AutoCRC Undergraduate Research Projects 2007

Please contact Kate Neely the Education Program Co-ordinator to access the full thesis.

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UG7806
John Carlson

Development of a Lightweight Vehicle Prop-Shaft

Abstract

The book The Future for Automotive Technology published in 1984 (Seiffert & Walzer 1984) asked the question what kind of cars will we be driving in the year 2000. The answers included, they will give twice fuel economy of 70-80mpg compared to 30-40mpg of today and they will be made largely of Plastic and Aluminium reducing the steel content to around 50% compared to 70% of today. In Australia these figures have not been reached however government regulations on the fuel consumption of vehicles are becoming more stringent. Therefore vehicle manufacturers need to find ways of meeting these regulations. There are numerous ways of reducing fuel consumption through new technology but one of the best methods, and one that hasn't been fully utilized, is the reduction of the vehicle's mass. Modern low mass and high strength material developments provide a basis for this, as these materials have been used and proven in the aerospace industry for many years.

Cars are made up of hundreds of different components so it stands to reason that reducing the mass of just one of these components is pointless. However each component has its own purpose in the vehicles structure and needs to have mechanical properties that fulfil this purpose. Therefore when considering alternative materials for the component, that component may need to be redesigned to take advantage of the new materials properties. An automotive prop-shaft is one of these components and is used in rear wheel drive vehicles and the aim of this study is to design a one piece lightweight prop-shaft to replace the current heavy two piece unit. The prop-shaft provides a means of transferring the torque developed by the engine at the front of the vehicle to the differential located at the rear of the vehicle.

This thesis will endeavour to develop various lightweight prop-shaft designs that fulfil the necessary requirements set out by Holden and required in prop-shaft design. The design must be economical to manufacture and safe. Modern materials such as composites possess mechanical properties of high stiffness and low density required for the design. Analysis techniques used consist of Finite Element Methods and analytical methods and comparisons made where possible. The selection methods will use the Analytical Hierarchy process (AHP) to select the best material and design option. Ultimately a prototype will be manufactured and tested to ensure the design can fulfil all requirements. By developing a lightweight prop-shaft for a large car manufacturing company which will ultimately be used in a lightweight fuel efficient large vehicle it will set the precedent for all other manufacturers to follow suit. In addition it will show that Holden is committed to developing fuel efficient vehicles that can satisfy the demand for this type of vehicle.

UG6906
David Beesley

A Study of the Effect of Tail Pipe Back Pressure on Fuel Consumption Measurement Variability

Abstract

It is the aim of this practical work to define and quantify sources of variation in the measurement of Fuel Consumption at the GM Holden Vehicle Emission Laboratory. Using the Carbon Balance Method of measurement GM Holden has identified a 2% underestimation of fuel consumption figures on Constant Volume Sampling System 1 compared to Constant Volume Sampling System 3.

In a climate where fuel consumption figures are an important and vital marketing tool manufacturers must work hard to precisely measure and advertise the economic figures of their vehicles.

Previous studies have identified exhaust back pressure as a significant contributor to fuel consumption measurement variability. Ambient conditions, driver cycle, dynamometer/tyre interaction and fuel chemistry have also been named as significant causes of variability. Considering that a correlation vehicle – that is common to both sampling systems – is used and ambient conditions are maintained and controlled by the same system the effect of these factors has been omitted from this research.

A key difference between the two sampling systems is the control of exhaust back pressure. Sampling System 3 uses a pressure transducer and secondary dilution pump feedback loop to keep the pressure at one atmosphere [1 atm] – zero positive pressure/ zero negative pressure. Sampling System 1 uses a Positive Displacement Pump (PDP) that operates at fixed pump rpm.

Highlighting this as a fundamental difference between the two emissions sampling systems the exhaust back pressure was recorded at the entry to the delivery pipes and it was found that a;

Ptailpipe = 1.6”H2O

pressure head exists. The implementation of the Critical Flow Venturi (CFV) implies that the volume flow rate is unaffected for small values of downstream pressure fluctuation. The presence of this positive pressure has also been deemed to have a negligible impact on the vehicle exhaust system and the production of emissions.

It can therefore be said that the existence of a 1.6”H2O positive pressure head does not directly contribute to the 2% discrepancy in fuel consumption figures as recorded by GM Holden.

UG5306
Jaemes McArthur

INFLUENCE of automotive seating properties on IIHS rear impact protection ratings

Abstract

In broad terms, this research project was an investigation into the optimisation of automotive seating design to minimise injuries suffered by occupants in rear-end collisions. The primary injury suffered in rear-end collisions at low velocity is Whiplash, which leads to various symptoms entitled Whiplash Associated Disorders (WADs). Rear-end impacts occur frequently, and the resulting injuries have a significant human and financial cost to society. While WADs are common, their causes and the best ways to mitigate them are not clearly established. Previous research has identified that the most influential factor in preventing whiplash injuries is seat design. The currently accepted method for assessing seat performance in preventing whiplash is the IIHS Rear Impact Protection Ratings Test (RIPRT). The test rates the level of seat protection based upon head restraint position, compressive and shear loading on the upper cervical vertebrae, T1 vertebrae acceleration and time to contact between the head and head restraint.

The preliminary work in this project was the development of a background study into whiplash and its likely causes, a critique of the RIPRT and then an evaluation of its effectiveness in rating automotive seating in terms of occupant protection against whiplash. The bulk of the project consisted of the identification of key seat design features which influenced the outcome of the RIPRT and determining which features had the most influence on the achieved rating. This was achieved by first developing a model of a specific seat and the dynamic component of the RIPRT using modelling package MADYMO. The model was then validated against results of a real world test of the same seat, and a sensitivity analysis was completed on the aforementioned whiplash injury rating criteria for each of the identified design features.

It was discovered that the injury criteria used in the RIPRT represented all aspects of the current school of thought on whiplash injury, which define the primary injury mechanisms as neck hyperextension, muscle strains, pressure increases in the spinal column, facet impingement and neck shear. The use of the BioRID II ATD in the test was also established as a major positive for its effectiveness in rating whiplash protection.

Twelve critical seat design parameters where selected for analysis. They were derived from head restraint stiffness and frame rigidity, seat back stiffness and frame rigidity, seat cushion stiffness, seat track rigidity and head restraint position. In general the most influential seat design parameters on the level of occupant protection were head restraint height and head restraint backset. Upper neck compressive force was found to be most sensitive to head restraint height, which had far greater influence than any other seat parameter. Upper neck compressive force was most sensitive to head restraint and seat cushion stiffness, although the exact reason for the influence of seat cushion stiffness could not be established. T1 vertebrae acceleration was most sensitive to head restraint height and backset specifically, but in general the magnitude of T1 acceleration was dictated by the location of the head restraint during rebound. Time to head restraint contact was most influenced by head restraint backset in addition to seat track and seat back frame rigidity. In general, time to head restraint contact was found to be sensitive to any parameter which altered the height difference between the head and head restraint. Since the injury indicators of the model were dominated by the influence of head restraint geometry, the effect of more subtle parameters such as seat back pad stiffness may have been overshadowed. The results of the sensitivity analysis were found to agree reasonably well with those found in literature.

Given the results of this study, the direction of ongoing research was identified as establishing any coupling between the influence of seat parameters on ratings via a Design of Experiments Analysis. Following this, a number of different seat geometries should be tested to determine if any seat design parameters are influential in all cases. The ultimate aim of continued research is identified as the development of general seat design guidelines to help minimise whiplash occurrence in rear-end impacts.

UG5106
Pranavkumar Desai

Crash Compatibility between Vehicles

Abstract

In the automobile industry, crash analysis has become an essential field of interest. In order to obtain the best possible crashworthiness of the vehicle a set of methods has been developed. This project aims at developing the best crashworthiness test of a full vehicle considering the earlier methods available for single component testing. To simulate different crash scenarios, standard models available on NCAC (National Crash Analysis Center) have been used. Using LS Dyna and Hypermesh the crash analysis has been simulated on two bogies. FE analysis has been carried out for four different crash velocities for frontal impact. The report gives an over view for the approach for vehicle to c\vehicle crash simulation methodology. The modeling and simulation technique has been detailed and it also discusses the effect of speed on various parameters like maximum acceleration and maximum displacement.

UG4706
Thaarak C. Dhaamodaran

Bolt Attachment Model Fidelity Study

Abstract

Bolted attachments can be modeled to various degrees of complexity in CAE applications.

It is impossible to use complex bolted model that includes the threads of the bolt and the nut along with their interactions for every analysis.

There have been so many simplified bolted models used at present. Most of them have a bolt without thread and emphasis is given on the friction and contact between the bolt and the attachment. This simplification reduces the computational cost but one has to be cautious about its accuracy and if it captures the actual process or not.

This report is a step towards using simplified bolted attachment models with a proper understanding of both the advantages and disadvantages.

The bolt model explained here will study the loosening mechanism of the threaded bolts due to shear loads.

UG3606
Paul Maxwell

Multi-Objective Design Optimisation of Lightweight Automotive Structures

Abstract

Lightweight materials are becoming ever more important in the automotive industry as auto makers try to find more ways to reduce weight and increase stiffness in a vehicle chassis. This report looks at generating FEA models that replicate the behaviour of the chosen lightweight materials, the aim of which is to provide a base model that can then be optimised using an MDO software package.

The properties of the materials used in the manufacture of the final structures are found through experiments and the final structures are experimented on in order to have data to be compared against after FEA simulation. The FEA simulation of the chosen materials is attempted using two dimensional modelling coupled with generalised plane strain elements.

The simulations carried out in this report show where errors may lie in this type of simplified modelling and also where accuracy exists. While the results are not perfect, some models are good base models for further improvement and others show that a more complex method may be required for accurate results.

UG2806
Sajeev Gerard Dep

Prediction of blower performance curves using computational fluid dynamics

Abstract

The capabilities of Computational Fluid Dynamics (CFD) in predicting automotive blower performance was tested. Performance was quantified through static pressure, efficiency, power and torque performance curves.

For this purpose, several CFD models in the commercial software package FLUENT and GAMBIT were created. Separate models were created to test the effect of various geometrical features, such as scroll shape, tip-clearance and blade shape on the performance of the blower.

The reliability of the standard k-ε and RNG k-ε turbulence models was also contrasted and it was found that the former was easier to converge, whereas the latter was more accurate. The RNG k-ε models failed to converge adequately and thus, flow predictions were approximate at best.

It was found that scrolls without 'spiral casing' were able to predict static pressure performance with errors of up to 22%. Tip-clearance effects diminished the static pressure rise. Efficiency and power predictions were found to be conformant with previous studies but were slightly under-predicted. Torque trends were also found to be accurate but deviations from empirical results reached to 43% at low flow rates.

The flow regimes in the blower were also analyzed along the XY and XZ planes using CFD and expected features of the flow were detected. It was suggested that deterioration of results for lower flow rates was the result of greater mixing and recirculation in the blower.

UG2506
Kaveesh Kumar

Evaluation of Cabin Sensor Options for an HVAC System

Abstract

With the advancement of technology, expectations of customers have always been on the increase in every industry. The automotive industry is no exception. New technologies are being continuously invented all over the globe, thereby fueling the competition. A major player of the automobile industry is the car industry. A crucial feature of any car these days is the ease and comfort while driving. This aspect of being comfortable has become extremely important in the past few decades. Human comfort in automobiles include various aspects like, visibility, ease of driving, ergonomics and a significant part of human comfort is human thermal comfort. This has revolutionized the changes in the air conditioning aspect of automobile design. All the manufacturers aim to improve their air conditioning systems to achieve the best thermal comfort.

This has led to innovative solutions in the market, on how to predict thermal comfort most accurately and hence be able to manipulate the car cabin climate to suit the passenger's needs. Sensors are employed within the car cabins to fine tune the cabin climate. Through this research project, it is being tried to improve the accuracy in prediction of thermal comfort. The Overall aim is to compare the proposed solutions with the existing sensors in use and hence discuss possible future options. The scope of the project was limited to on road test evaluation of the sensor performance and wind tunnel tests of the same sensors. However due to unavailability of the wind tunnels, the testing plan was modified, which will be discussed subsequently in the report. Also, it should be noted that the project aims at finding ways of improved prediction of accurate thermal comfort and not actually improving the thermal comfort. Actual improvement of thermal comfort would be part of the further work that can be done.

To solve this problem, initial research on sensors was carried out and this was related to the research on thermal comfort, which was being done by my project partner, Jarrod Marsden. The working principles of the sensors were understood and various cabin sensors from different brands were studied and compared with each other to choose the ones that were decided to be used for our testing. Seven sensors were short listed in total, which were to be used for our tests. However, not all of them were put to use due to various reasons. After deciding on the sensors, testing plans were developed, which included test designs and car sensor arrangements. This was followed by implementations of those plans, which included learning to use those sensors, data taking and data management and analysis of the tests.

Once the results were analysed, conclusions were drawn from the analysis and recommendations were made, which will be presented in the main report.

UG2806
Rajeevan Jeyarajah

Prediction of blower performance curves using computational fluid dynamics

Abstract

A commercial Computational Fluid Dynamics (CFD) package, Fluent, has been used to predict performance curve of a nominated blower from Air International. The study initially concentrated on a segment of the impeller and once a reasonable output was obtained the simulation was carried out on the whole centrifugal blower including the inlet, impeller and scroll. From the simulation, parameters such as static pressure and efficiency were obtained. These parameters were used to plot performance curves which are then compared against results obtained from performing physical tests on the nominated blower. It was found that the simulation was able to predict the trends in the performance curves accurately; however the values obtained for were only in reasonable agreement with physical tests at low flow rates. This could be due to inadequate grid resolution and insufficient convergence.

The mechanical torque for various rotational speeds were obtained from the simulations, these values were also compared against the torque testing performed on the nominated blower. The trend is predicted accurately however the accuracy decreases with increasing RPM.

CFD's advantage over traditional analytical methods has also been utilized to study the characteristics of the flow field within the blower's scroll and in the blade passages at various flow rates. As expected at low efficiency flow rates, significant flow separations and non-uniformity in the flow was found. Apart from flow separation, various interesting flow patterns such as reverse flow near the cut off and pre-rotation before entering the impeller were observed.

The ability of CFD in optimizing blower design is examined by making changes to the blade profile. Three different blade profiles were tested for the same scroll and the results show evidence that the blade inlet and exit angles play a key role in the blower's performance.

To validate the dependency on grid resolution, grid dependency tests were performed. Three different grids were created for the model with increasing mesh density. The difference in outputs for the different grids was minimal, with the medium mesh returning the most accurate results.

UG2506b
Jarrod Marsden

Evaluation of Cabin Sensor Options for HVAC

Abstract

In modern times people spend an average of 1.1 hrs per days within a vehicle (1), and thus it is no surprise that consumers are demanding more of the vehicles in which they spend their time. Comfort within a vehicle is key issue that needs to be addressed in order to maintain driver satisfaction, safety, and ultimately from the manufacturers point of view to sell more vehicles.

This investigation focuses on the key factors which influence a person's level of thermal comfort within a vehicle, aiming to measure these parameters and to develop a means of more accurately predicting an occupant's thermal sensation.

This was completed through a range of on road experimental tests, assessing a number of different sensor types with respect to their performance, as well as focusing on the importance of sensor location within the cabin itself. The current location used by many vehicle manufacturers was also considered a point of interest, assessing the validity of a sensor at this location for the purposes of comfort analysis.

It was found that the location currently being used, although providing a moderate response to changes in cabin temperature brought about by the HVAC system, was discovered to be an inadequate sensor location. Testing showed that the optimal locations for temperature measurement were those exposed to direct flow from the Heating, Ventilation and Air Conditioning (HVAC) vents. In particular it was found that temperature sensors located directly in front of the driver's face (breath level) and within the vents themselves, produced the most accurate readings, following any temperature changes induced by the HVAC system.

Through a number of experimental tests, a system of comfort prediction was created that allows for temperature measurements taken at the HVAC vent, to be transformed into human comfort predictions in the form of a predicted mean vote (PMV). These comfort predictions were found to be a valid means of predicting the general level of comfort of an occupant within a vehicle.

Theoretical calculations were also completed in order to evaluate an alternative form of comfort prediction. It was found that this method of prediction also provided moderately good results, and thus is also deemed a valid means of general comfort prediction.

UG1906
Inderjit Singh Dhillon

End of Life Vehicles

Abstract

The automobile industry is the largest manufacturing industry in the world and also the industry connected to the recycling of those automobiles is equally large. The Directive of the European Union, U.S and Japan sets targets for the reuse, recycling and recovery of the parts and materials in end-of-life vehicles (ELV). In the future, most automotive parts and materials must be reused, recycled or recovered. The minimum percentages to be reached from 2006 onwards are 80% for reuse and recycling (85% including thermal recovery). These minimum levels are intended to be raised in 2015, when they will be set at 85% (95% including thermal recovery). The directive also encourages vehicle manufacturers, in liaison with material and equipment manufacturers to limit the use of hazardous substances in vehicles. The increase recovery quotas foreseen (95% by 2015) will require the development of new recycling technologies and solutions.

Although ELVs are among the most widely recycled consumer product, only 15-25% of their total mass is currently discarded with no material recovery. To meet the European regulations the amount of this waste material called Shredder Light Fraction (SLF), needs to be further reduced. This goal can be achieved by the different ways, firstly with increased dismantling and reuse of parts before the further treatment of the car body in the shredder, secondly by the development of improved post treatment procedures for SLF.

Currently, the important issue associated with end-of-life vehicles in America is the prevention of environmental contamination by mercury. Reducing the use of mercury in motor vehicles has progressed to the stage that no part containing mercury is used in new motor vehicles, apart for a few that are related to safety.

The recycling targets imposed by the Ministry of Economy, Trade and Industry (METI), Japan in July 2005 call for the recycling of at least 85% of ELV air bags by 2007. The recycling rates set for automobile shredder residue (ASR), which is difficult to process, is 30% or greater by 2005, 50% or greater by 2010, and 70% or greater by 2015 (corresponding to vehicle recovery rates of 88%, 92%, and 95%, respectively).

Over the past few years, a significant amount of research and development has been undertaken to enhance the recycle rate of end-of-life vehicles (ELVs), including enhancing dismantling techniques and improving remanufacturing operations. There is currently no legislation regulating the disposal of end of life vehicles in Australia. It is estimated that 500,000 vehicles reach the end of life cycle each year (Environment Australia) as there is no way of recycling of these vehicles. Approximately 70% of materials by weight are recycled in Australia. The remainder of the ELV, primarily plastics, seat foam, glass and rubber, is sent to landfill as waste and is known ASR. Considering the tightening of the recycling laws for ELVs all over the world, it can be assumed that in the near future a similar situation might be present in Australia requiring an increase of the current recycling rate. Australian car manufacturers are producing cars that will be easier to dismantle and using materials that will be more viable to recycle, but there still have been no steps taken to put in place legislation to govern the disposal of end of life vehicles, as the European Union and Japan have.

UG1906b
Ali Akbar Ahmed

End of Life Vehicles

Abstract

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Ref (1) & Ref (I)

UG1706
Ali Ahmed

Non – Conventional Design solutions for heavy components of a car

Abstract

The project describes of design solutions and finite element analysis of a driveshaft in order to optimize its weight and strength. The project focused on the driveshaft of Deakin Race Technologies SAE racing car, as there were no design specifications inputted by Holden Motors.

Firstly, the focus was laid on the theoretical analysis. The theoretical analysis focused on the adhesive design calculated for composite driveshaft. The different material drive shaft were designed using composites in order to reduce the weight keeping in mind the strength was in accepted value.

Afterwards, the driveshaft was designed virtually using Solidworks and an initial analysis was carried out on Cosmosworks. The mass and volume obtained from these analyses and later on further analysis were carried out on Abaqus to calculate the stresses, strains and final torque. CES EduPack2007 was used to obtain the correct values of the material properties.

UG0806
Arun Viswanath

Assessment of knowledge management capabilities in the product Development process

Abstract

The fight to maintain a competitive edge has guided companies to manage resources and knowledge within them effectively. With the need to manage knowledge arises the need to assess knowledge. Holden is a part of General Motors, a global organisation. This project aimed to develop a framework to assess knowledge management capabilities in standardised processes in the Vehicle Development Process at Holden.

The developed framework includes interviewing a process expert regarding the process and tool. Answers from the interview are quantified and mapped on what is called the Knowledge Management (KM) Spectrum. A process specific assessment of the tool's KM capability is measured by comparing performance of the tool to the process requirements.

The developed framework was used to assess and map KM in the standardised processes. Characteristics of KM in the Vehicle Development Process at Holden were identified.

UG0306
Matthew Pham

Life Cycle Assessment of Self-Pierce Rivets

Abstract

In this modern age of being 'green' and becoming one with the environment, it is often misunderstood the depth of environmental quantities by which anyone or anything impacts on this planet. The goal of this project was to understand the processes involved with the self-pierce riveting project from the drawing board all the way down to the factory floor with the scope of developing an accurate model of the process and analyse it for its environmental impacts, not just for greenhouse gas emissions but for acidification, eutrophication, ozone depletion and photochemical pollutants.

The key to determining the environmental impacts was to conduct a life cycle assessment study on the self-pierce riveting process itself in a cradle-to-gate format, for a single spot join, with a view to extending the study to include five other joining techniques which are currently used or have great potential within the automotive industry. The life cycle engineering software used to model this process was GaBi 4.

Although not all data was attainable, the process and almost every part of the process was represented in some way within the model. What the study found was that the power generation (to provide the energy to the processes) was linked to the environmental impact, and that the number of rivets had the highest contribution to the overall result. By optimising the rivet-die combinations the joint strength would increase resulting in less rivets required, ultimately reducing the environmental impact.

Additionally the study found that the consumables production had an overwhelming contribution to the ozone layer depletion potential. This was found to be related to the energy intensive stages of the production process and the zinc refining.

UG0306b
Clark Orams

Life Cycle Analysis (LCA) of Friction Stir Blind Riveting

Abstract

The life cycle assessment (LCA) is a very useful and powerful tool that assists users in developing products or processes that are friendly towards the environment.

The purpose of this study is to assess what environment impacts are related to the welding process; friction stir blind riveting (FSR) and determine and evaluate the key areas of interest. Based on this, design changes will be made in order to reduce the impacts on the environment.

Acquiring information proved to be a little difficult, with many manufacturers and companies being very tight-lipped and secretive about specifications.

From the analysis it was found that the welding process has the largest environmental impacts overall, with the production of the rivets coming second. The reasons behind this is due to the fact that the cycle time for one join in the welding process is approximately 15 seconds, where the cycle time for one rivet in the production ranges from 0.0114 seconds to 0.3648 seconds depending on the processes associated with the production.

The major influence of environmental impacts from the production is due to the zinc plating of rivets to protect them against corrosion. Transportation had only a minor effect on the environment compared to the welding and production even though the rivets were travelling all the way United Kingdom to Australia.

Six impacts were used in order to analyse friction stir riveting environmental friendliness; global warming potential, acidification potential, eutrophication potential, ozone layer depletion potential, and photochem ozone creation potential. It was found that global warming was the most significant impact out the six as it posses the biggest threat to society and our way of living; today and in the future.

UG0106
Prateek Puri

Material & Recycling Options for Door Skins of ELVs

Abstract

The current energy crisis, high oil prices and demand for higher recyclability rates with only 5% landfilling by 2015, as per the EU ELV Directive, have all led to increased research in material alternatives and recycling strategies. In this context, the objective of this study is to assess an existing automotive component, in particular a door skin of an ELV and various recycling scenarios including metallic recycling, landfilling, energy recovery and mechanical recycling, in order to determine the most eco-efficient material alternative and the corresponding recycling option.
Through the analysis of a door skin, the study attempts to develop a framework for producing an eco-efficiency portfolio for the entire car. Eco-efficiency analysis is a process of ecological optimization of overall systems while not disregarding economic factors. In this study, a life cycle assessment of door skin is performed where the environmental impacts such as energy consumption, raw material or resource depletion, global warming potential, acidification potential, ozone depletion, water emissions and solid waste emissions are assessed for the production, use and recycling phases of the door skin.
These are combined with the costs of producing, using and recycling door skins, to obtain an eco-efficiency portfolio of the material alternatives and recycling technologies. Six material alternatives were tested under this scheme of Life Cycle Analysis and Eco-efficiency portfolio development. These include steel which was the base case, virgin aluminium, a mixture of 89% virgin aluminium and 11% recycled or wrought aluminium, polypropylene, glass and carbon fiber reinforced skins with polypropylene matrix. A recycling scenario was associated with each of the material alternatives studied. Magnetic and eddy current separation techniques followed by appropriate method of melting and recasting were associated with steel and aluminium skins respectively.
Three different recycling scenarios were studied in detail in the case of plastics. These included landfill involving no material treatment and simple disposal onto waste land, energy recovery involving the recovery of heat and other forms of energy from the plastics and the third option being mechanical recycling which involves the treatment of the ELV skins for material recovery in the form of recycled granules to be used in an open loop or closed loop recycling process.
The results of life cycle analysis and thereafter the eco-efficiency portfolio determined that steel and carbon-fiber composite are both eco-inefficient due to high environmental and economic cost, respectively. Glass Fiber composite is eco-efficient only if the recycling scenario is mechanical recycling while polypropylene and wrought aluminium are both ecoefficient for all the recycling scenarios studied.
Further research into improving data quality through greater industry contacts is essential for developing a more accurate and transparent eco-efficiency portfolio. Greater research into improving the mechanical properties of polypropylene is required such as the study of tailored composites with preferred orientation of fibers. Inclusion of bio-composites as an additional material alternative will address the needs of sustainability in automotive design and help in development of a better comparison between the conventional materials and new automotive materials.
Sensitivity analysis should be performed by accounting for varying substitution factors which represent the amount of material that can be substituted back after recovery to produce new skins of sufficient strength. The qualitative aspects of Toxicity and risk potentials should be addressed in a more quantitative way through discussions with experts. The societal factors determining the relevance of the impact categories need to be determined through public surveys and interviews to increase the Australian context of this study and benefit the Australian automotive industry.

UG0606
Steven Repinac

An Experimental Investigation of the Steady-State Aerodynamic Effects Between Two Vehicle Reference Models in Adjacent Lanes.

Abstract

A lot of research has been dedicated to what is called platooning. Platooning is achieved when one vehicle, controlled by an Automated Highway System (AHS), travels directly behind the other to take advantage of a number of benefits which exist; the main ones being that of highway congestion relief as well as aerodynamic drag reduction and hence energy consumption, resulting in less green houses gases. As it may seem that platooning is a promising answer for future transportation systems there are a number of drawbacks and hurdles which exist making the idea of platooning less and less robust.

For this reason an alternative solution exists called 'Free Agent Theory'. The main difference between these two transportation solutions is that 'Free Agent Theory' allows the participating vehicles to travel in multi-lane arrangements in and around today's manually controlled traffic [2]. Therefore this paper investigates thepossibility of achieving a net drag benefit through carefully organised multi-lane arrangements.

With the ability to reduce aerodynamic drag and hence energy consumption the discovery made in this paper is a fundamental finding for both the international transportation and environmental communities.

UG0506
Timothy Cole

Courtney Boughen

Low Speed Reverse Object Detection System

Abstract

Document Purpose

This document presents the requirements of a mechatronic system for automotive applications designed to assist drivers in avoiding collisions while reversing. The design relates particularly to the implementation of an automatic object detection and brake actuation system to reduce theincidence of rear impact collisions between automobiles and pedestrians.

About the Project

The automotive industry is currently developing and implementing sensor systems designed to aid in the prevention of low speed reversing collisions. These systems are effective at providing information to the driver about collisions with relatively large stationary objects, but fail to provide adequate means to detect impacts with smaller and/or moving objects. Statistical evidence shows that impacts such as these often occur between reversing cars and pedestrian traffic and lead to numerous deaths and injuries. Reducing this type of accident, and reducing the severity of injuries potentially inflicted in these collisions is the primary focus of this project.

The aim of this research project, with the sponsorship of GM Holden Innovations, is to design and develop a system that can detect and discriminate objects on the ground in the path of the vehicle when reversing. When an object detection takes place an electric actuator will apply the handbrake of the vehicle to avoid or minimize the impending impact. Simultaneously, the system will alert the driver of the vehicle to the activation of the system whereby the driver should manually check clearance at the rear of the vehicle. It is desired that the system provide similar functionality to current sensor systems, but with extended capabilities of detecting small and non-stationary objects with very high accuracy and automatic braking capabilities.

UG0706
Edhem Custovic

Current global status of Intelligent Speed Adaptation and steps for commercial implementation in Australia

Abstract

The overall aim of the research is to provide a current global status of ISA and review what leading countries have done in order to push ISA as an obligatory device in all vehicles. As well as providing evidence as to why ISA needs to implemented in Australia, the research studies the acceptance of ISA amongst a 1000 Melbourne drivers of all ages through the use of a survey. Road trauma is today considered one of the world's major health problems; according to the World Health Organization road traffic injuries rank second to HIV/AIDS as the leading cause of ill health and premature death of adult men aged 15-44 years, world-wide. Evidence has proven that 95% of vehicle accidents are caused by driver behavior and in a large proportion of these; excessive speed was the main factor. Recent study has shown that people are very easily confused with impact speeds and believe accidents at 100km/h zones are dangerous, but really half of all fatalities occurred at an impact speed ("delta V") of 50km/h or less. All European countries who have undertaken ISA trials have proven that it has many benefits.

Average speeds were reduced, emissions were lowered and fuel consumption dropped on average by 5%. Following times increased in between vehicles and travel times did not increase as some professional predicted. Some countries are using insurance companies as a means of making ISA more acceptable by offering lower insurance premiums. Many European countries have developed plans by which they plan to make ISA a standard in new vehicles by the year 2010. Although Australia has not spent not nearly as much money on ISA research as Europe, they have produced two excellent products.

SpeedAlert is a passive product which advises drivers if they are exceeding the speed limit on a certain stretch of road. It currently is on the market but is only functional in the Sydney metropolitan area. SpeedShield is Melbourne based and is an active system which helps drivers by not allowing them to exceed the posted speed limit unless they want to override the system. Both companies are slow to get going and are having problems due to the lack of support from the government and leading automotive companies. The survey proved that ISA was highly thought of as a means of speed reduction. The passive systems were very acceptable while the active system was not as popular unless it was easily overrideable at the driver's convenience. Australia has an opportunity which it can not allow to slip. If ISA can be successfully launched, Australia will be the leader in the technology and have a valuable export product. Therefore it is in the governments best interest to help with the build up of a national speed limit database in order to help this ground breaking technology grow. Indeed it will not only help save lives and prevent accidents but also save the government millions of dollars in the future. There can be no doubt that ISA would be a wise investment.

UG0706
Michael Salt

CBD Traffic Simulation

Abstract

The automotive industry is always at the cutting edge of technology, constantly researching and developing technologies that will make vehicles smarter, safer and more efficient. At present there is an interest in the possible implementation of drive-by-wire technologies such as Intelligent Speed Adaptation (ISA) in motor vehicles. Full-ISA is expected to improve traffic conditions and provide further occupant safety by automating the speed of vehicles in road networks. To view the possible improvements that ISA may provide a means of simulating the technologies is required. A number of different traffic simulation techniques are available and software micro-simulation currently a good method of simulating vehicle interaction in large networks. With further manipulation this software may also be used to simulate the implementation of drive-by-wire technologies such as ISA. This may provide the automotive industry with the necessary proof to further investigate and implement the new drive-by-wire technology. AIMSUN NG is a popular microscopic traffic simulation package with the ability to implement ISA and possibly other technologies and provide useful data that highlights improved traffic conditions. This document considers the benefits and limitations of AIMSUN NG to simulate ISA technology.

UG2206
Adam Williams

Modelling and control of an evaporator using a variable stroke compressor in automotive hvac systems.

Abstract

This report details the completed analysis of controlling an evaporator in an automotive HVAC system that utilises a variable stroke compressor. The report reviews the past eight month's progress completed by the author. The overall aim of this analysis was to attempt to control the evaporator component and therefore overall stability of the HVAC system by varying the operating conditions of various experimental tests to find and avoid various existing issues.

With a focus on controlling the refrigerant mass flow rate and heat input rates of the evaporator, the report identifies a series of prevailing issues and details possible resolutions and recommendations. The report informs the reader of the major advantages and disadvantages that are present with the use of a variable stroke compressor operated automotive air conditioning unit and makes comparisons to the contrasting clutched compressor run systems. A set of performance curves for systems operating with a varying blower fan have been produced to avoid a variety of the known issues. Topics such as the vapour compression cycle, refrigerant selection, experimental investigation and the feasibility of creating an experimental HVAC bench test are covered.

UG4106
Yan Chiang Lim

Haryo Kumoro Rahmandhewo

Yee Cheng Ma

Application of DFFS and MDO to design of Crash Structures

Abstract

At the present time, vehicle structure is designed to increase passenger safety during collision by absorbing energy. The crash structure will be investigated by applying DFSS (Design for six sigma) and MDO (Multidisciplinary design optimization) method. The investigation will include analysis of energy absorption, buckling theory, strain energy method, material of the structure, temperature, geometric shape and orientation of loading. There are various types of mode/shape that will occur as soon as axial load is applied on the structure member. In a case where the structure has a large value of L, length, the structure will experience buckling. When buckling occurs, the structure will also experience energy impact due to the load applied. The properties such as the material, temperature, geometric shape and orientation of loading will also influence the energy absorption ability of the structure.

UG4606
Lindsay Vine

CAN Bus Simulator

Abstract

The Controller Area Network (CAN) Bus has become the standard for in-vehicle system control, CAN Bus is a controller network where devices can be controlled via short messages in a reliable manner. This project aims to develop a CAN general purpose IO module that can be networked with a lower speed single wire CAN so as to provide reading of sensors as well as logging and control of ancillary devices within a vehicle by a boot mounted computing system.

This project is apart of the Standardised Approach for Emergency Vehicles (SAFE) project being conducted by VPAC with the support of AutoCRC. The SAFE vehicles project aims to improve power supply management for multiple in-vehicle technologies, minimise driver distraction and incorporate ergonomic and human factors principles to improve safety for drivers, passengers and other road users.

With this project, we hope to develop a system with its own onboard CAN IO capabilities and functionality. By utilising various aspects of two development boards and experimenting with their onboard capabilities, it will be possible to then determine a desired CAN configuration. From this it will be possible to develop a stand alone hardware and software configuration which will allow us to communicate and control various in vehicle electronics systems.

UG5106b
Mehul Pajwani

Compatibility between Car and Roadside Structures

Abstract

This project deals with Compatibility of passenger cars with the roadside structures. The Finite Element Analysis (FEA) approach is used to address this and the front collision is considered as worst case scenario based on the literature review.

FE model of Ford Taurus car model was used first to address this but due to some technical reasons it was not working to get the desired output parameters and so the FE car model was simplified to more simple one, i.e. 'Breakaway Bogie' which is a representative model of 1979 Volkswagen Rabbit[22]. The pole was selected as roadside infrastructure based on literature review as worst case and modeled using HyperMesh(v8.0). Two different materials viz. Aluminum and Steel were chosen for the pole and different results were requested for initial velocity of 40 kmph for bogie crash with these poles. The software used for these analyses purpose was LS-DYNA (ls97ld.7600.398 version)

The results are then post-processed with eto/Post GL. and LS-Prepost and discussed in detail. Finally some recommendations are made based on these results to improve compatibility. Some future work is also suggested at the end.

UG6206
Ben Charles

Evaluation of Radio Frequency Identification technologies for supply chain applications characterised by metallic environments

Abstract

Assets and inventory represent a large investment for companies throughout the supply chain. Managing assets and inventory effectively is critical to the success of a supply chain as it increases efficiency and productivity while reducing costs. Radio Frequency Identification (RFID) relying on radio waves for communication, can aid this endeavour. These radio waves however, are scattered by metallic items thus hindering RFID system operation.

This thesis presents an evaluation of current RFID technology. It provides an assessment of both the technical and commercial feasibility associated with a RFID system implementation in a supply chian context categorised by a highly metallic environment. Much of the work was undertaken in conjunction with the ANU-Toll Auto Logistics Wireless Supply Chain Tracking (WSCT) project which aims to investigate the use of wireless tracking technologies, in particular RFID in the automotive logistics sector.

The project was conducted in four main phases:

1. The first phase involved a theoretical evaluation of commercially available RFID products. Data collected included attributes such as: tag read ranges, data capacity, price etc. A quality function deployment (QFD) was then used to determine which products should be purchased for further testing and evaluation.

2. The second phase involved performing laboratory based tests on the products identified in phase one. Evaluation comprised a combination of static and dynamic testing.

3. The third phase of the project involved performing subsets of the laboratory based tests onsite at Toll's Melbourne warehouse. These test were undertaken to verify the phase 2 results.

4. Phase four involved the development of equations to compare the benefits and costs associated with the implementation of a RFID system. A Net Present Value (NPV) analysis was used to determine the return on investment. Results showed that, for the WSCT project, read range was an important attribute of the RFID system, closely followed by price. These two attributes were found to be linked inversely. Results showed that on average it costs $2.50 per metre of read range for passive tags.

Results also showed that there is currently available RFID tag and reader technology that performs to a level appropriate for the WSCT project. Such technology is capable of functioning in metallic environments. Performance decreases in metallic environments were noted however, with the vendor specified read range being reduced by 32% (on average) in a metallic environment.

RFID system attributes were analysed to develop a cost benefit equation. An example scenario was used to test this equation. Outcomes from the test indicate that a detailed Net Present Value (NPV) required careful consideration of intangible costs and benefits which are application specific.

It was concluded that even though RFID is still in the early stages of technology maturity and is rapidly developing, current RFID technology has great potential in supply chain applications, even where there is a high presence of metals.

UG7106
Roland Stokes

Analysis of Fuel Consumption Improvements through Improved Automatic Transmission and Engine Warm-Up

Abstract

There are improvements in fuel consumption to be found in passenger vehicles by increasing automatic transmission, engine oil and engine coolant warm-up and operating temperatures. This study looks at a simulation of a 2007 5-speed automatic V6 VE Holden Commodore for the effect of various increased temperatures on fuel consumption over both the NEDC and FTP75 drive-cycles. An attempt was made to correlate the simulation model, the UVM, with real test data. It was found that a large proportion of fuel used during a cold-start is due to increased idle speed for faster warm-up. This factor was excluded as an unwanted experimental variable from the perspective of investigating powertrain sensitivity to temperature. The study also investigates one potential relocation of the automatic transmission heat exchanger for improved warm-up.

Based on the simulation, over the NEDC drive-cycle there are fuel consumption improvements to be found of up to 0.70% for an increase of ATF temperature of 50°C by the end of the cycle, 0.94% for a similar increase in temperature of engine oil and 0.32% to be found for an increase of 20°C by the end of the cycle for increased engine coolant warm-up temperature. A fuel consumption improvement can also be found when the ATF, engine oil, and engine coolant are started warm; the ATF shows greatest fuel consumption improvement of 1.68% over the FTP75 cycle, as compared to a 0.7% saving over the NEDC cycle.

The engine oil also shows greatest improvement over the FTP75 cycle with a 2.90% improvement when started warm, as compared with the NEDC cycle saving of 2.76%. The engine coolant shows an improvement in fuel consumption over the FTP75 cycle of 0.90% and 0.04% over the NEDC cycle. When all three components are started warm the NEDC cycle shows the greatest change, with 3.78% improvement in fuel consumption over the cycle. The FTP75 cycle shows a similar saving of 3.69%. Real world test data indicates there is an improvement in fuel consumption of 7.99% between a hot start and a cold start over the NEDC cycle and 4.59% over the FTP75 cycle. The UVM simulation data to real data correlation thus ranges from 0.47 for the NEDC cycle to 0.8 for the FTP75. This shows that the UVM is not a highly precise tool, but can give useful order-of-magnitude results.

The NEDC cycle has greater scope for improvement in fuel consumption overall due to increased warm-up temperatures, as it is a gentler load, low heat generation drive-cycle, when compared with the more aggressive FTP75 cycle. The explanation for why the individual components of the FTP75 cycle give the greatest saving in the simulations is unknown, however it is suspected it is due to the more transient nature of the FTP75 cycle.

The study continues to describe a suitable placement for relocation for a transmission heat exchanger to the inlet (hot) side of the radiator for increased transmission warm-up. The best potential location for this requirement is defined to be the top tank of the radiator or above the radiator, provided the radiator is lowered to maintain a suitable clearance to the bonnet. The simulation of thermal properties of the new location show there is a very small improvement in fuel consumption, of about 0.05%, to be found. With the UVM underestimation taken to be roughly 0.5, the potential improvement in fuel consumption would be about 0.10%.

UG6606
Adnan Mohammad-Ali

Danny Tran

Michael Santos

Sensorless Brushed DC Motor Position Control

Abstract

There are several alternatives in controlling a DC brush motor for position estimation control without feedback (essentially sensorless). One of the main alternatives in controlling a DC brush motor is by using the program MatLab to simulate. Another option is using a PIC microprocessor to execute our instruction input signals. This allows the user to communicate with the DC brush motor and retain generic values by using MatLab and/or a PIC microprocessor.

Within Matlab there are program codes that are generated by Simulink. The programming language that Matlab uses is the C language which then with minimal adjustments can be directly uploaded to PIC. This is then converted to low level assembly language to communicate with the Motorola digital signal processing (DSP) chip.

The Motorola digital signal processing (DSP) chip to send pulse width modulated (PWM) signals to the DC brush motor thereby controlling the output of the motor but also retaining the Back EMF (BEMF). By analysing the risks that are involved with this project, the solutions can be derived to eliminate or reduce the risk from occurring thereby minimizing cost and time to complete the project.

As this project is in partnership with Futuris, measures are in place to protect RMIT University, their students and Futuris through a confidentiality agreement. This agreement does not allow the people involve divulging cost and financial information within the design proposal.

UG5806
Dusan Popovic

Technical & Commercial Feasibility of Introducing Lightweight Body Closures to Australian automotive Manufacturing.

Abstract

The environmental impact of the burning of fossil fuels has become clearly evident in recent years as the side effect of human activity such as the Greenhouse Effect and global warming shift from scientific predictions to undeniable facts. The transport sector is significant contributor in the increase in carbon dioxide levels in the atmosphere and alternative methods such as solar, hybrid electric and fuel cell technology are continually becoming more readily available. However until these alternatives can totally replace internal combustion engines, solutions need to be sought to increase the efficiency and fuel economy of existing automobiles and in turn reduce CO2 emissions.

In addition to this, rising fuel prices and increasingly stringent legal requirements are encouraging consumers, particularly in Australia to opt for smaller, lighter vehicles. Hence, there is a desperate need to minimize the weight of car bodies and the aim of this project is to analyse the technical and commercial feasibility of introducing lightweight automotive body closures through changes in design, production processes and material selection.

UG5406
Chris Simmons

Elderly and disabled seating critical justification.

Abstract

This project aims to address the needs of a rising population of elderly people and the consequent increase of people with movement-impairing disabilities and injuries. A review of current products and services that cater for this demographic has found that although there are systems in place to accommodate wheelchairs within vehicles of transportation, many of these systems do not use space efficiently, are not cost effective, lack configurability and are often created with the removal and replacement of original seating. It is therefore the project's obligation to design transportation seating for both elderly and disabled people with as little discrimination between each person's physical capacity as possible. In other words, a seat for anyone: 4NE1.

After extensive research into current products that aid elderly and disabled people, talks with industry personnel and health care workers at local councils and service providers, and discussions with an accredited Ergonomist and Occupational Therapists, has resulted in a wealth of information about the chosen demographic about their specific needs and requirements.

As a result of compiled information and professional opinions on issues relating to current seating and products for elderly and disabled people, a transpo seat has been designed to assist passengers of varying sizes and physical abilities, whilst having the flexibility to be rearranged to best utilize space within a vehicle, or be removed for easy repair and maintenance.

UG1706b
Paphan Tungcharoen

Non-conventional Design Solutions for Heavy Components of Vehicles

Abstract

This thesis describes the design solutions and finite element analysis which were conducted to optimize the weight and strength of drive shaft. This project was focused on the drive shaft for SAE racing car. The result between theoretical and finite element analysis was led to make a decision for the best driveshaft model.

In the first section of this project, the theoretical analysis focused on adhesive designs which were calculated for composite driveshaft. The different material drive shafts were designed to use composite materials in order to reduce the weight while the strength was in the accepted values. There were three designs and in each model has two different values of diameter.

In the second part of this project, finite element analysis, SolidWorks and CosmosWorks were used for generate models and make the finite element analysis, and CES EduPack2007 was used for correcting the data of material properties. In this section, there were three more homogeneous material models for driveshaft which were made for finite element analysis.

UG2306
Natasha Coelho

Modelling and control of Evaporator with Clutched and Variable Stroke compressor in an Automotive Air Conditioning System.

Abstract

This report details the advances made towards automotive air conditioning technology with a particular focus on clutched and variable stroke compressor analysis and parameter relationships. A wide-ranging body of preliminary work, including air conditioning operation and system performance; compressor description; the effect of lubrication on compressor performance; and the phenomenon of evaporator frosting, was completed in order to set up a successful outcome for the later compressor and thermodynamic analysis. Preliminary Air International experimental data investigation validated current theory and also identified some gaps in knowledge, for which experimental results for Air International were produced.

The performance of the control valve is analysed in this paper in order to study the characteristics of the variable stroke wobble plate compressor. Based on force balance equations and mass and energy conservation equations, a mathematical model of the control valve has been developed. The refrigeration cycle performance was evaluated through the following parameters: cooling load of the evaporator, compressor power input, and coefficient of performance. The wind tunnel inputs such as ambient temperature, humidity, wind speed, solar load and FR (front roller) and RR (rear roller) load are compared and analysed in different Air International tests, as well as vehicle variables and inputs such as engine speed, Air conditioning current and compressor discharge and suction pressures. The mechanics of a heating, ventilation and air- conditioning (HVAC) system have been explored through an operational HVAC description set up, for use in future experiments in the Mechanical Engineering workshop.

As a result of these substantial findings, this project provides a rigorous framework for future research in this area. This project fulfilled all of its objectives and produced a detailed insight into the behaviour and parameter relationships behind an automotive air conditioning system.

UG2006
Shalin D Desai

Driver Distraction Test Rig

Abstract

In today's age, a car can have everything from a small audio system to stylish TV screens, or from a simple air conditioning system to complicated HVAC system. All these systems are being designed and developed to give users added comfort while in the car. Many of these systems are really clever and well thought innovations, but some of them are just gimmicky. These systems are source of distraction for the driver.

The project Driver Distraction Test Rig is an AutoCRC project, sponsored by Holden. The project aims to design and develop a test rig that will be used to test the level of distraction cased to the driver of a vehicle by in vehicle information system (IVIS).

UG4406
Justin Dopierala

Topology and parametric geometry design ofload paths in an energy absorbing structure

Abstract

The purpose of this paper is to document the design of an energy absorbing structure to be used in an automotive vehicle during frontal collisions. The researcher is currently a student at Swinburne University of Technology and has undertaken this research project as a final year project in his Bachelor of Engineering (Mechanical) degree. The research covers the use of topology optimisation in identifying load paths in the energy absorbing structure and parametric geometry in the creating the model of the energy absorbing structure. The research project found that parametric geometry helps in aiding the optimisation of the energy absorbing structure by changing its characteristics easily. It was also found through the literature review studied, that topology optimisation is a possible tool in the use of finding load paths on a vehicle during its concept design. Further, recommendations are made on this area of study to aid in its continued research.

UG7206
Nikko Ravel

Foong Cheah

Monitoring of Knocking Combustion in Gasoline Engines During Dynamometer Operations

Abstract

Holden has become actively involved in the search for appropriate knock detection systems and with AutoCRC are proud sponsors of this project. It was Holden's requirements that a knock detection system is capable of dynamometer detection, as the project title suggests. Therefore, an investigation into the reliability, advantages and disadvantages of different methods of detecting knock was carried out based on dynamometer operation. Another key criterion of the project was the ability to distinguish between the intensities of engine knock. This would prove to consume the majority of the analysis.

The main objective in achieving a higher reliability was to be able to replace the copper pipe method, which is heavily subjective to the hearing of the operator. In obtaining the data, two engines were employed to provide data for the analysis, an eight cylinder engine and a four cylinder engine. These two engines were selected due to the nature of the majority of the engines produced in today's market. Furthermore a correlation between the two engines would allow interpolation to obtain values for a six cylinder engine. The two engines were operated by different dynamometer operators that immediately highlighted the issue with reliability of the copper pipe method.

The large amounts of raw data that was obtained was difficult to process through normal means, as a result, Holden provided a copy of Concerto (an offline version of their combustion analysis program Indicom). This improved the ability to process the data and enabled a visualization of the data to allow cross checking. From the experimental data, it was concluded that the pressure transducers provide significantly more accurate results when the knock detection was actively conducted. Although the pressure transducers are more difficult to install, it was clear that this was merited. Moreover, several analysis methods were discussed and it was determined that peak methods were more relevant to the pressure transducer, whereas integral methods were more applicable to the accelerometers. In turn, the third derivative peak method was initially selected as the preferred analysis method. Unfortunately, due to restrictions in the criteria and the processing power of computers it was not a viable option. This lead to the selection of the second most effective method: peak to peak. With this method, the pressure transducers are several times more sensitive than any of the accelerometer methods.

The set back was originally thought to be of high consequence but due to the nature of the methods and the system, it was possible to scale the data and recalculate the values, ratios and limits that were previously determined. Additionally, the module and layout that are used to calculate and display the knock events respectively were easily modified to allow the utilization of the peak to peak method. The data from the four cylinder engine and the eight cylinder engine suggests that the ratios between the engines are virtually identical. This was deduced to the fact that they are ratios of the combustion in the cylinder, that does not varying significantly with the variation in engines.

Although the aim of the project was to attempt to eliminate subjectivity, the selection of the knock ratios was to a certain degree subjective. The data provided concurs with the selection of ratios of 2.25 for light knock, 3.5 for medium knock and 4.75 for heavy knock. This provides a reduction in

the subjectivity related to the monitoring of knock and offers a reliable estimation as to the intensity of the knock. The system that was created illustrates the events as they occur in their respective rating and the frequency of their occurrence which is further utilized to determine the severity.

UG2906
Umashankar Gunashekar

Influence of Heat Exchanger Air Flow Distribution on Exchanger Effectiveness

Abstract

The performance of heater core was often assessed ideal fully developed airflow conditions were the air is uniformly distributed across the heat core face. In a HVAC design the air distribution is far from uniform and is rated with a Key Performance Indicator (KPI). The influence of the KPI against real heat exchange output is not well understood.

In order to understand the relationship between the velocity profiles KPI on the heater core surface and output of heater core, series of CFD simulation were carried out and the project was split in to small number of modules to get accurate results.

Module 1:- Developing relationship between the baffle height and KPI on heater core surface.

Module 2:- Modelling the heater core with no fins and zero wall thickness tube.

Module 3:- Calculating the correction factor on effect of fins.

Module 4:- Calibrating the Model to the Lab test condition.

Module 5:- Developing relationship between the KPI and the Heat transfer rate.

The project results will give better understanding and relationship between the effect of the velocity profile KPI on the heat exchanger output.

UG1306
Pranav Thaker

Zahid Manzoor

Rear Visibility in Vehicles

Abstract

This dissertation is the report for a final year engineering project undertaken at Swinburne University of technology in accordance with the Faculty of Engineering, within the year 2007. Research and literature were undertaken during semester 1 in 2007. This provided us with the reasons that cause poor rear visibility and the approach that should be undertaken to rectify them. Implementation, testing and discussion of the devices were carried out in semester 2 in 2007. This states the ways by which the barrier of poor rear visibility can be overcome and provide safety to the people.

The objective of the research was to define the problems caused by poor rear visibility of different vehicles and how well current technologies perform in detecting objects, particularly small children. Latest back-over avoidance technologies were identified and examined. The object detection performance of sensor-based system was measured using a set of test objects in both static and dynamics conditions. Rearview camera system was examined to determine the field of view and subjectively estimate the clarity of the image they provide of the area behind the vehicle.

Sensor-based systems generally exhibited very poor ability to detect pedestrians, especially children, located behind the vehicle. Systems' detection performance for children was inconsistence, unreliable, and in nearly all the cases very limited in range. Based on the calculations of the distance required to stop from a particular vehicle speed, detection ranges exhibited by the system was not sufficient to prevent many collisions with pedestrians or other objects.

The rearview video system examined had the ability to show the pedestrians or objects behind the vehicle and provided a clear image of the area behind the vehicle in daylight and indoor lighted conditions. In order for backing system to prevent crashes, drivers must look at the video display, perceive the pedestrian or obstacle, and respond correctly.

UG5406b
Kate Wardley

Intergenerational Automotive Access and Seating Innovations

Abstract

In 2006 over one billion people worldwide lived with a functional impairment. By 2030 that figure is projected to increase to two billion – 1 in 4 of the Earth's inhabitants (World Health Organisation, 2006). Some of these functional impairments include mental and physical disabilities, old age, and injuries. All of these impairments decrease a person's mobility and ability live independently. There is an increasing demand to accommodate this growing market needs into product design.

This report outlines the research and design of Life, an automotive seat which assists the occupant to overcome their physical impairments, in alighting and disembarking passenger cars independently. It is proposed the vehicle seat will be launched in the year 2020 on a Global platform, within a small luxury model automobile.

This paper offers a bridge between automotive seat design and research on the physical impairments of the elderly and physically impaired. Research findings include market feasibility, user considerations and seat system design parameters; packaging, interior space, ergonomics, H-point control, seat loading, materials, manufacturing and safety.

The final design solution incorporating a rotary mechanism, innovative materials and style can be integrated into most standard passenger vehicles with little additional design effort, and that the adaptations should also increase vehicle marketability. Finally, while most, if not all, of the proposed seat adaptations would be made to largely benefit the elderly, they will nevertheless support and improve driving and comfort across all age groups.

With a projected rise in the number of elderly, most who have relied primary on the private automobile for their mobility, it is likely Life, a future vehicle seat design will improve the long term use of private vehicles by the elderly and physically impaired.

UG1806
Vaishampayan Saxena

Material Selection for Automotive Purposes

Abstract

This report is concentrated about developing a systematic procedure of material selection for automobile components only. There are around 15000 automobile components which are used to manufacture of a car. This report will revolve around automobile material selection because Weight saving is one of the major concentration point in automobile industry. This is because of the reason to improve the fuel economy of automobiles. Easily, this can be done by reducing the weight of the vehicle components. So the materials with lower densities have become point of concentration. For few decades engineers are trying to use low density materials for automobile application, and to some extent they are successful too.

This report introduces the design process and how material selection is related to design process. Traditional material selection process has been described and Ashby method of material selection process has been discussed. There are some computerized material selection software has been talked about but CES is explained in detail. CES is the most popular software these days so making it as a base and its shortcomings a solution has been suggested. Main task of this report is to develop a strategy to select a single material for a specific application. For a single material to be selected neutralization technique and weitage application system has been suggested.