motion. Notable cable-pulley power transmission mechanism can provide this desired characteristic and thus has been adopted. It possesses two stages of reduction, with the gear ratio of 3:1 for each of them. Together with the selected D.C. motors, the robot is capable of withstanding the payload of 10 kg at the distance 315 mm from the shoulder center. Due to kinematic constraints, the motion range is limited to $\pm 65^{\circ}$ for pitch and yaw degree of freedom.

Mathematical model of the system has been developed based on the Euler-Lagrange formulation. In addition, we have employed the bond graph modeling framework to provide the systematic and unified formulation of the equations. Important dynamical effects are taken into account, particularly the compliance and the loss in transmission. This model will be useful for future control and simulation purposes. As a verification of the correctness of the proposed model, two simulations are conducted and their results are discussed.

Keywords*:* shoulder joint, cable-pulley driven robot, flexible joint robot model

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An iPhone-Based Device to Give Surrounding Area Information for Guiding Tourist or Aiding Visually Impaired

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Abstract

The data from National Statistics Office (NSO) of Thailand show that 543,332 people in Thailand are blind or visually impaired (2007). Even though, many navigation devices are made for visually impaired people, the vast majority of the devices are expensive and available only in some country. Therefore, iPhone, which is one of the most popular GPS-enabled smart phones today is selected as a platform for the development of the navigation system for the blind and visually impaired.

The navigation map is limited to 500 acres of Mahidol University, Salaya Campus. This navigation devices is not only used by a visually impaired person, but can also be used for a self-guided audio campus tour. By pointing iPhone to any direction of interest, it can give information of the building in the nearby range and provides distance, direction and information of the building on screen and voice.

To identify a distance and a direction of a building to the user, a novel navigation algorithm for local area, where a building or place cannot be represented as a point, was developed. The algorithm includes two main parts. The first part is a marking process, in which multiple points are manually selected to represent corners of the area encloses a building or place. Then the centroid of the area is calculated and used as the center of the building to determine the location of the building with respect to the user. The second part is a navigation algorithm, which determines a nearby building in each direction by splitting the area around the user into 4 sections with an X shape. In case that an area of a building fall into multiple sections, the algorithm can determine the direction of the building or inform that the user is already inside the building correctly.

Key Words: GPS Navigation, Visually Impaired, Blind, iPhone-Based, Visual Aids

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Sliding Mode Control for Humidity and Temperature Control in an Evaporative Cooling System of a Poultry house

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Abstract

This paper presents a control method based on the well known sliding mode control for temperature and humidity control in an evaporative cooling system of a poultry house. The control method can compensate for changing of ambient air condition of the house. A control law of the method was designed from mathematical models which are mass and energy balance relations of air and water of the system. To validate the mathematical model, its responses were compared with a real system. And the model was simulated in case of summer condition to study its behavior and demonstrate ability of the proposed control technique.

Key words: Sliding mode control, Evaporative cooling control, Poultry house

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Communication Design of Human-Hardware-In-the-Loop simulator (HHILs) for Steer-by-Wire Testing

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Abstract

Steer-by-Wire (SBW) system offers a number of benefits over conventional steering systems such as handling performance and safety. This system uses the electrical connections between the steering wheel and the vehicle's wheels instead of mechanical ones. But there are still concerns such as reliability and its interactions with drivers. To test a SBW system, a test rig with both Hardware-In-the-Loop and Human-In-the-Loop is desirable. This can decrease error from complicated model such as the tire force generation and can test interaction between the driver and the proposed SBW system. This paper presents the development of Human-Hardware-In-the-Loop (HHIL) system which designed to test SBW systems. This system combines a driving simulator and a hardware that consists of tire, suspension, and steering system. Choosing and testing of the system architecture, especially the connections and communications between various components such as the steering hardware, a car dynamic simulator, the virtual environment simulation for the driver, a number of hardware controllers and sensors, is the main concerned in this paper. The system must also work with a low level hardware controller which is an NI CompactRIO system chosen for its I/O flexibility. Choices of the car's dynamic simulator are either a digital signal processor board (DSP board) or a PC running real-time program (xPC). A dedicate PC is also chosen for rendering visual environment for the driver and also to keep and supply data of the environment. Various system architectures are considered and two communication schemes which are the RS-232 and the TCP/UDP are tested. The final selected design with all components, signals, and communication methods are presented.

Keywords: Steer-by-Wire (SBW), Hardware-In-the-Loop, Human-In-the-Loop, Human-Hardware-In-the-Loop (HHIL)

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Study on Driving Behavior in Follow State Driving Condition in Bangkok

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Abstract

Since, each driver has his/her individual characteristic. This will lead to different driving behavior which significantly affects to the safety on the road and also traffic system. Nowadays, driving behavior is considered in designing active safety systems. Thus, the objective of this experiment is to study on driving characteristic by using drive recorder. The study was conducted concerning the follow state (car-follow-car situation) driving characteristic focus on Bangkok driving. The specific urban route had been chosen and experiment time is fixed to obtain data from a similar traffic condition, participants in the same range of age [20-30] performed an experiment on the same vehicle. The data were collected by using drive recorder to collect velocity and video capture in order to apply image processing technique. Image processing is the technique to calculate distance by transforming perspective view from video into bird's-eye view so distance can be measured directly. The terms called headway distance and time headway is investigated. Headway distance is the distance between experiment vehicle and preceding vehicle, obtained by image processing technique. Time headway [sec] is obtained from headway distance divided by velocity of experimental vehicle, then use time headway to conduct histogram comparing the occurrence of driving time headway of each driver. For the result, time headway range of participants is around 0.5-1.5 sec. with peak at 1 sec. Note that lower time headway may lead to frontal accident also.

Keywords*:* Follow state driving, driving behavior, drive recorder, image processing, time headway

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Air-Path Control in Diesel-Dual-Fuel Premixed-Charge-Compression-Ignition (DF-PCCI) Engine Using Supervisory Fuzzy System

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Abstract

DF-PCCI engine is a type of diesel-dual-fuel engines. DF-PCCI engine, patented by PTT, uses new combustion strategy corresponding to Premixed-Charge-Combustion-Ignition (PCCI) combustion mode. Diesel injection is advanced till early of the compression stroke along with nature gas (compressed natural gas, CNG) is injected in the intake ports of each cylinder before intake valve close (IVC). Two quantities, mass fresh air flow rate (MAF) and intake manifold absolute pressure (MAP), are controlled in the air-path of the engine. Their set-points vary with wide ranges and with more abrupt changes than those of diesel engine. The engine is in need of an accurate and sophisticated air-path control system to achieve beneficial PCCI combustion efficiency. The system identification presents that throttle has primary effect on the MAP, and Exhaust Gas recirculation (EGR) valve has primary effect on the MAF. However, since throttle has secondary effect on the MAF, and the EGR valve also has secondary effect on the MAP, this so-called actuator interaction problem has to be considered in the control system design. Accordingly, the fuzzy supervisory control system is applied for the MAF and MAP tracking control.

The DF-PCCI engine, modified from a Toyota 2KD-FTV diesel engine, was connected with AVL engine test-bed and performed on New-European Driving Cycle (NEDC). The MAF and MAP tracking results showed excellent performance and enhancement by the proposed control system.

Keywords*:* Supervisory Fuzzy control, Air-path control, Diesel-dual-fuel engine, Engine control. *ddison-Wesley Longman, Inc.*

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Design of Driving Simulator for Studying Vehicle Rollover

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Abstract

Generally, vehicle dynamics is studied by the simulation and experiment test. The simulation is used in early design and development stage to reduce development cost and time. Simulation is safer for the test driver, especially when testing may result in severe motions such as rollover. Therefore, experiment is mainly used only for confirmation. In this research, Driving Simulator (DS) for testing vehicle roll motion is presented. The proposed has 2 degree-of-freedom which consists of pitch and roll that can also be used for longitudinal and lateral acceleration simulation. DS was designed based on human motion perception.ual reality motion. The DS was design to have roll and pitch axes at the driver's head position to minimize the driver's head from moving from the pitch and roll motion. The motion and force analysis are presented in this paper. These analyses were carried out both manually and with computer program. Range of motion, actuator force, and required stroke was adjusted by moving various joint positions. Finally, actual measurement is made and compared with the design values.

Keywords*:* Driving Simulator, Human Perception, Rolloverts, *Research report 2006*

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Design and Construction and Motion Control of 6-Axis Robot Manipulator for Industrial Applications

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Abstract

In this research, a 6-axis robot manipulator arm is designed and constructed for industrial applications. Then, the robot arm motion is controlled in a position mode by users' specified angular motion of each joint so that the robot arm can move to desired locations with high accuracy even with load variation and repeatability less than 10 micrometer. A motion control has been developed within Visual C++.NET to control individual or combined joints' position, velocity, acceleration. The purposes of this robot-arm motion-control implementation are to accelerate users' learning process and to interact with the industrial robot in a user-friendly environment.

Keywords*:* Industrial Manipulator Arm, Motion Control Software, Accuracy and Repeatability. Thailand.

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Frequency Characteristics and Explanation of Notches Seen in Frequency Responses of Vehicles

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Abstract

The dynamics of vehicles has been widely studied since 1960s. Tremendous efforts have been spent to understand the dynamic behaviors of vehicle systems. Typically, the responses in the time domain and in the frequency domain are the primary validation techniques used to achieve this goal. In the experimental frequency characteristics of a vehicle, particularly the frequency responses from the front road-wheel steering angle to the lateral velocity, to the yaw rate, and to the roll rate, a unique characteristic similar to that of a notch filter can often be observed. Moreover, the cause of this characteristic is slightly known. Although high-order vehicle models can simulate this characteristic, there still is a need of a less-complex model to describe this characteristic. This work is the first effort to understand this characteristic through a low-order linear vehicle dynamic model. A vehicle dynamic model called the roll dynamic model is proposed in this work. Not only can the proposed model explain the cause of this notch characteristic, but also significantly improve the behavior matching to the experimental data once compared to the matching of the typical “bicycle model”.

Keywords*:* Vehicle, Vehicle Dynamics, Vehicle Modeling, Frequency

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Development of Guide Robot by Using QR Code Recognition

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Abstract

In this paper we describe the development of guide robot by using QR code (Quick Response Code) recognition. We propose to use a QR code as a landmark of a guide route and implement the navigation system that can perform the autonomous run throughout the guide route by using real-time QR code recognition. By the experiment, it is shown that an autonomous guiding function was achieved. The average deviation gap from the ideal guide route was 6.29 cm. As a result, the effectiveness of the proposed system is confirmed.

Keywords*:* Guide robot, QR code, Navigating system, Autonomous

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Dynamic Simulation of Three High Rolling Mill Run by Two Prime Movers

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Abstract

This paper presents the static and dynamic analysis of three high rolling mills run by two prime movers. The rolling mills normally reduce the billets of (100 mm x 100 mm) size to 12 mm round in 12 - 21 successive passes. The static and dynamic power requirement of the rolling varies from 100 Hp to 800 Hp depending on the product being rolled and the size of input billets. In this paper a computerized simulation model was given for analyzing the dynamic response of the mill, studying the loading pattern and its statistical distribution. The dynamic response was calculated in terms of flywheel energy requirement which in turn can be represented in terms of fluctuations in angular speed of flywheel. The drive system suggested can comprise of a combination of two prime movers which can supply the desired power to the system singly or in combination. This analysis is helpful for all the designers of the rolling mills for optimizing the power consumption in the rolling mills.

Keywords*: Static, Dynamic, Prime Mover*

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Optimal placement of solar farm on the power system network

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Abstract

Nowadays, solar energy is a main green energy source which can reduce green house gas emission. Solar panel produces electricity by using the natural light power from sun and convert solar energy to direct electricity current during daytime. The solar energy is a clean and sustainable source, it does not produce emission of pollutants and it will never run out as it is constantly replenished by energy from nature.

Small scale solar panel can be used in domestic, community and smaller solar energy projects can be stand-alone or grid-connected systems. Stand-alone systems are used to generate electricity for charging batteries to run small electrical applications, often in remote locations where it is expensive or not physically possible to connect to a mains power supply. With grid-connected from PV solar farm can directly connect to the existing mains electricity supply by using modern inverter circuit which is known as STATCOM. It is composed of six insulated gate bipolar transistor (IGBTs) in a matrix with its snubber circuits and is used to generate real power output during daytime. A grid-connected solar farm can be a good proposition if consumption of electricity is high during daytime, and it is clean energy resource.

In this paper, PV solar farm is utilized as a STATCOM which perform voltage control to improve system performance and can directly connect into a power system topology. An optimal placement of solar farm on the power system topology is proposed aiming to minimize fuel and emission costs of overall system. The multiobjective bees algorithm (MOBA) is used to minimize simultaneously fuel cost and emission of thermal units by changing location and varying sizes of solar farm with security constraints of power system. We employ IEEE 30 bus system to verify the proposed method. The results show that the proposed method found the optimal position of solar farm with minimum cost of fuel and environmental pollution.

Keywords: Solar Farm, Power System, Multiobjective bees algorithm (MOBA).

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The Quasi-steady State Performance of a Solar-Biomass Hybrid Cooling System

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Abstract

The world is currently confronted with challenges of energy crisis and global warming. To address these serious problems, renewable energy is one of the major options. Solar energy along with biomass utilization is a win-win solution. This paper reports on the experimental study of a solar-biomass hybrid air conditioning system. The study aims at developing a fully renewable energy based air conditioning system and assessing the feasibility of this new hybrid system. The experimental data demonstrates that when the chiller was operated at about 75% of chiller nominal capacity its coefficient of performance was about 0.6. To compare the performance of solar cooling system with different driving energy sources, the experimental results of three modes of operation, with the same operating parameters and almost the same weather conditions, were compared. The comparative study results show that the proposed system can be operated with higher reliability and performance compared to the conventional systems which operate with and without auxiliary heater. Therefore, application of a solar-biomass hybrid air conditioning system is promising in tropical locations.

Keywords*:* Solar; Absorption; Biomass; Cooling; Hybrid.

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Towards Commercialization of Alternative Biofuel: Improving the Stability of Pyrolysis Liquid by Physical Fractionation

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Abstract

Amidst climate change and global energy crises, the need for renewable and low-carbon fuels is increasingly dire. Many fuels derived from biological sources have emerged as promising contenders, due to their low-carbon life cycles, comparable performance to conventional fossil fuels, and prospects of being produced from domestic feedstock. Besides already commercialized biodiesel and bioethanol, alternatives such as pyrolysis liquids are also gaining momentum. Pyrolysis liquid, also known as bio-oil, is a dark brown, free-flowing organic liquid that is a product of fast pyrolysis, which is rapid heating of biomass in the absence of air. The use of bio-oil in boilers and engines has been shown in several studies, and it was estimated by the International Energy Agency to be the lowest-cost liquid biomass-based fuel. Nonetheless, before commercialization, certain aspects of bio-oil's quality, especially its storage stability, need to be improved. The inherently low stability of bio-oil is tied to its "aging" during the storage period when bio-oil experiences phase separation and increasing acidity and viscosity. Previous studies suggested that removing bio-oil's light compounds, which participate in aging reactions and could pose problems when used in engines, would improve the bio-oil's stability. The objective of this work is, thus, to improve the stability of bio-oil by physical separation and removal of the light-compound fraction. The work endeavored to maximize the yield of more stable bio-oil and removal of light compounds, while trying to minimize the amount of time, energy, and resources required. Combinations of different processes, such as liquid-liquid extraction and vacuum evaporation, were tested, and key conditions were varied and analyzed. The results showed that fractionation using water as an extracting liquid, which is a relatively cheap resource, at a water-bio-oil ratio of 5 vol% could effectively remove the light compounds from bio-oil and improve its qualities.

Keywords*:* bio-oil, pyrolysis fuel, stability improvement

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Thermal Behavior in a Square Channel with Angled Ribs

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Abstract

This research presents a study of heat transfer enhancement and pressure drop in a square channel heat exchanger fitted with 45° and 90° inclined ribs. The rib to channel height ratio (*e/H*) of 0.1 and the rib pitch to channel height ratio, *PR*=1, 2 and 3 are introduced in the present work. The tested channel has a constant wall heat flux condition. The experiments are carried out by varying airflow rate in terms of Reynolds number ranging from 4000 to 26,000. The experimental result of heat transfer in the form of Nusselt number and pressure drop in terms of friction factor are compared between the channel mounted with inclined ribs and the smooth channel. The inclined rib with PR=1 gives higher heat transfer rate and friction factor than the one with PR=2, 3 and the smooth channel respectively the rib with 45° provides the higher value of heat transfer and pressure drop than 90° for all rib pitch ratio.

Keywords: inclined ribs, Nusselt number, friction factor, square channel.

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Effect of Inclination Angle on Heat Transfer in a Square Channel with U-Shaped Ribs

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Abstract

The paper presents a study of heat transfer in a heat exchanger square channel inserted with 20°, 30° and 45° angled, U-shaped ribs. The test channel has a square section with uniform wall heat flux conditions. The fluid flow and heat transfer characteristics are presented for Reynolds numbers based on the hydraulic diameter of the channel ranging from 4000 to 25,000. The U-Shaped ribs with axial pitch equal to three times of channel height and two rib-to-channel height ratios e/H = 0.1 and 0.2 are introduced. The experimental result of heat transfer in terms of Nusselt number and pressure loss in terms of friction factor are compared between the inserted channel and the smooth channel. The U-shaped rib with the attack angle of 45° gives higher heat transfer and friction factor than the one with the attack angle of 30°, 20° and the smooth channel. It is worth noting that the heat transfer and pressure loss for the rib with e/H = 0.2 provides higher Nusselt number and friction factor than these with e/H = 0.1 for all rib angles.

Keywords*:* turbulator, angle rib, square channel, U-Shaped rib, pressure loss

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Heat Transfer Behavior in a Solar Air Heater Channel with V-Shaped Ribs

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Abstract

The research work presents the study of heat transfer enhancement in a solar air heater channel fitted with V-Shaped ribs. The experiments are carried out by varying airflow rate for Reynolds number ranging from 5000 to 25,000 in the test section with a constant surface heat flux on the upper plate of the channel which is similar to a solar air heater channel or solar collector. The V-shaped ribs with a transverse pitch value equal to two time of channel height and with the attack angle of 30° are mounted on the upper plate only. The effects of five rib to channel height ratios (e/H) of 0.05, 0.1, 0.15, 0.2 and 0.25 on heat transfer in terms of Nusselt number and friction loss in the form of friction factor are experimentally investigated. The experimental result shows that the V-Shaped rib with the e/H = 0.25 provides higher heat transfer and friction factor values than others. The mean Nusselt number values are found to be about 5.35, 4.75, 4.41, 3.72 and 2.74 times over the smooth channel while the mean friction factor values are around 22.58, 14.48, 9.98, 4.88 and 2.35 times for using the ribs with e/H = 0.25, 0.2, 0.15, 0.1 and 0.05, respectively.

Keywords*:* V-Shaped rib, Nusselt number, friction factor, solar air heater.

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Effect on KPIs of Energy Policies of Thailand

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Abstract

The objective of this paper is to develop a tool to evaluate key performance indicators (KPIs) of energy policies of Thailand. The KPIs are related to energy cost, degree of self-reliance of energy, environmental impact, and energy security. The evaluation tool is developed using an LP model that considers energy supplies, transformations, and demands from seven economic sectors. The LP model tries to balance entire energy system of the country by matching demand and supply of all energy types in the way that the total energy cost of the country is minimized. Current Thailand's energy policies are used for setting energy scenarios. This paper is valuable for policy makers since it provides decision makers the effects on KPIs of various energy policies and how they affect the energy supplies, transformations, and demands of the country.

Keywords*:* energy system model, key performance indicators, energy policy, optimization f Thailand.

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Analysis of Platinum Particle-size Effect on Performance of PEFCs Using Modeling Approach

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Abstract

The high production cost and low performance at high potentials are the major barriers preventing Polymer Electrolyte Fuel Cells (PEFCs) from wide-scale use. Many researches have been carried out in order to overcome those barriers. For example, the effect of platinum particle size on catalyst oxygen reduction reaction (ORR) activity that is a very popular issue in electrochemistry. In previous studies, there were contradictory conclusions whether the Pt particle-size affects the ORR activity or not. Nevertheless, the recent studies showed that no Pt particle-size effect on ORR activity was observed. In this study a modeling approach, which is inexpensive and less time-consuming as compared with the experimental approach was employed to verify the result of Pt particle-size effect. The model was developed based on cylindrical secondary pore structure of the catalyst layers for gas-phase PEFC Membrane Electrode Assemblies (MEAs). The simulation was carried out with the assumption that ORR activity was identical, regardless of Pt particle size. The simulation results coincided well with experimental results for the Pt particle sizes of 2–8 nm. Thus, it implied that the model was successfully developed to verify the results in previous studies that there was no Pt particle-size effect on ORR activity of gas-phase PEFC MEAs.

Keywords*:* PEFCs; ORR activity; Modeling; Pt particle-size

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Enhancement of Flat-Plate Solar Collector Thermal Performance with Silver Nano-fluid

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Abstract

This research is to study performance of a flat-plate solar collector when silver nano-fluid is taken as the working fluid. With higher thermal conductivity of the working fluid the solar collector performance could be enhanced compared with that of water.

In this study, water mixed with 20 nm silver nano with concentrations at 1,000 and 10,000 ppm were undertaken as the working fluid in three identical closed-loop flat-plate solar collectors each of 0.15 x 1.0 m^2. The tests were performed following ASHRAE Standard 93-2003. The flow rate of working fluid was between 0.8 - 1.2 liter/min-m^2 and the inlet temperature was controlled in a range of 35 - 65 ^{o}C.

The results showed that as the concentration of the nano particles increased the thermal performance increased. The solar collector efficiency with the nano-fluid was still high even the inlet temperature of the working fluid was increased. For 10,000 ppm concentration, the values of $F_R(\tau\alpha)$ and $F_R U_L$ were 0.690 and 4.869 W/m^2K, respectively compared with 0.684 and 7.178 W/m^2K, respectively for 1,000 ppm concentration and 0.720 and 8.318 W/m^2K, respectively for water.

Key words: Silver nano-fluid, Flat-plate solar collector, Thermal performance.

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Energy Recovery from Pyrolysis and Gasification of Mangrove

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Abstract

Mangrove is a biomass material that grows in wetland sea waters and is often used to produce charcoal due to its unique characteristics of long and sustained burning and negligible residue. High temperature pyrolysis has been conducted for mangrove biomass in a laboratory scale semi-batch reactor. The effect of reactor temperature on syngas yield and syngas characteristics has been investigated. Reactor temperature was varied from 600 to 900oC in 100oC intervals. The increase in reactor temperature resulted in increased syngas yield, hydrogen yield and energy yield. Evolutionary behavior of the syngas characteristics has also been investigated. The increase in reactor temperature increased the peak value of syngas flow rate, hydrogen flow rate and output power. The increase in reactor temperature decreased the time duration of pyrolysis. Cumulative yield of syngas, hydrogen and energy was calculated based on the time dependent relationship. Higher reactor temperatures shortened the time duration required for 99% release of syngas, hydrogen and energy. For example, time duration required for 99% yield of hydrogen was approximately 73 minutes at 600oC and only about 26 minutes at 900oC. Required time duration for 99% yield of energy was ~62 minutes at 600oC and ~15 minutes at 900oC. The gasification of the same material at 900oC has been carried out to determine the role of gasifying agent on the fate of material and resulting syngas properties. The results showed gasification yielded more syngas, hydrogen and energy than that obtained from pyrolysis.

Keywords: pyrolysis, gasification, biomass, syngas, hydrogen yield

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Development of a Motorcycle Driving Data Logger for Emissions and Fuel Consumption Assessment.

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Abstract

In this study, a driving data logger for a four stroke gasoline motorcycle has been developed. Recorded data of a driver was used to generate a driving cycle with emission data for exhaust gas and fuel consumption rate assessment. The data from the device can be transferred to the computers by the SD memory cards. This device has been improved from a garage made speed-time data logger. It is more suitable and compact in design. Not only the device can record the movement parameters (velocity and position of a vehicle) but the amount of exhaust emissions, Engine speed, and mass flow rate of intake air via a manifold of a test motorcycle can be written to its memory also. Recording process controlled by a microcontroller. These recorded results will then be used to evaluate a motorcycle driving model in each area. The model could be used to estimate fuel consumption and emissions of a vehicle relating to its driving cycle within any prospective urban area.

Key words: Driving and Engine efficiency data logger, Emissions detector, Driving cycle.

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Study and Testing of a Split-Type Air Conditioning Unit by Using Microchannel Condenser

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Abstract

The microchannel heat exchangers are widely used in automobile air conditioning systems. Thus, this research aimed to develop, study, and test a split type air conditioning system by using microchannel heat exchanger at a condenser. The split type air conditioning unit with a cooling capacity of 18,000 Btu/hr was used in this study. The microchannel condenser was constructed of multiport microchannel aluminum tubes having two rows of horizontally aligned serpentine heat exchangers in series. The condenser was installed in a wind tunnel in order to maintain the inlet air temperature and to measure the temperatures and air flow rate. The performances of microchannel and fin-and-tube condensers were investigated and compared by having the same air-side heat transfer area and heat exchanger volume. The effects of the condenser inlet air temperatures on the condenser heat rejection rate, effectiveness, and energy efficiency ratios (EER) were examined.

The test results showed that the heat rejection rates of microchannel condenser were lower than those of fin-and-tube condenser, at the given condenser air inlet temperatures of 35 ºC, 38 ºC, and 42 ºC, by 0.28%, 1.39%, and 0.45%, respectively. However, as the condenser air inlet temperatures increased from 35 ºC to 38 ºC and to 42 ºC, the effectivenesses of microchannel condenser were higher than those of fin-and-tube condenser by 3.66%, 5.65%, and 3.64%, respectively. The EERs of the split type air conditioning system with the microchannel condenser were higher than those of the system with the fin-and-tube condenser as the condenser air inlet temperatures were increased from 35 ºC to 38 ºC and to 42 ºC by 1.14%, 3.08%, and 2.80%, respectively.

Key words: air conditioning unit, condenser, microchannel, fin-and–tube.

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Development, Study, and Testing of Small-Scale Refrigeration System for Electronics Cooling Using Cold Plate Evaporators

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Abstract

A small-scale refrigeration system (SSRS) for electronics cooling was designed, developed, and tested. The refrigeration system consisted of four major components: a compressor, a mini-channel condenser, an expansion valve, and a mini-channel cold plate evaporator. The effects of the mini-channel evaporator dimensions and the channel numbers on the efficiency of the small-scale refrigeration system were studied. Three different channel dimensions of the cold plate evaporator were tested. The cold plate evaporator had a refrigerant-side cooling area of 1650 mm^2. The hydraulic diameters of Evaporator 1, 2, and 3 were of 1.075 mm, 1.253 mm, and 2.151 mm, respectively. The channel number of Evaporator 1, 2, and 3 were 27, 27, and 18, respectively. The refrigerant mass flow rates were varied from 1.175-1.596 g/s, the refrigerant suction and discharge pressures of R-134a were 143-360 kPa and 760-1220 kPa, respectively. The compressor speed was between 4500 and 5500 rpm, the inlet air temperature of condenser was from 23 to 29^{O}C, and the heater input powers of the simulated electronics were ranged from 200-310 W.

From the test results at heat dissipation of 200 W, the overall system Coefficient of Performance (COP) of Evaporator 2 were higher than those of Evaporator 1 and Evaporator 3 by 2.60-9.80% and 7.38-12.50%, respectively. While, the evaporator thermal resistances of Evaporator 2 are lower than those of Evaporator 1 and Evaporator 3 by 38.70-50.02% and 37.04-50.92%, respectively. The evaporator and overall system thermal resistances of Evaporator 2 are ranged from 0.3803 to 04107 K-cm^2/W and from -0.1071 to -0.2646 K-cm^2/W, respectively. The experimental results indicated that Evaporator 2 with a hydraulic diameter of 1.253 mm and aspect ratio of 5.06 had the best performance because of higher condenser effectiveness and overall system COP and lower evaporator and overall system thermal resistances.

Keywords*:* electronics cooling, refrigeration system, cold plate evaporator

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Impact of Toroidal Flow on ITB *H*-Mode Plasma Performance in Fusion Tokamak

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Abstract

A self-consistent 1.5D integrated predictive modeling code BALDUR is used to predict plasma performance of standard *H*-mode scenario in International Thermonuclear Tokamak Reactor (ITER). The core transport model used are NCLASS for calculation of neoclassical transport coefficients and semi-empirical Mixed Bohm/gyro-Bohm (Mixed B/gB) with inclusion of ITB effects for calculation of anomalous transport coefficients. In addition, the boundary condition is taken to be at the top of pedestal where its values are described using a theory-based pedestal model which is based on magnetic and flow shear stabilization pedestal width scaling and an infinite-n ballooning pressure gradient model. Theoretically, ITB is formed as a result of suppression in anomalous transport due to the effects of ω_{ExB} flow shear which can be computed from a combination of toroidal flow, poloidal flow and pressure gradient effects. In this work, an impact of toroidal flow is studied with respect to ITB formation, plasma profiles and plasma performance. The toroidal velocity is estimated using an empirical approach model in which it is directly proportional to local ion temperature. Time evolution of plasma profiles for standard type I ELMy *H*-mode ITER are simulated to study the impact of toroidal flow. Simulation results show that the central ion temperature, total fusion power output and alpha power are approximately 50 keV, 800 MW and 220 MW, respectively with evidence of ITB formation when toroidal rotation exists. In addition, the effect of toroidal velocity seems very crucial because it significantly enhances plasma performance.

Keywords: Tokamak, Toroidal Velocity, BALDUR, Internal Transport Barrier

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Economy-wide Impacts of Policy on Promotion of Electric Motorcycles in Thailand

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Abstract

The economy-wide impacts of promotion on substitution of electric motorcycle for gasoline motorcycle were assessed in terms on total primary energy supply (TPES), CO_2 emission, and employments. Influences of the measure on the inter-industry relationship in Thai economy through 2011-2030 were evaluated by Input-output (I-O) analysis according to the structural change in Thai economy. Embodied energy intensities of 180 commodities produced from 2011 - 2030 were derived from 2005 I-O table and 2000 energy I-O table. In the business-as-usual (BAU) case, the I-O data are annually updated by the changes in the power sector corresponding to 2010 Thailand's power development plan (PDP 2010). By adoption of promotion on electric motorcycles of 60% replacement in the gasoline ones in 2030, fuel mix effect, structural effect, and final demand effect were presented in this study. As a result, the promotion was expected in positive economy-wide impacts in energy and CO_2 emissions. The TPES under the program of electric motorcycle was found to be 6.9% less than the BAU. In 2030, the total CO_2 emissions would also be 0.38% less than the BAU. However, the household income would be 0.03% less than the BAU.

Keywords*:* Input-output analysis, Economy-wide impacts, Electric motorcycle, Total primary energy supply, GHG emissions.

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Preliminary Testing of Integrated Simulation for *L*-mode Tokamak Plasma from consistent Core-Edge-SOL with BALDUR Code

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Abstract

An integrated predictive modeling code BALDUR based on transport model with neoclassical transport which calculated by NCLASS module and the anomalous transport Multi-Mode-Model version 2001 (MMM2001) is used to calculate for a core region of tokamak plasma. Moreover, the small amount of residual plasma between the edge of the plasma and the tokamak vessel named scrape-off-layer (SOL) is performed as boundary conditions of the edge and core region, it has been included to carry out self-consistent effects on low confinement mode (*L*-mode). Therefore, the experimental data of *L*-mode discharges from tokamak named TFTR and statistical analysis root mean square (RMS), and offset are used to calibrate and to validate the simulation data that carried out by BALDUR code. The results show good agreement of the simulation data compared to the experimental data for electron temperature, ion temperature, and electron density.

Keywords*:* tokamak, tokamak plasma, SOL, *L*-mode and BALDUR

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Investigation of Load Profiles of Lithium-ion batteries for Electric Vehicle Applications

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Abstract

Vehicle electrification become and continues to be the major trend in the automotive industry and a main part of this is batteries. Unfortunately the battery testing presently does not represent the real-world condition, in which the battery load profile comprises complex charge-discharge wave. Therefore in this study, the load profile of batteries for electric vehicles was investigated. An integrated simulation and testing approach is used to predict the battery load. In simulation the battery load profile is calculated based on the utilization of vehicle and battery model. The present vehicle and battery model are developed using a vehicle dynamics technique and equivalent circuit modeling technique respectively, whereas the model development is focused on a specific vehicle which converts conventional propulsion into pure electric propulsion. The results are demonstrated through the current profile of advanced batteries subjected to standard driving cycles. With this approach, the battery loads correspond to actual driving condition or any driving cycle can be predicted and can be used for battery testing. This creates a new aspect to evaluate advanced batteries for power train application.

Keywords*:* Current Profile, Vehicle Modeling, Battery Modeling, Driving Cycle

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Design of Regenerative Braking System for an Electric Vehicle (EV) Modified from Used Car

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Abstract

In general one of the main objectives of regenerative braking system is to recover as much as possible kinetic energy while braking instead of being dispersed in form of heat by only friction brake. In Electric Vehicle (EV) with regenerative braking system, most braking energy is converted to electrical form via generator switched from its motor, and stored in storage device or battery to use in vehicle's electric application or use to propel itself. Thus, the EV with regenerative braking system can extend driving range. In this study, a prototype of the EV is modified from an internal combustion engine vehicle. The regenerative algorithm and equipment, based on a conventional braking system of this EV, are presented and its functional validation is investigated by using numerical simulation. Regarding the braking torque distribution between regenerative and friction brake, the available regenerative torque from electric motor is computed depending on current vehicle velocity, the torque characteristic of the motor-generator, and the state of charge (SOC) of the Li-Ion batteries**.** The friction brake torque of driven wheels, front wheel, will be reduced equal to regenerative torque by reducing brake fluid pressure. To determine the regenerative system efficiency, three regenerative strategies are investigated: non-modified braking system, modified braking system with emulated ABS signal, and modified braking system with brake fluid distribution in master cylinder. In this study, the criteria for analyzing these regenerative systems are energy recovery, and braking performance represented by braking distance. The simulated results indicate that the regenerative strategy of modified braking system with emulated ABS signal is the most proper in this study.

Key words: Regenerative braking system, Electric vehicle (EV)

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An experimental investigation of temperature distribution and heat transfer through a closed rectangular enclosure bounded with solid wall comparing with finite calculation

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Abstract

This research study an experimental and numerical investigation on the temperature distribution in a rectangular enclosure bounded with solid wall. This research have developed the computer program in order to determine the temperature profile in the closed enclosure by using finite different method. The research parameter can be classified to external factor (solar radiation, sky radiation and environmental convection heat transfer) and internal factor(conduction heat transfer , internal convection heat transfer and internal wall radiation). The data collection from the experiment has been collected every 5 minutes 24 hours a day for 1 week. The comparison between computer program and the experimental data have been analyzed by using statistical method. The result found that the correlation coefficient between experiment and calculation during day time is 94% and during night time is 89%

Keywords*:* Temperature Profile, Heat Transfer , Finite Different, Form Factor , Solar Radiation

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Wind Machine for Wastewater Treatment

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Abstract

This paper presents the study of using wind turbine for wastewater treatment application. Wind energy is clean power resource that can be applied into many useful works. And the wind turbine is a machine which converts the power in the wind into many forms of energy such as electricity, hydraulics or air pressures etc. However, most of the wind turbine nowadays is using for electricity generation purpose, while others are not applicable and world wide uses especially, in low wind speed areas. In this paper, others application of wind machine was studied and investigated. As in many applications and areas, the electricity is not the main requirement but the need of air and oxygen is required. Especially, in agriculture areas and some industrial sites, the water pollution is a big issue to be solved. Therefore, the used of wind machine for oxygen generation was studied and presented in this paper. This research shown that the prototype was generates 3 bar of air pressure circulates of 1.3101×10^{-3} m^3/s volumetric at wind speed of 5 m/s average into the wastewater pond. Additionally the suitable engineering design using Computational Fluid Dynamics (CFD) indicated that high performance airfoils could be applied in wind turbine rotor for wastewater treatment at low wind speed areas.

Keywords : Wind turbine, Wind Energy, Air-Pressed Turbine**,** Air pump

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An Experimental Study of Thermo-syphon Solar Water Heater in Thailand

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Abstract

The thermo-sysphon solar water heater (TSSWH) is probably the most widespread application of solar thermal energy during the past years. This paper presents the experimental study and the mathematical models for prediction of hot water temperature produced from the TSSWH. Results are presented of collector temperature, storage temperature and thermal efficiency of the TSSWH. From the experimental study, it is found that the average TSSWH thermal efficiency was about 56% during the test days. The characteristics of this TSSWH are then used in simulation to predict its annual performance in Thailand using the three-year weather data during 2006-2008. Results from the simulation showed that the average year-round thermal efficiency is about 48%, average collector temperature is 51°C, and average hot water in the storage tank is 46°C. Finally, the technical and economic parameters of the TSSWH are used to assess its cost effectiveness under conditions in Thailand. Results from economic analysis revealed that TSSWH is competitive to the conventional electric heaters, especially when electricity price is high and utilization factor is high.

Keywords*:* Thermo-syphon solar water heater, thermal efficiency, collector temperature, storage tank temperature

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Biogas Purification by Uniform Bubbly Flow in Ethanolamine Solution

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Abstract

Purification of biogas could reduce corrosion in biogas equipment and increase the gas heating value. This research is to separate carbon dioxide from biogas by flowing through a column of ethanolamine solution. In the experiment, biogas of 60% CH_4 and 40% CO_2 with various flow rates of 2-4 liter/min was fed through a 10 liters column of 0.01-0.2 M ethanolamine solution. The biogas was fed through a porous nozzle of which the 1.5-2.5 mm gas bubbles could flow uniformly. By this technique, the solution could absorb the gas effectively. The CH_4 concentration could be up to 93-96 % and after that it tended to decrease with time since the solution was closing to the saturation point. The characteristic absorption time for CO_2 absorption could be set as $t = \frac{1}{k}\ln\left(\frac{C}{C_o - C}\right) + \tau$. The absorption constant (1/k) was found to be in a range of 7.94-21.36 which was lower than that from the literature which meant that the more effective absorption was obtained at the same operating period.

Key words: Carbon dioxide Separation, Biogas Purification, Uniform Bubbly Flow

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Progressive State of Charge Estimation for Electric Bus

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Abstract

In order to use electric vehicles (EVs) and get the most efficiency out of it, the information about the battery status is significant for drivers. As a battery monitoring system is a major part in electric vehicles, a high-accuracy State of Charge (SoC) monitor is needed. The aim of this paper is to present the progressive State of Charge estimation for deep cycle lead-acid batteries powering an electric bus prototype.

In this study, the SoC of battery was estimated by means of a discharge test and a specific gravity test. An ampere-hour counting method was used in a discharge test. While this method could provide an accurate physical remaining capacity of battery, it was inconvenient in real automotive application and can only be used with flood-type lead acid battery. Alternatively, the Kalman Filter method was also considered in this study in an attempt to improve the current battery SoC estimation technique. The results of proposed study can be used initially in an electric bus prototype and can be used as a guideline for development of other electric vehicle projects in Thailand.

Key words: State of Charge, Lead-Acid Battery, Ampere-hour counting

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Bio-gasoline production from SSHCs via catalytic cracking reaction

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Abstract

This research was focused on the role zeolites in the catalytic cracking process for the production of bio-gasoline by using synthetic straight-chain hydrocarbons (SSHCs) as feed stock in the continuous plug flow reactor. Three different zeolites (Y, BEA and MOR) were used as support impregnated with platinum metal. Catalytic activity of each catalyst was determined at various reaction conditions, temperature and space velocity. The results showed that these catalysts had potential in the production of bio-gasoline. A Pt/MOR showed the most activity followed by Pt/Y and Pt/BEA. However, selectivity to gasoline range of Pt/BEA was higher than Pt/Y

Thermal System and Fluid Mechanics (TSF)

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Numerical Simulation of Ventilated Cavitation behind an Axisymmetric Body

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Abstract

A numerical unsteady approach is fallowed to simulate ventilated cavitation behind an axisymmtric body. In this study liquid-gas interface is modeled, using the volume of fluid (VOF) method based on young's algorithm. Transient Navier-Stokes equations are solved along with an equation to track the cavity interface. Turbulent fluctuations in the velocity field are modeled using the Reynolds Averaged Navier-Stokes (RANS) methodology. Turbulence is assumed to be isotropic and $RNG\,k-\varepsilon$ turbulence model is used in this investigation. Different free stream velocities are considered. First, the results for variation of cavity length with cavitation number have been compared to the available experimental data for a two-dimensional wedge. The good agreement between the computational and experimental results validates the present numerical method. Then this method has been used to simulate the ventilated cavitation behind a cone with the same chord and angle as the wedge. Simulation shows that, the cavity length will increase by decreasing the cavitation number. The results show that at the same cavitation numbers, the cavity lengths of the wedge are longer than those of the cone.

Keywords*:* Ventilated cavitation, Numerical simulation, Cavitation number, Axsymmetric body

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Effects of Soret/Dufour on Steady MHD Mixed Convection over an Infinite Vertical Plate embedded in a Porous Medium with a Convective Boundary Condition

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Abstract

The focus of this paper is to study the effects of Dufour and Soret on steady magnetohydrodynamic mixed convection over an infinite vertical plate with a convective boundary condition embedded in a porous medium in the presence of first-order chemical reaction. The boundary layer equations governing the flow are written into a dimensionless form, which are numerically solved by applying an implicit finite-difference scheme. A discussion is provided for the effect of Dufour number (Du), Soret number (Sr) and Biot number (Bi) on the velocity, temperature and concentration profiles. Numerical results for the local skin-friction coefficient, the local Nusselt number and the local Sherwood number are also illustrated graphically for different physical parameters.

Keywords*:* MHD flow, Convective boundary condition, Dufour and Soret effects, Porous medium

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Enhancement of Heat transfer and Pressure drop in a Channel by grooving the Walls

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Abstract

Surface heat transfer and friction coefficients of a channel with laminar air flow through it and with walls set to different constant temperatures have been investigated numerically. Validity of results investigated in a comparison with previous existing experimental data. Effect of two parameters, groove depth to channel height (e/H) and groove width to channel height (w/H) been investigated in different Reynolds numbers. The e/H ratio was between 0.5 and 0.8 and w/H ratio was between 1 and 2.5. Reynolds number of flow was set between 100 and 1760. Using grooves on a channel wall causes an increase in local and global nusselt numbers of it but also causes a pressure penalty too. It is necessary to investigate the conjugate effect of heat transfer improvement and increased pressure drop to see if a method is efficient or not. The results have been compared to find the best efficient configuration of placing grooves.

Keywords*:* Enhanced heat transfer, grooved channel, Energy consuming optimization

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Two-Phase Flow in Vertical Circular Micro-Channel

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Abstract

Two-phase air-water flow in a vertical micro-channel is experimentally investigated. A fused silica channel, 320 mm long, with an inner diameter of 0.53 mm is used as the test section. The test runs are done at superficial velocities of gas and liquid ranging respectively from 0.375 to 21.187 m/s and 0.004 to 2.436 m/s. By keeping the water flow rate constant at a pre-selected value and increasing the air flow rate by small increments, the two-phase flow pattern and pressure drop data are obtained. According to the flow visualization results, five different flow patterns, i.e. slug flow, throat-annular flow, churn flow, annular flow and annular-rivulet flow, are observed in this work. The two-phase pressure drop measured in the experiments includes friction, gravitation, fluid acceleration and sudden contraction terms. However, the frictional pressure drop is found to dominate over the other three components. The frictional pressure drop increases with increasing superficial gas velocity or superficial liquid velocity. The results also illustrate that churn flow experiences relatively high pressure drop in comparison to the other observed flow regimes.

Keywords*:* Micro-channel; Two-phase flow; Flow pattern; Void fraction; Pressure drop

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Preliminary Hydraulic Design and Test of A Centrifugal Blood Pump

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Abstract

The paper presents the design scheme and considerations for the preliminary hydraulic design of a centrifugal blood pump, the evaluation of the design via model testing, and finally the more realistic prediction of the prototype performance parameters based on the results of the model testing. The design is based on 'one-dimensional' Euler's turbomachine equations and the design speed of 1,000 RPM, together with heart parameters, and some blood trauma and mechanical considerations. A 2X scale-up model is subsequently constructed and tested. The initial test of the model shows that the pump cannot achieve the prototype-equivalent desired head-flow at the design speed. Subsequently, a series of additional model tests are performed, and the result shows that the characteristic dimensionless head-flow curve of this pump, $C_H = -5{,}423C_Q^2 + 20.66C_Q + 0.1615$, is Reynolds number (Re) independent over the range of Re tested of 1.4-2.9x10^6, yet still 10 times higher than the prototype Re of 1.2x10^5. Similarity scaling, based on the Re-independent assumption of the newly acquired dimensionless head-flow curve, is then used to predict the required operating speed of the prototype, 1,185 RPM, approximately 20% above the design value. Additional test at this RPM confirms the prediction and shows that the model pump can successfully achieve the prototype-equivalent head-flow at this speed. The more realistic performance parameters of the prototype, based on the results of the model testing, are then predicted. It is subsequently concluded that, if the dimensionless head-flow curve of this pump is independent of Re down to the prototype Re, the prototype should be able to deliver the desired head-flow successfully at 1,185 RPM. The remaining issue is then whether the assumption of Re independence down to the prototype Re is valid.

Keywords: centrifugal blood pump, ventricular assist device, VAD, hydraulic design, pump test

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Evaluation of γ-Re_θ and k_L Transition Models on Riblet-Induced Transition Delay

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Abstract

Riblets are well known for the drag reduction when they are properly scaled. The transition delay is a key mechanism to reduce the drag force. For the first time, two popular transition models, i.e. γ-Re_θ and k_L models, are evaluated in this paper to simulate the flow over a combination of smooth and riblet surfaces. It is aimed to assess how realistically these two transition models can predict the transition delay induced by riblets. The LES data of Klumpp et al [3] are used for both the flow-condition calibration and the model evaluation in case of K-type transition and oblique transition. For flow over a totally smooth surface, the inlet flow condition is tuned up to match the RANS result with the LES data for each model. Under the same calibration, the response of both models to the riblets can be investigated when the fluid has to flow over a combination of smooth and riblet surfaces. It is found that the k_L model is more accurate for K-type transition while the γ-Re_θ model is more accurate for oblique transition. Moreover, the γ-Re_θ model has a better convergence rate for both types of transition.

Keywords: Laminar kinetic energy; Intermittency; Transition; Riblet; RANS.

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The Microwave Processing of Banana Sliced by Using Multi-Feed Microwave Continuous Belt Drier

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Abstract

In this study, the drying of banana sliced by microwave energy using multi-feed microwave continuous belt drier was compared to that by hot air, combined, hybrid method. By using multi-feed microwave continuous belt drier, the microwave power was generated by means of 12 compressed air-cooled magnetrons of 800W each that gives a maximum of 9.6 kW. The power setting could be adjusted individually in 800W steps. Hot air is generated by heater in the system. Most importantly, this work focuses on the investigation of drying phenomena under microwave environment. In this analysis, the effects of the irradiation time and drying method on overall drying kinetics and electrical power consumption were studied. The results showed that using the continuous microwave applicators technique has several advantages over the conventional method such as shorter processing times, volumetric dissipation of energy throughout a product, high energy efficiency as well as improvements in product quality. The results presented here provide a fundamental understanding of microwave-heating of various kinds of dielectric materials.

Keywords*:* Microwave, Processing, Banana sliced, Drying, Hybrid

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Heat Transfer Enhancement on Surface with Jets Impingement from Some Arrays of Elongated Round Orifices

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Abstract

The aim of this research is to enhance the heat transfer on a target surface of an array of impinging jets by decreasing effect of crossflow. Conventional round orifices (Aspect Ratio, AR=1) were substituted by elongated round orifices with aspect ratio AR=4 and 8 in base on same jet exit area. Two types of orifices arrangement; in-line and staggered arrangement were considered. The experimental investigation was carried out at constant distance from orifice plate to impinged surface $H=2D_E$ (D_E is equivalent diameter of orifice). The heat transfer characteristic was visualized using Thermochromic liquid crystal sheet (TLCs) and Nusselt number distribution was evaluated by image processing techniques. The flow characteristic on the impinged surface was also visualized by oil film technique. The results show that the elongated round orifices with AR=4 can increase average Nusselt number more than case of AR=1 for 6.04% and 12.52% in case of in-line and staggered arrangement, respectively. However, the heat transfer for case of AR=8 was enhanced only for in-line arrangement when compared with the case of AR=1. The results from flow visualization on jets impinged surface show that the jets from elongated round orifices with AR=4 were received crossflow effect smaller than jets from orifices with AR=1 and 8.

Keywords*:* Impinging jets, Crossflow, Heat transfer enhancement, Elongated round orifice, Orifices arrangement

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Effect of geometrical parameters towards the heat transfer in modified 80kW DC motor with radial water cooling duct.

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Abstract

One of the risks in using 80 kW DC induction motor as a prime mover for high performance vehicles is thermal failure due to cumulative heat generation from electrical loss. This unwanted heat could be taken out of the unit by a water coolant. This work deals with the effect of geometrical parameters on heat removal capability of the unit. The case of study can be divided into three parts. Part one is on the effect of cooling duct size. Part two is on the effect of base diameter and part three is on the number of cooling ducts. The model which has the best result among others is the 7.5 millimeter duct size with one cooling duct in the model of 30 centimeter of base diameter.

Keywords*:* DC Motor, Cooling, Three-dimensional, CFX, Heat transfer

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Effect of Installing a Curved Venetian Blind to the Glass Window on Heat Transmission

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Abstract

This article is about a study on the effect of installing a curved venetian blind to the glass window on heat transmission to the space. The curved venetian blind, whose optical properties are considered as nonspecular optical element, is modeled as an effective layer. The mathematical model of the glass window installed with a curved venetian blind is developed by using matrix layer calculation method. Empirical model of heat convection coefficient between the glass window and the venetian blind is adopted in the proposed mathematical model. The effect of diathermanous layer on the radiative heat transfer between the glass window and space behind the installed venetian blind is also considered. The predicted results from the mathematical model are verified with the experimental results. The variation of the solar heat gain coefficient and overall heat transfer coefficient, which are the key parameters used to calculate the heat transmission through the glass window installed with venetian blind to the space inside, are studied. It is found that installed the venetian blind behind the glass window significantly reduces the heat transmission through the space. The reduction in heat transmission is greatly influenced by the characteristics of the venetian blind and the glass window such as the optical properties of the slat, the slat angle, the solar profile angle and the optical properties of the glass window. It is also found that installed the high reflective blind (white blind) behind the glass window in certain slat angle and solar profile angle can reduce the solar heat gain coefficient as much as 59.7 percent compared to the plain glass window.

Keywords*:* Glass window, Venetian blind, Solar heat gain coefficient, Heat transmission.

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Comparison on Effect of Electrode Arrangements between Wire-to-Wire and Wire-to-Plate Types on Swirling Flow under Electric Fields in a Channel Flow

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Abstract

This study aims to explore and compare the characteristics of swirling flow induced by electric fields performed from two electrode arrangements, i.e. wire-to-wire (WW) and wire-to-plate (WP) electrodes, in a channel flow. In both cases, location of an electrode wire, which is suspended from the upper wall of the channel, is initially located at the center line of the channel, and ground electrodes are fixed on the bottom wall. In wire-to-wire case, position of electrode is varied in the normal flow direction, while in wire-to-plate case, it is varied both in the normal and flow directions. Electrical high voltage is applied at 20 kV, and air flow velocity is tested in the range of 0.3 – 1 m/s. The numerical results show that electric field patterns from both cases are quite different. These results cause characteristics of swirling flows to appear differently. In WP case, when electrode is laid in line with plate ends, a swirling appears. While electrode is laid between two plate ends, two vortices are observed. Details of strength and shape of vortex in various cases are discussed in this paper.

Keywords: Swirling flow, Electric fields, Electrode arrangement.

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Non-Destructive Inspection of Brazed Joint by Pulsed Phase Thermography

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Abstract

In this study, hot air was used as the pulsed heat source and infrared camera was used to record the variation of outside surface temperature of the joint. These temporal sequences of thermal images were transformed to frequency domain by using Fourier Transforms. The phase data in the frequency spectrum can be determined and used to specify the defects. The specimens are cylindrical lap joints of 10-millimeter diameter and were brazed by brass filler. This method can used to detect the boundary of the voids by investigating the Phase difference at various locations.

Key words: Non-destructive Testing, Brazed joint, Defect, Pulse Phase Thermography

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Modified Flash Method for Thermal Diffusivity Measurement of Porous Materials

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Abstract

In this research, a new technique for measuring thermal diffusivity of porous material using thermography is presented. This technique has at least two advantages than the traditional flash method. First, there is no temperature sensor installed on a specimen, so there is no heat accumulation in the sensor. Moreover, it is not necessary to have a good sensor installation skill to make a good contact between the specimen and the temperature sensor. Therefore, the measured temperature distribution should have more accuracy. Second, the initial condition used for calculating the thermal diffusivity is obtained immediately after flash heating the specimen. The special algorithm was developed for treating data in order to obtain the temperature initial condition function in an appropriate form. The specimen was installed in an apparatus that has insulated walls and contains stationary air to reduce heat losses by forced convection for better results. The specimen was heated using laser beam or hot spot wire and the evolution of temperature distribution was recorded by thermographic camera. The measured data in conjunction with present numerical method are used to calculate thermal diffusivity of the tested specimen. Stainless steel AISI 304 which represented a homogenous material and a series of Alumina ceramic, which represented porous material, were used for validation the present method. The measuring results were well agreement with the value found in material properties standard books.

Keywords*:* thermal diffusivity, thermography, porous material, infrared camera

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Heat transfer enhancement and flow characteristic of Al_2O_3-water nanofluids flowing through a microchannel heat sink

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Abstract

The research presents an experimental study on the heat transfer and pressure drop characteristics of Al_2O_3-water nanofluids flowing through a microchannel heat sink (MCHS). The effects of Reynolds number and particle concentrations on the heat transfer and flow behavior are investigated. Comparison of the heat transfer coefficient obtained from water-cooled MCHS and nanofluids-cooled MCHS are also presented. MCHS with rectangular flow channel made from aluminum with dimension of 5x5 mm are used as the test section. Al_2O_3-water nanofluids with particle concentrations of 1.0, 2.0 and 3.0 wt.% are tested. Two electric heaters with each capacity of 50 W are used to supply heat to the test section. The experimental conditions are described as follows: 1) fluid temperature is setted at 15 ^{o}C and 2) Reynolds number ranging between 1500 and 3000. The results indicated that the heat transfer performance of MCHS increased with increasing Reynolds number as well as particle concentrations. Compared with pure water, the result indicated that heat transfer performances of nanofluid-cooled MCHS are higher than those of water by about 7 – 15%. Finally, the pressure drop of nanofluids is close to the water.

Keywords: heat transfer coefficient, Pressure drop, nanofluid, microchannel heat sink

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Computational investigation of quantitative entropy generation in centrifugal compressors with different exit beta angle

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Abstract

This research proposed for investigation on the quantitative entropy generation in the streamwise location of flow passage of centrifugal compressors with different exit beta angle which its operating condition designed for small gas turbine application. The flow field was obtained by 3D numerical simulation technique (CFD), with the help of commercial CFD code. The analysis was coupled both of flow structure and quantitative entropy that generation from the compressor inlet to the outlet. The comparison have been made between 10, 20, 30, 40 and 50 exit beta angle. The simulation result, shows the streamwise location of 0.1-0.6 entropy generate around 60 J/kg.K per streamwise location length for all exit beta angle, because of the inflow direction is parallel with the flow passage. In contrast, at the location 0.6-1.0 entropy generate around 480 J/kg.K per streamwise location length, around 8 times of the entropy generated in location 0.1-0.6. This is correspondent to the high deformation rate of the flow field in this area. The separation and secondary flow can be observed by blade tip leakage. Moreover, strong flow distortion resulting from switching the rotating reference frame to station reference frame, along with massive turbulent intensity that consequence in high local eddy viscosity. The beta angle was alleviated on jet-wake shear layer at the exit area of the compressor. Consequence in less entropy generation in such area.

Keywords*:* Entropy, flow passage, centrifugal compressor

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Development of Computer Program for Two-Dimensional Complex Geometry Flows

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Abstract

This research proposes a CFD computer program for simulating the two-dimensional steady laminar flow based on finite volume method and triangular unstructured mesh. The numerical algorithm is developed based on SIMPLE algorithm for solving the Navier-Stokes equations, which are consisted of momentum equations and continuity equation in form of the pressure correction equation. The strategies of CDS and UDS schemes are respectively used to discretise the convection and diffusion terms of those governing equations. A lid driven cavity flow with Reynolds number of 100, 400, 1000, 3200 and 5000 is investigated to validate the developed computer program. The predicted results show that the in-house computer program gives good results compared with the reference data.

Keywords: Computational Fluid Dynamics, Finite Volume Method, Triangular Unstructured Mesh, Cell-Centered Grid

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Investigations of Radiative Properties Estimated from Rayleigh and Mie Scattering Theories

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Abstract

Radiative properties are very important parameters for the numerical simulation of thermal radiation transfer through porous medium. To estimate the radiative properties of the porous medium, Mie and Rayleigh scattering theories are usually preferred to compute the radiative properties of a single sphere, and applied for estimating the radiative properties of a porous media. But, there are some limitations. Therefore, in this work we have investigated the differences of radiative properties computed by these two scattering theories. The results shown that, for a very small sphere, there are no significant differences in radiative properties computed from Rayleigh and Mie scattering theories. But, for a particle size larger than 1/10 of the radiation wavelength, Mie scattering is preferred. The spectral transmittances of porous mediums made from different materials that the radiative properties were estimated from Rayleigh and Mie scattering theories have also been simulated and reported.

Keywords*:* Mie scattering / Rayleigh scattering / Radiative properties / Porous medium.

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Preliminary Hydraulic Design and Test of A Centrifugal Blood Pump: Effects of Reynolds Number and Blade Number

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Abstract

In our design and model test of a centrifugal blood pump as described in Anansukkasam *et al.* [1], two questions arise. The first question is regarding the effect of Reynolds number on the dimensionless head-flow ($C_H - C_Q$) curve of the pump. The second question is regarding the suitable number of blades for the impeller. Consequently, this paper has the objectives in investigating the effects of Reynolds number and blade number on the $C_H - C_Q$ curve of the designed pump. The experiment is conducted over a wide span of Reynolds number, a factor of 100, from 0.17 to 18.6 times of the predicted prototype Reynolds number (Re_p) and with 4- and 6-blade impellers. The results show that the $C_H - C_Q$ curve changes relatively little over what can be considered the high Reynolds number range, approximately from 18.6 to 1 Re_p, a span of a factor of 20. However, C_H does decrease more significantly as the Reynolds number decreases into the lower Reynolds number range, approximately from 1 to 0.17 Re_p, a span of only a factor of 5. In addition, the effect is more pronounced towards the high C_Q end than the low C_Q end. As for the effect of blade number, the results show that the 6-blade impeller gives higher C_H than the 4-blade impeller, both in the high and low Reynolds number ranges, but being more pronounced in the high Reynolds number range. Finally, the prediction of the prototype speed in [1] is evaluated. It is found that at the prototype-equivalent Reynolds number, which can be considered at the end of the high Reynolds number range, the pump delivers the head slightly lower than predicted, by approximately 10%, albeit still within the uncertainty. On the one hand, this can be attributed to the effect of Reynolds number since in [1] the much higher Reynolds number $C_H - C_Q$ correlation is employed in the prediction. On the other hand, the fact that the predicted prototype Reynolds number is at towards the end of the high Reynolds number range results in only slight deviation from the prediction. Finally, qualitatively, the implications of the effects of Reynolds number are 1) the use of (Reynolds number independence) similarity law for scaling the $C_H - C_Q$ curve is reasonably valid at high Reynolds number range, but Reynolds number effect may need to be taken into account at low Reynolds number range, *especially* towards the high C_Q end, and 2) as far as the $C_H - C_Q$ curve is concerned, the choice of the suitable number of blades is more critical at high Reynolds number than at low Reynolds number.

Keywords: centrifugal blood pump, head-flow, similarity law, Reynolds number, blade number

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A Numerical Analysis of Gas Enthalpy - Radiation Converter (GERC) by Using Single Cordierite Open-cellular Porous Plate

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Abstract

The gas enthalpy-radiation conversion (GERC) utilizing cordierite porous material, which is a ceramic open-cellular porous material, is theoretically investigated. The mathematical model of the GERC consists of separated energy equations for fluid and solid phases, which include all modes of heat transfer i.e. conduction, convection and radiation heat transfer. The convective heat transfer between the two phases based on an empirical volumetric heat transfer coefficient proposed by Kamiuto and San San Yee is estimated. The Kamiuto radiative property model is used for the cordierite open-cellar porous material. The P_1 approximation method is employed to evaluate the radiative transfer equation. While explicit finite different method is used to estimate the energy equations. The results show that the gas temperature drop across the cordierite porous converter and the gas enthalpy to thermal radiation conversion efficiency increases with the porous' thickness and is asymptotic to a certain value. Low pore per inch (*PPI*) is significantly effective to raise the asymptotic temperature drop; however it effects to decrease backward radiative heat flux.

Keywords*:* GERC, cordierite, temperature drop, pure reflective, porous converter

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Investigation of effectiveness of a closed-end flat thermosyphon heat exchanger (CEFTHE)

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Abstract

This paper presents effectiveness of a closed-end flat thermosyphon heat exchanger (CEFTHE). The CEFTHE having lengths of both the evaporator and condenser sections were 300 mm and its central adiabatic section had a length of 100 mm. The CEFTHE made by a standard copper tube (ID = 8.6 mm, and 0.46 mm of wall thickness) with bent to many U-shape and then pressed in a mold to reform its cross-section and closed at two end. The CEFTHE was filled with water as the working fluid with filling ratios of 50% of the internal volume. In experiments, the temperatures of hot air across the evaporator section were varied in the range of 105-145^{o}C while the cool air temperature that flows into condenser section was nearly constant 30^{o}C. The hot air velocities flow across the CEFTHE were varied in the ranged of 0.5-2.0 m/s while the cool air velocity that flows into condenser section was kept constant at 0.5 m/s. The experimental results indicated that the effectiveness increases with temperature inlet into evaporator section, and reduced air velocity though the evaporator section. The minimum effectiveness of 0.35 occurred at conditions: low velocity and temperature of hot air. The maximum effectiveness of 0.72 obtained at high temperature and velocity of hot air flow into evaporator section.

Keywords*:* Thermosyphon, heat exchanger, heat recovery, flat heat pipe, closed end.

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Effects of working fluids, working temperatures and inner diameters on internal pressure and heat transfer rate of a closed-loop oscillating heat-pipe with check valves (CLOHP/CV)

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Abstract

Effects of working fluids, working temperatures and diameters on the internal pressure and heat transfer rate of a closed-loop oscillating heat-pipe with check valves (CLOHP/CV) were investigated in this research. The CLOHP/CV was made of a copper capillary tube with 1.77 and 2.03 mm ID. There were three working fluids (distilled water, ethanol and R123) and the temperatures in the evaporator were 100, 150 and 200°C with a filling ratio of 50%; the number of meandering turns was 40 and the number of check valves was 2. The lengths of the evaporator, adiabatic and condenser sections were 50 mm. The research reports the working fluids effects, inner diameters and working temperature were on internal pressure, heat transfer rate and thermal resistance. It was found that; the CLOHP/CV (R123, 2.03 mm ID and T_e 200 °C) had the maximum internal pressure and heat transfer rate of 7.53 Mpa, 0.83 kW, respectively and the minimum thermal resistance was 2.51°C-m^2/kW. The increased working temperature varied directly with the internal pressure and heat transfer rate accordingly, but it reversed variation when thermal resistance was decreased.

Keywords*:* Closed-loop oscillating heat-pipe, Check valves, Heat transfer rate, Thermal resistance

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3D Numerical Study on Prediction of Turbulent Heat Transfer in Horizontal Impinging Jet

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Abstract

In the age of technology, it is vital to cool the different parts of a device to use it more beneficially. One of the newest methods is the “Impinging Jet” on a surface which has shown very effective results. Cooling a hot surface with constant temperature with circular, rectangular and triangular nozzles with the same hydraulic diameter is discussed in this paper. In this context, the results of a two-dimensional simulation are compared with experimental data and the effects of different nozzle shapes are studied. V2F turbulence model had the best prediction for Nusselt number, however, $k-\varepsilon$, $k-w$ Realizable and RSM models over predicted the heat transfer rate in compare with the experimental data. In addition, the three dimensional impinging normal jet with stated nozzle shapes is studied with V2F model and discussed for Nusselt number per geometry. This method can be discussed by adding swirl to the jet to rise the heat transfer rate in the future studies.

Keywords: Impinging Jet, V2F, $k-\varepsilon$, $k-w$ and Nusselt

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Numerical Study of the Heat Transfer Characteristics of a Turbulent Jet Impinging on a Cylindrical Pedestal

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Abstract

In this paper the three dimensional round jet impinging on a circular pedestal is simulated. The predictions are carried out through numerical procedure based on finite volume method. The effects of the nozzle to target spacing (H/D=2, 4 and 6) and Reynolds numbers (23000 and 50000) are investigated. The flow field is considered to be incompressible and the buoyancy and radiation heat transfer effects are neglected. Turbulent fluctuations in the velocity field are modeled using the Reynolds Averaged Navier-Stokes (RANS) methodology and various turbulence models such as $SST\ k-\omega$, $RNG\ k-\varepsilon$, *Realizable* $k-\varepsilon$ and v^2-f are also used. The results of convective heat transfer obtained on the pedestal and the flat plate, using v^2-f turbulence model have good agreement with the experimental data compared to the other models and also heat transfer increases with increasing Reynolds number and the maximum heat transfer coefficients occur for H/d equals to six.

Keywords: *Turbulent impinging jet - Cylindrical pedestal - Numerical simulation - Heat transfer characteristics.*

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Effect of Filling Rate of Working Fluid on Thermal Performance of Flat Heat Pipe

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Abstract

This research is investigated effect of filling rate of working fluid on thermal performance flat heat pipe. The flat heat pipe (FHP) made a copper tube with an internal and external diameter of 5.4 mm and 6 mm, respectively. The wick structure made from copper pounder sintering. The copper tube is flatted of 3 mm after sintering, the porosity of wick was 50% ± 5%, and the wick thickness was 0.6 mm. In the experimental, the filling rates are 40%, 50% and 60% respectively. The FHPs were set to operate at horizontal heating mode. It was found that the filling rate at 60 %, heat pipe can transfer heat maximum is 40 W and the thermal resistant is 0.02 ^{o}C/W.

Keyword: Filling Rate, Thermal Performance, Flat Heat Pipe

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A Study of Bypass Transition in a Zero-Pressure Gradient Boundary Layer Subjected to Free stream Turbulence

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Abstract

Bypass transition induced by freestream turbulence has been investigated using the direct numerical simulation (DNS) data of a zero-pressure gradient boundary layer. The DNS data are provided by T. A. Zaki's group, at Imperial College London. The choice of the zero-pressure gradient boundary layer allows the study to focus on the effect of freestream turbulence exclusively. The boundary layer is subjected to 3.5% freestream turbulence at the inlet of the computational domain where Reynolds number based on 99% boundary layer thickness is 800, it undergoes a bypass transition further downstream and eventually becomes fully-turbulent toward the outlet of the domain. A proper orthogonal decomposition analysis of the fluctuating velocity field is carried out in order to objectively extract the most-energetic structures (coherent structures) in the boundary layer and their energy contents. The first five dominant structures carrying 10% of fluctuating energy are composed of important structures such as elongated streamwise streaks or perturbation jets, also known as Klebanoff modes, turbulent spots and traveling-waves. The first five mode description is able to capture almost all the processes in bypass transition except the receptivity of the freestream turbulence into the boundary layer and the formation of Klebanoff modes. Future study in the seek of coherent structures associated with the receptivity and the formation of Klebanoff modes will be undertaken in order to obtain a compact description of bypass transition in a zero-pressure gradient boundary layer.

Keywords*:* bypass transition, freestream turbulence, proper orthogonal decomposition (POD), coherent structures

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A study of heat transport in unsaturated porous media involving vapor diffusion

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Abstract

This paper presents the experimental analysis of unsaturated flow over flat plate which is embedded in a porous packed bed. In this study, the influences of particle size, supplied fluid flux, particle size and supplied heat flux on flat plate on heat transfer and mass transport during unsaturated flow over flat plate which is embedded in a porous packed bed are systematically investigated. It is found that the optimum control of some parameters results in the highest transport phenomena in a porous packed bed.

The results presented in this study provide more physical understanding of the characteristics of unsaturated flow in a porous packed bed.

Keywords*:* porous media, unsaturated flow, flat plate, heat transfer and mass transport.

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