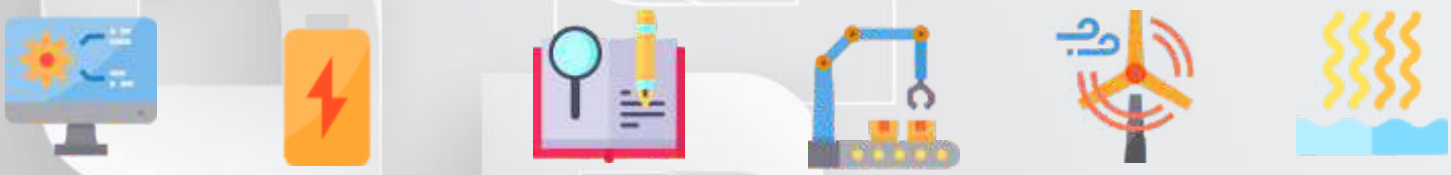
PES UNIVERSITY

pmr LAB

January 2020 - ISSUE 4

Department of Mechanical Engineering



N E W S L E T T E R

From the Editor's Desk

The new year heralded a change of guard at the top level in the University. On 18th January 2020, **Dr. J Suryaprasad** took over as the second Vice-Chancellor of the University from Dr. KNB Murthy who had completed two terms while **Dr. KS Sridhar** took over as the second Registrar from Dr. V. Krishnamurthy, who too had completed two terms. Both are not new to the PES ecosystem. Dr. Suryaprasad was a faculty member in the Department of Computer Science and Engg., in the late 1990s, before he went to Florida Atlantic University, USA to pursue his PhD. He returned in 2005 to take over as the Director, PES School of Engg., later PESIT South Campus, now PES University (Electronic City Campus). Dr. KS Sridhar, joined PESIT in 1989 and has served the Institution in every several capacities including Principal, PESIT West Campus, Dean - Training & Placement, Chairperson - Department of Mechanical Engg., among others. We wish them the very best in their efforts to take PES University to the next level.

Dr. V Sambasiva Rao, a PhD from BITS Pilani and former Deputy Director, ISRO Satellite Centre, joined PESIT in July 2011 as a Professor in the Department of Electronics and Communication Engineering and is presently the Director of Crucible of Research and Innovation (CORI), PESU. He was instrumental in PES launching its very own satellite – PISAT (PES Imaging SATellite) in September 2016, which received encomiums from no less a person than Hon'ble Prime Minister Sri Narendra Modi. We are happy to feature a special article on him in this edition.

Dr. N Rajesh Mathivanan has taken charge as the Chairperson, Department of Mechanical Engg., from 7th February 2020. He is an alumnus of PESIT and belongs to the graduating class of 1997 and joined PESIT as faculty member in Department of Mechanical Engg., in November 2000 and presently holds the designation of Professor in the Department besides being the Chairperson. He was deputed under 'QIP' and completed his PhD from NIT Trichy in 2011 in the area of Impact Characterisation of FRP Composites and brings with himself a rich experience of teaching, research and administration. We wish Dr. Rajesh the very best in his efforts towards making the Department ready for the challenges of the next-gen and taking it forward.

The last six months have seen interesting research work in frontier areas. Projects such as – Development of a Case Carburisation Model in collaboration with Sansera Engg. Pvt. Ltd., Quenching using Nanofluids, Study of Subcooled Liquid Boiling, Use of Artificial Neural Networks (ANN) and Genetic Algorithm (GA) in Heat Transfer Problems, Use of Phase Change Materials (PCM) for Battery Management and many more have added a new dimension to the research happenings in the Lab. Amongst the consultancy projects the Lab executed, one was on analysis and development of a prosthetic foot for one of our clients, spearheaded by **Dr. BK Keshavan** (Dean of Engineering & Technology), **Dr. MJ Venkatarangan** (Professor, Electrical Engg. Dept.) and **Dr. B Rammohan** (Associate Professor, Mech Engg. Dept.) and another on flow analysis of a cross flow heat exchanger used in power generators by **Mr. Babu Rao P.** (Assistant Professor, Mech Engg. Dept.) The successful completion of both, brought many a cheer to both the clients and the Lab team. The Lab team presented a number of research articles in International and National Conferences, besides bringing out a number of peer reviewed journal publications. Our deepest appreciation to all authors.

Two esteemed professors have been kind enough to join the PMR Lab team as Distinguished Adjunct Professors – **Prof. Perumal Nithiarasu,** Research Director and Deputy Head, College of Engineering and Dean, Academic Leadership (Research Impact), Swansea University, UK and **Dr. C Ranganayakulu**, Sc. H / Outstanding Scientist, Associate TD(GS) & Group Director (ECS), Aeronautical Development Agency (ADA), GOI, Bengaluru. The Lab expresses its grateful thanks to both these stalwarts and looks forward to working closely with them on cutting edge research in their chosen areas.

Wishing all readers, a safe and healthy season as the nation and the world battles a real virus, which threatens to bring the world and its furiously paced netizens to a grinding halt. Maybe this is nature's way to detox the environment and bring some sense to an otherwise insensitive humankind.

- Dr. V Krishna
Editor, Head, PMR Lab

Readers' Response

what we've heard from you

Dear Professor,

Congratulations for sending the excellent newsletter of your PES University it is very interesting to read.

Thanks & Regards,

T R N Prakash
Rotary

Heartiest Congratulations Sir. Keep up the good work.

Dr. T. S. Chandar
Professor,
Department of E&C, PESU

Dear Sir,
Congratulations sir.

Dr. Mohandas K N
Department of Mechanical Engineering
Ramaiah Institute of Technology

Dear Dr Krishna,

Greetings !
Thank you for your mail.
If possible kindly forward newsletter in PDF version.

Dr. G R Narasimha Rao
Director
Industrial Energy Efficiency Division
The Energy and Resources Institute

Students' Speak

We are students who are currently working on the case carburisation project at PMR Lab, PES University. Working at PMR lab provided us with opportunity to work on a real time industrial project with SANSERA industry and has also provided us mentors who have industrial knowledge and are field experts who guide us through the project progress. The lab also has ensured that any required facilitates including and not limited to softwares, experimental setup have been made available. Overall it has been a very motivating and supporting environment.

Muskaan Jain, Ina, K A Arun

8th Semester, B.Tech., Mech. Engg. Dept.

PMR Lab initially seemed very hostile and intimidating, but within a week of joining, all our fears were put to rest. There are so many experienced faculty who take interest in your project and are ready to help you every step along the way. PMR Lab project has made us put our engineering knowledge to practical use. Seeing classroom theories come to life in front of you is a great pleasure. At all times, you are surrounded by passionate people - teachers, guides, and friends from other projects, who are always there to help you, and who take a genuine interest in your project. Everything is systematic and the weekly project reviews ensure that progress is consistently happening. Overall, PMR Lab is one of the best places to be in PES.

Zabi Ur Rahman, Gaurav Sushrut S, Ujwal N

8th Semester, B.Tech., Mech. Engg. Dept.

During the course of our final year project on investigating the use of nanofluids as quenchants, at the PMR laboratory, we have learnt a significant amount technically and in planning one's research project. Our project was highly experimentally oriented, wherein there was a sizeable data set to be dealt with. To be able to grasp the essence of such a large data set and interpret, compare and arrive at conclusions from the same is a skill that we strongly feel has been developed in our tenure of working at the PMR laboratory. It has definitely been a very professional experience and an eye opener for us as students who plan to carry out our own research in the future.

Shreyas Padmaraman, Vansh Narasimhan, Surya Prasad

8th Semester, B.Tech., Mech. Engg. Dept.

Professor With a View

inspiration indeed

Dr. V. Sambasiva Rao

Professor, Department of Electronics & Communication Engineering
Director, Crucible of Research & Innovation (CORI)

Dr. V. Sambasiva Rao is an engineering graduate (1973) from College of Engineering, Kakinada, (Andhra University) and obtained Ph.D from BITS, Pilani in 2010.

For over 37 years (April 1974 to June 2011) , he had associated with ISRO in various capacities. He was responsible for the development of high bit rate data transmitters for all IRS series of satellites and various RF and microwave systems as Head of Data Transmitters and Digital Communication Techniques Division and Group Head of Communication Systems Group at ISRO Satellite Centre. He was responsible for various studies related to Satellite Technology Development at ISRO Satellite Centre.

He was also associated with the planning of communication satellites and development of associated technologies as Associate Director, Satellite Technologies in Satellite Communication during the period July 2008 to January 2010. He was Director, Satellite Communication and Navigation Program Office at ISRO Head Quarters for a brief period. After superannuating as Dy. Director from ISRO Satellite Centre in June 2011, he joined PES Institute of Technology/PES University in Bangalore in July 2011 as a Professor in E&CE Department and associated with Crucible of Research and Innovation (CORI). Design and development of Student Satellite – PISAT, Satellite Earth Station, design of 4π Steradian Sun Sensor, RF Communication System configuration for LEO satellites, RF LAN for satellites and development of algorithms for space based Automatic Identification System (AIS) for NRB are some of the major research activities carried out by him in CORI. He also participated in various design reviews at ISRO, DRDO centers. Currently he is Director of Crucible of Research & Innovation and also heading a Centre for Research in Space Science and Technology (CRSST), for spearheading the development of nano/micro satellites - RSATs for DRDO.

He has taught CRCD, DAMD subjects for M.Tech and Satellite Communication, Basic Electronics for UG classes. He is guiding Ph.D aspirants, UG & PG students for various projects. Four of his students have been awarded Ph.D.

Dr. Sambasiva Rao, a Senior Member of IEEE, Fellow of IETE, Member of IET, a Member of Astronautical Society of India, and Vice President of the Society for Small Satellite systems, has received the Distinguished Achievement Award from the Department of Space for launching Aryabhata in 1975, NRDC Award 1994 for the development of X-band high bit rate QPSK modulator, IETE-IRSI (83) Award 2006 for the development of high bit rate data transmitters, Team Excellence Award from ISRO for the development of X-band spherical phased array and ASI-ISRO Award for 2007 from Astronautical Society of India (Spacecraft & Related Technologies).

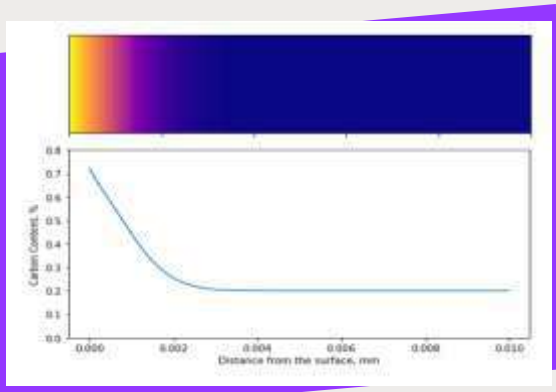
He has published 100+ technical papers in national & international journals and symposia and has delivered over 30 lectures at seminars and various institutions.

Happening Now

its all in the works

Development of Case Carburization Model

In association with SANSERA Engineering, Development of Case Carburization model was carried out to predict case depth for the given material. 1D model has been developed using FEATHERSOL and is showing accurate predictions when compared with experimental results given by SANSERA. Currently 2D and 3D model development is going on to predict case depth for given 3D component.

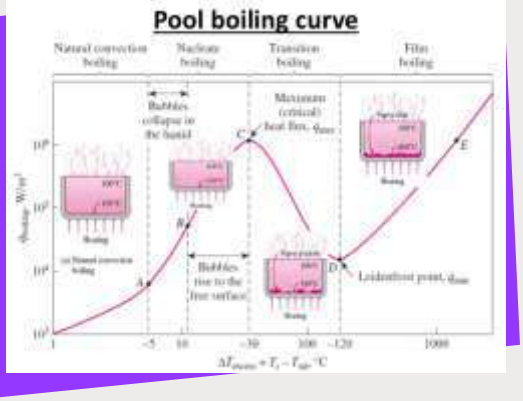


Quenching Analysis using Nanofluids

Quenching of metals is often carried out using deionized (DI) water, oil, polymer solutions, etc. However, with water solutions, complex shapes cannot be quenched uniformly; oil as a quenchant puts forth various environmental issues and polymer quenchants show low cooling rate and cannot be used with some common additives and antioxidants. A solution to this is the use of nanofluids as quenchants. This study focuses on analyzing the effects of using carboxyl graphene and graphene oxide nanofluids on stainless steel.

Parametric Studies on Sub-Cooled Liquid Boiling

Pool boiling refers as under natural convection process and flow boiling liquid flow over heated surface. Generally pool boiling is a mode of boiling where the fluid is stationary in the beginning with respect to the heating surface. Parametric studies of heating coil wire for different L/D ratio and different bath temperatures is carried out to calculate critical heat flux for the process. Kanthal and Nichrome wires are used for the experimentation and distilled water is used as sub cooled liquid.



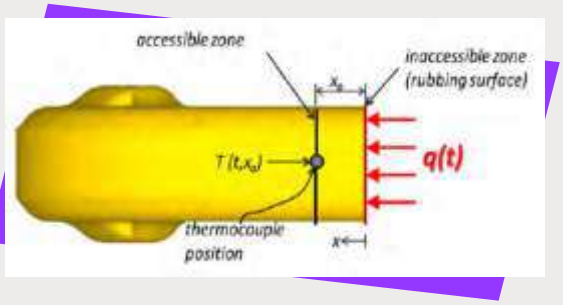
Happening Now

its all in the works

Developing a Heat Flux Correlation for Carbon Steels

Experiments with various carbon steel grade specimens were conducted and surface heat flux were predicted using FEATHERSOL. The Artificial Neural Network was used to correlate surface heat flux of carbon steels with standard cooling curve data obtained from Inconel as per ASTM D6200-01 standards. Currently various formulations are tried to correlate thermal data of various carbon steel grades to predict heat flux and heat transfer coefficient.

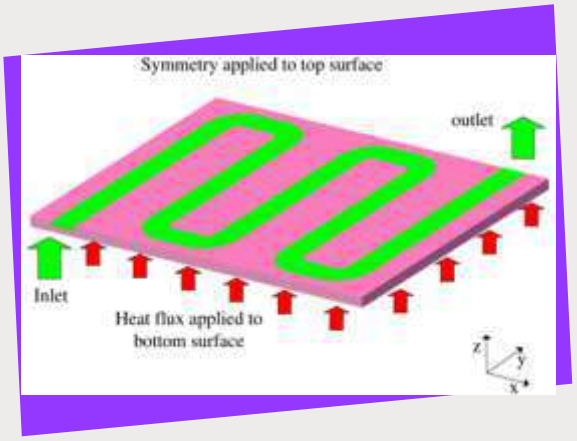
Inverse Heat Conduction Solver using Genetic Algorithm



Majority of studies in the Heat Transfer and Fluid Flow Laboratory are based on experimental measurements. Temperature histories in test samples are recorded during laboratory experiments. Similar data are obtained during plant measurements. The measured temperatures are input for evaluation where surface temperatures, heat fluxes and heat transfer coefficients will be computed. The calculation procedure of IHCP is reverse to calculation procedure of heat equation and is calculated numerically with FEATHERSOL using Genetic Algorithm for 2D and Axi-symmetric model.

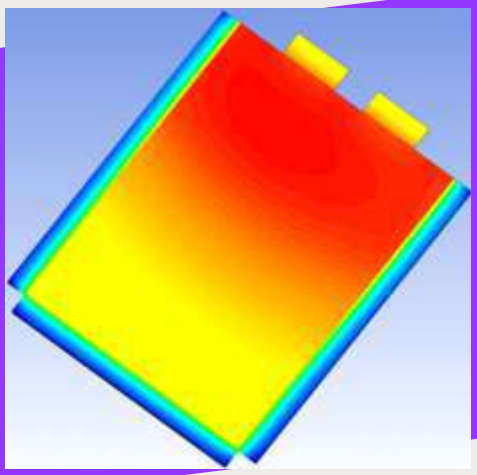
Thermal Investigations on Cold Plate

Evaluation of temperature distribution in the Cold Plate is made for Lithium ion battery thermal management under steady and transient state with and without consideration of the effect of radiation. A general-purpose code for the discretization of the cold plate into n-elements is developed. Based on the user input, this code generates the connectivity matrix essential for the assembly of stiffness matrix. Maple software is used to compute the Galerkin's integrals. MATLAB is used for the creation of connectivity matrix and solve the FEA equation.

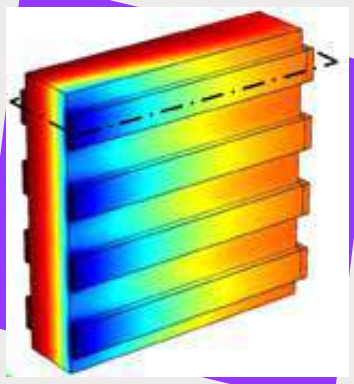


Thermal Management of Prismatic Battery using PCM

Li-ion batteries are highly sensitive to temperature rise and need to be cooled appositely. Phase Change materials provide very good cooling properties and also occupy less space. This work is mainly concentrated on placement of phase change material to get optimum operating conditions of a typical prismatic Li-Ion battery. Parametric studies are carried-out using commercial CFD solver (ANSYS-Fluent) and using Genetic Algorithm placement of PCM is optimized.



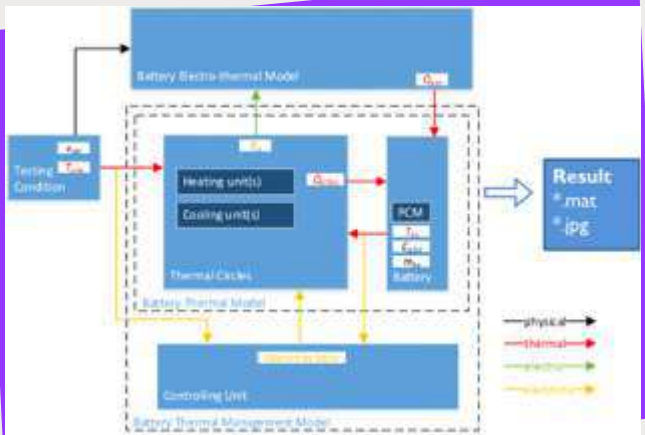
Thermal Management of Prismatic Battery using Mini Channel



Mini-channels around a prismatic Li-Ion battery for cooling during discharge are studied using ANSYS-Fluent. Effect of various parameters such as geometry of the mini-channel, internal heat generation (C-rate), inlet temperature and velocity of coolant, on the performance of Li-Ion battery, are studied. From the results obtained and using optimization solver (IOSO), mini-channel configuration is optimized.

Thermal Management of Battery Systems using Simulink

A BTMS is a responsive system that operates under a control strategy dictated by an electronic control unit to maintain a battery pack within its optimum operating temperature range and a nearly uniform temperature distribution. In this project, battery management system is developed using MATLab Simulink®. Also, the performance of the battery pack with the selected cooling technique is evaluated for various standard driving cycles.

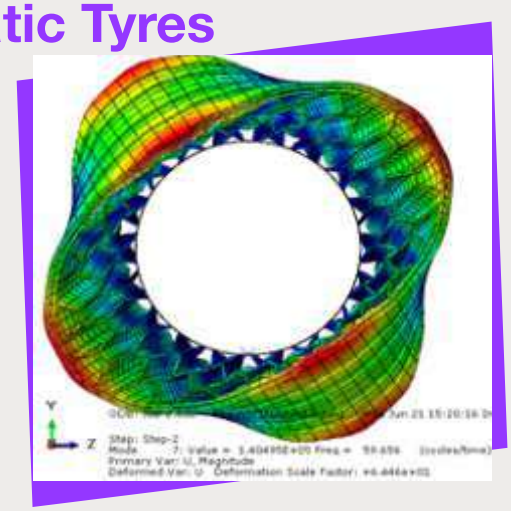


Happening Now

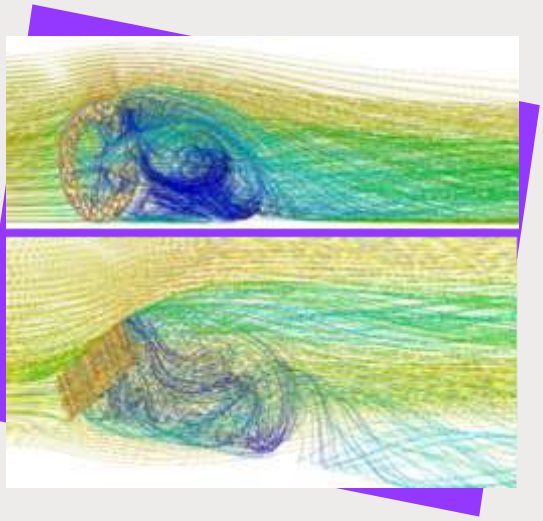
its all in the works

Structural Analysis of Non-Pneumatic Tyres

Pneumatic tyres have been ruling the streets with their better riding comfort, swift handling capability, vertical stiffness and low rolling resistance. The air part of the pneumatic tyre is replaced by a flexible elastomer spokes made of polyurethane which gives the strength to sustain the loads just like in air filled tyres. Structural analysis is carried out to understand the behavior of non-pneumatic tyres and results are compared with pneumatic tyres.



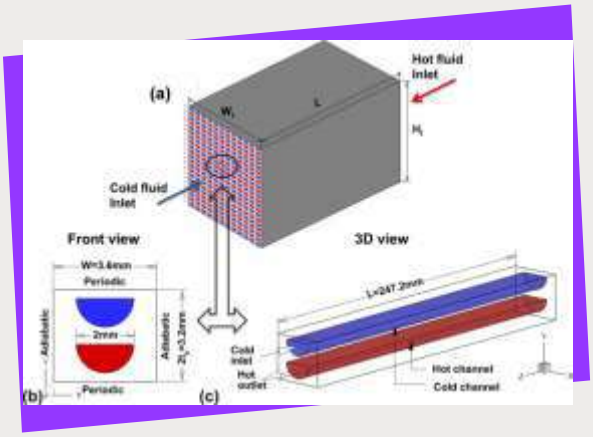
Aerodynamic Analysis of Non-Pneumatic Tyre



In this work, an attempt is made to study the aerodynamic characteristics of a non-pneumatic tyre with hexagonal spokes in rotating conditions using SimScale®–CFD. Effect of various parameters such as camber angle, steering angle, and velocity on the aerodynamic performance is studied by determining coefficients of drag and lift. Also, the results are compared with that of static condition, to understand the effect of a rotating wheel on aerodynamic performance. Results show the increase in camber angle and steering angle results in reduced drag and lift coefficients.

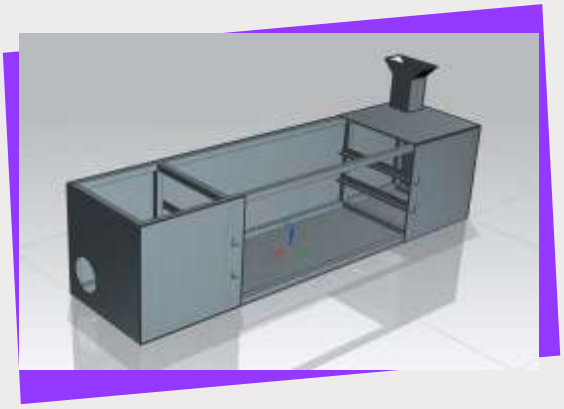
Analysis of Printed Circuit Heat Exchangers with S-CO_2

Fins designed to streamline shape prove to be excellent replacement to zig-zag channel printed circuit heat exchangers (PCHE). Pressure drop in such streamlined fins is considerably less compared to other types of PCHE. The objective of the present study is to use numerical techniques to predict heat transfer and pressure drop characteristics in two such streamlined bodies. Numerical results are verified using modified Dittus-Boelter equation for Nusselt number across the channels. Based on the present studies a new model is proposed that maximises the heat transfer effectiveness in PCHE using super critical carbon dioxide (S-CO_2).

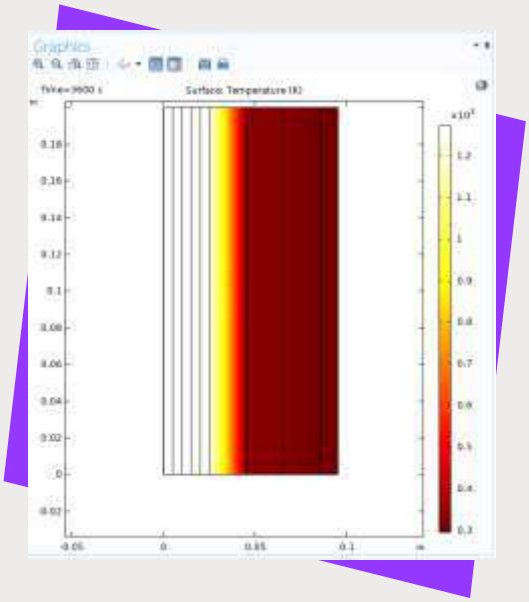


Design and Development of Solar Food Drier

The utilisation of solar energy in the present day scenario has been extended to a wide range of applications and the potential of using solar energy in the agricultural sector has increased significantly due to fluctuation in price of fossil fuels and other environmental concerns. A solar dryer basically heats up the air to a constant temperature by means of solar energy which helps in the humidity extraction from the crops in the drying chamber. Ventilation is provided at a constant rate through air inlets and outlets. Solar dryers can prove to be beneficial in wide range of agricultural and marine products.



Development of Thermal Insulation Wall using Thermal Coating



Thermal Insulation in components plays a major role in areas where high temperatures have to be addressed. Different types of thermal resistant coating are done on SS304 stainless steel. The simulation is conducted using COMSOL Multi-physics software. Different types of arrangements are studied after which the component will be machined and tested experimentally.

Industrial Collaborations

SANSERA ENGINEERING

KARNATAKA ENGINEERING

Garrett ADVANCING MOTION

Just out

for the world to see

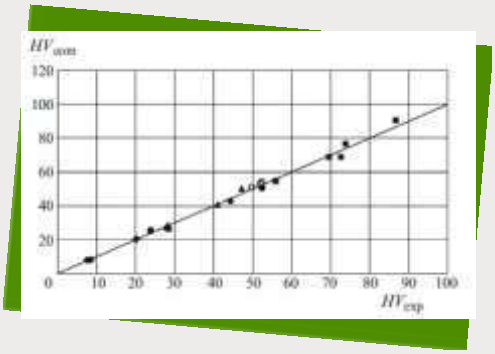
Journal Publications

Estimation of Hardness During Heat Treatment of Steels

Authors : **Abhaya Simha N R,** Sushanth M P, Sachin V Bagali, Maruti, Prasanna Kumar T S, **Krishna V**

Publisher : Metal Science and Heat Treatment, Springer Publication, Volume 61, December 2019, Pages 448-454, DOI: https://doi.org/10.1007/s11041-019-00444-9

A hardness model employing the end quench Jominy method is developed for steels C25, EN8, EN19, EN31 and EN24. The time-temperature data are obtained from four thermocouples mounted at critical places of a specimen. The heat flux during the quenching is determined from the cooling curve obtained with the help of the thermocouple closest to the end of the specimen (quenching place). The two-dimensional axisymmetric equation of heat conduction is solved and used jointly with the models of decomposition of austenite to obtain the distribution of microstructure at the places used to plot the cooling curves. The computed distribution of microstructure and the chemical compositions of the steels are used to estimate the hardness. The computed hardness values agree well with those determined experimentally over the length of the specimen.



Influence of machining parameters on the response variable during drilling of the hybrid laminate

Authors : N S Manjunatha Babu, **N Rajesh Mathivanan,** K Vijaya Kumar

Publisher : Australian Journal of Mechanical Engineering, Taylor & Francis Publication DOI: https://doi.org/10.1080/14484846.2019.1704492

Hybrid laminates made of Carbon Fibre and Glass Fibre Reinforcement have become widely popular in various applications which are mainly due to their excellent structural strength coupled with lower cost. This paper deals with the examination of the influencing parameters (feed rate, tool material) on thrust force during drilling of hybrid laminates. Statistical Design of Experiments has been used for the analysis of the drilling parameters on the thrust force. Taguchi's L9 (32) array has been used to determine whether the response function is minimised by feed rate or tool material. Hole drilling on hybrid FRP laminate has been done using Solid Tungsten Carbide and High-Speed Steel tool material under controlled machining operations. The results reveal that the tool material has a higher influential effect on the thrust force when compared with the feed rate. Also, the morphology of hybrid laminate was obtained using a SEM and the results indicate that surface texture was observed to be optimum.

Just out

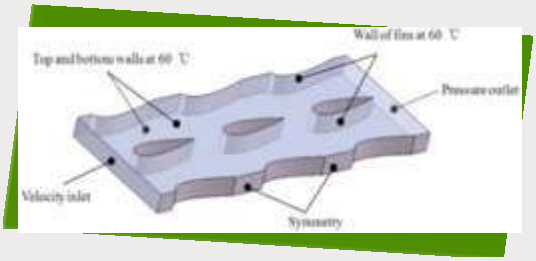
for the world to see

Proceedings of the 25th National and 3rd International ISHMT-ASTFE Heat and Mass Transfer Conference (IHMTC-2019), Dec 28-31, 2019, IIT Roorkee, Roorkee, India

Effect of Streamlined Fins on the Heat Transfer and Pressure Drop Characteristics in Printed Circuit Heat Exchangers for Super Critical Carbon-dioxide Cycle

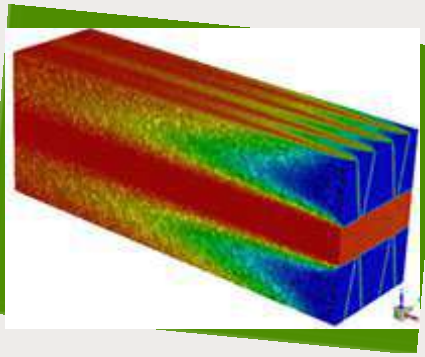
Authors : **Rajendra Prasad KS,** Kamal Raj K, Jeevan Devagiri, Ganesh Pratheek KM**, V Krishna, T R Seetharam**

Fins designed to streamlined shape proved to be excellent replacement to zig-zag channel printed circuit heat exchangers (PCHE). Pressure drop in such streamlined fins is considerably less compared to other types of PCHE. The objective of the present study is to use numerical techniques (Ansys-Fluent®) to predict heat transfer and pressure drop characteristics in two such streamlined bodies. (Fig 1). Numerical results are verified using modified Dittus-Boelter equation for Nusselt number across the channels. Based on the present studies a new model is proposed that maximises the heat transfer effectiveness in PCHE using super critical carbon dioxide (S-CO2).



Effect of Carboxyl Graphene Nano-Coolant on the Performance of Radiator – A Numerical Study

Authors : **Babu Rao Ponangi,** C Hari Gowtham, A Vishwajeeth, Ayman Ahmed Mubeen**, V Krishna**



Advancement in cooling systems being greater criterion for their remarkable improvement in the performance of an automobile, radiator plays an important role in this aspect. Small concentrations of nanoparticles, having superior thermo-physical properties, suspended in a base fluid can bring out better rate of heat transfer than that of water/water and glycol mixture alone. An elemental part model of the radiator is considered for the present study. The coolant comprises of a suspension of carboxyl graphene nanoparticles in water and ethylene glycol as base fluid. CFD simulations are carried out for different air, coolant mass flow rates at different volume concentrations of nanoparticles and coolant inlet temperatures. Maximum of 18.32% increase in effectiveness is achieved for coolant mass flow rate of 0.2778 kg/s and coolant inlet temperature of 323K at 2% volume concentration. It is observed that effectiveness decreases and pressure drop increases with increase in the mass flow rate of the nanofluid.

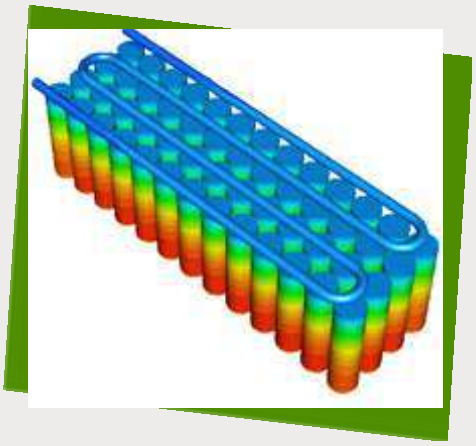
Just out

for the world to see

Proceedings of the 25th National and 3rd International ISHMT-ASTFE Heat and Mass Transfer Conference (IHMTC-2019), Dec 28-31, 2019, IIT Roorkee, Roorkee, India

Design and Analysis of Cold Plate for Electric Vehicle Battery Pack

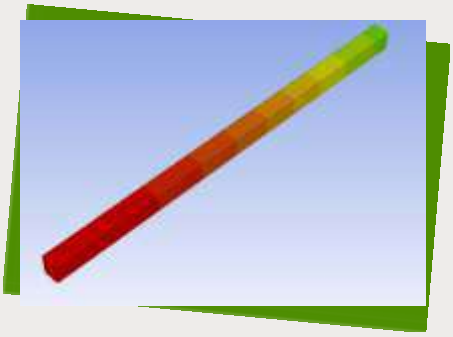
Authors : Joseph Raj Chandra Kanth B P, **Babu Rao Ponangi**



In this work, a cold plate is designed in order to cool the battery pack. A CAD model of a battery pack of having 52 cells in the configuration of 13 in series and 4 in parallel is designed. A parametric study has been conducted varying the dimension of cold plate and pipe, inlet velocity and temperature of the coolant, types of coolants and internal heat generation of the battery pack. Two types of designs are made with different inner diameter. Simulation results showed that even though both designs cooled the battery pack by more or less the same, Design 2(7.5mm inner dia) with water as coolant is the better design since pressure drop is significantly less. Both the designs can remove the excess heat from the cells up to 1.25 C-rate to maintain the battery temperature in optimal operating conditions.

Numerical Study on Thermal Performance of Functionalized Graphene – Ethylene glycol/Water Nanofluid in Mini-channel Heat Sink

Authors : **Babu Rao Ponangi,** B M Sakshi, Charan R S, Nand Dave, **V Krishna**



In the present work, numerical analysis of a single mini channel heat sink using nanofluid instead of water as the coolant is studied. The mini-channel heat sink considered is made of copper having a length of 50 mm and the cross-section area of the fluid domain is 1 x 1.5 mm. This model is taken into consideration for a simple, less time consuming and detailed analysis. The study is carried out using Functionalized Graphene suspended in 50:50 ethylene glycol and water as the base fluid at five different concentrations of volume percentages 0.5, 1, 1.5, 2, 2.5. The inlet temperature of the nanofluid is maintained at three different temperatures of 200°C, 300°C and 400°C. The heat flux of the bottom wall is varied from 105 to 106 W/m² and the remaining three walls are made adiabatic. A parametric study is done to investigate the effect of the change in velocity, inlet temperature and heat flux of the coolant on the performance parameters that is outlet temperature and pressure drop.

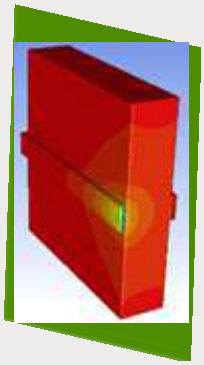
Just out

for the world to see

Proceedings of the 25th National and 3rd International ISHMT-ASTFE Heat and Mass Transfer Conference (IHMTC-2019), Dec 28-31, 2019, IIT Roorkee, Roorkee, India

Use of Mini-Channel for Thermal Management of Prismatic Battery

Authors : **Babu Rao Ponangi,** Ajay Nayak M, Adarsh SS

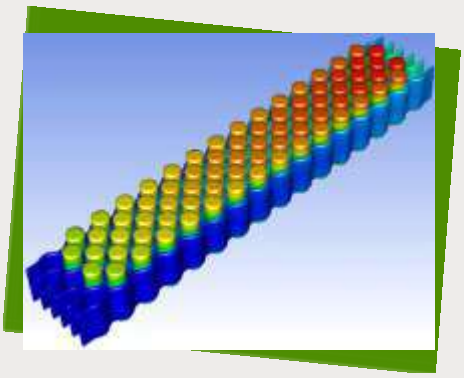


With the demand for the electric cars increasing year by year, lot of research is being carried out to improve the efficiency of the electric car. One such domain in this vast field is related to batteries of the electric vehicles. If the battery is maintained at optimum temperature, maximum efficiency can be obtained and battery pack be used safely. In the current work, the effect of placement and dimensions of mini-channels on thermal management of battery pack is studied. The effect of amount of heat generated from the battery at various discharge rates, flow rate of coolant (water) through mini-channel and inlet temperature of coolant on maximum temperature and temperature gradient across the battery is analysed. Effect of channel design with various parameters on pressure drop across the mini-channel is studied. The design with four mini-channels is recommended as the maximum cell temperature and temperature gradient is well within acceptable operating condition of the battery.

International Conference on Emerging Trends in Electro-Mechanical Technologies and Management (TEMT 2019), at HMR Institute of Technology and Management, New Delhi, India, 26th – 27th July, 2019

Single Pass Wavy-Channel Heat Exchanger for Thermal Management of Electric Vehicle Battery Pack – A Numerical Study

Authors : **Babu Rao Ponangi,** Pramath H Srikanth, Pratyush V Heblikar



This work involves the thermal management of 18650 Li-ion battery pack using a single pass wavy channel heat exchanger, where the cells are arranged in a staggered manner. Effect of various parameters like discharge of the battery, flow rate of the coolant across the channels and coolant inlet temperature, on the temperature of the battery pack and the pressure drop across the wavy channels is analysed. Results show that at a higher C-rate, a higher coolant inlet temperature and a lower flow rate of coolant, resulted in higher overall temperatures of the battery pack. It is found that the pumping power required to drive the coolant across the channels decreases as the inlet coolant temperature was increased and as the flow rate of the coolant decreases.

Just out

for the world to see

International Mechanical Engineering Congress (IMEC-2019), at NIT Tiruchirappalli, India, 29th November- 1st December 2019

Computational Fluid Dynamics Analysis on Thermal Comfort of Passenger Compartment

Authors : Monika, Balesh Babali, **Babu Rao Ponangi**

Thermal comfort in the passenger compartment of a car is one of the major requirements and one of the essential criteria in choosing a vehicle. An attempt is made to investigate the temperature and velocity distribution inside the car cabin through CFD simulation. Various parameters are selected to study their effect on flow fluid and temperature distribution inside a car compartment, like number and location of vents inside car compartment, different air temperature and air velocities at inlets and outlets. Effect of inlet temperature and velocity of air on the thermal comfort of passengers is carried out. Air inlet temperature is varied from 15 to 30°C in steps of 5°C and air velocity is varied from 4 to 10 m/s in the steps of 2 m/s. Results are obtained, defining the importance of the number and the locations of vents in the compartment. The obtained results are judged by comparing the values on (Predicted Mean Vote) PMV and (Predicted Percentage of Dissatisfied) PPD scales.

CFD Study of Aerodynamic Performance of Non-Pneumatic Tyre

Authors : Daksh Bhatia, Praneeth K R, **Babu Rao Ponangi,** Meghana Athadkar, Carine Viola Dsouza

Tyres are known to account for up to one-third of the total drag on a vehicle's momentum and it is the only part of the vehicle which is in contact with the road. In the present work, an attempt is made to study the aerodynamic performance of a non-pneumatic tyre using CFD tool – SimScale® - a cloud computing platform. The current work includes a comparative study of pneumatic tyre, non-pneumatic tyre with wedge spokes and hexagonal honeycomb spokes. Results show that non-pneumatic tyre has a higher coefficient of drag and lift when compared to a pneumatic tyre because of the flow passing through the spokes of the non-pneumatic tyre resulting in a lot of vortices. In the present work, effect of velocity, steering (yaw) angle and camber angle on the aerodynamic performance of the non-pneumatic tyre with hexagonal honeycomb spokes is studied using CFD. The results show that an increase in yaw angle has an adverse effect on drag and lift force while camber has a positive effect.

Just out

for the world to see

International Mechanical Engineering Congress (IMEC-2019), at NIT Tiruchirappalli, India, 29th November- 1st December 2019

Aerodynamic Improvement of Road Tanker – A Numerical Approach

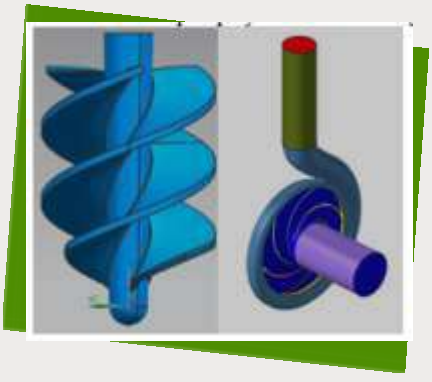
Authors : Md Rahil Khan, **Babu Rao Ponangi,** Meghana Athadkar, Carine Viola Dsouza

Aerodynamic analysis of a Road-Tanker is carried out using ANSYS CFX® software. Base model for Road-Tanker is prepared according to IS 13187:1991 specifications. The aerodynamic performance of the Road-Tanker is improved using various techniques, which reduce the drag force acting on the vehicle. Various improvements include modification of the cabin part by filleting the edges with radius as a function of width of the cabin to reduce frontal drag, modification of the gap between cabin and tank to reduce rear drag on the vehicle, tank modifications etc. are incorporated. Further CFD analysis is carried out on a total of 15 different cases by considering the modifications individually and also combined together. From the analysis, it can be seen that each modification is significant role in improving the aerodynamic performance of the Road-Tanker.

International Conference on Advances in Mechanical Processing and Design (ICAMPD 2019), at School of Mechanical Engineering, KIIT, Patia, Bhubaneswar, India, 18th – 20th October, 2019

CFD analysis of two-phase cavitating flow in a centrifugal pump with an inducer

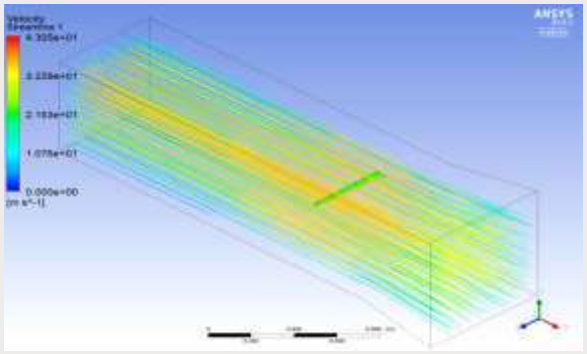
Authors : Debarpan Paul, Himanshu Agarwal, **Babu Rao Ponangi**



This study addresses cavitation modelling of a single stage centrifugal pump and aims at minimizing cavitation by introducing an inducer upstream of the impeller, which serves as a booster pump by increasing the pressure of the fluid before it enters the impeller using ANSYS Fluent. The generated meshed model is first validated against standard experimental data to ensure the credibility of the model and the results obtained from it. The results obtained show that the inducer is effective in reducing the amount of cavitation for a substantial number of operating conditions. It is seen that the inducer is effective in increasing the NPSH available of the pump by a maximum margin of 33%.

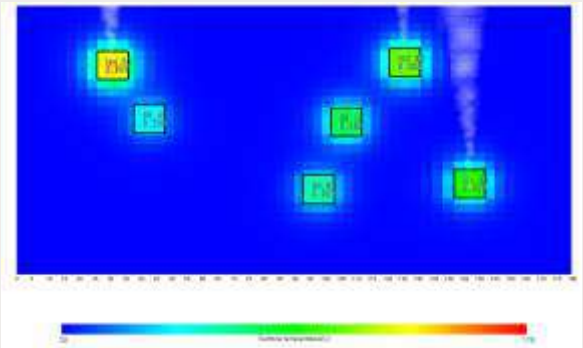
Projects
in the pipeline
Government Projects (Ongoing)

SL. NO.	Title	Funding Agency	Amount in INR (Lakhs)	Start Date	End Date
1	Optimization of Blending Winglets for Trapezoidal Wings	AR&DB	8.03	29-12-2018	29-12-2020
2	Centre for Design, Analysis and Development of Heat Exchangers	KCTU, PESU	100.00	15-09-2018	15-09-2020
3	Thermal Design Optimisation of Printed Circuit Boards (PCBs)	ISRO	28.60	21-01-2019	21-01-2021



A simulation result of wing inside wind tunnel.
-Optimisation of Blending Winglets for Trapezoidal Wings

A wind tunnel test facility to test radiators
-Centre for Design, Analysis and Development of Heat Exchangers



Six component PCB optimization predictions
-Thermal Design Optimisation of Printed Circuit Boards

Consultancy Projects

Advanced Prosthetic Devices

Customer: Dr. Haripriya

Professors Involved: Dr. BK Keshavan (Dean of Engineering & Technology), Dr. MJ Venkatarangan (Professor, Electrical Engg. Dept.) and Dr. B Rammohan (Associate Professor, Mech Engg. Dept.)

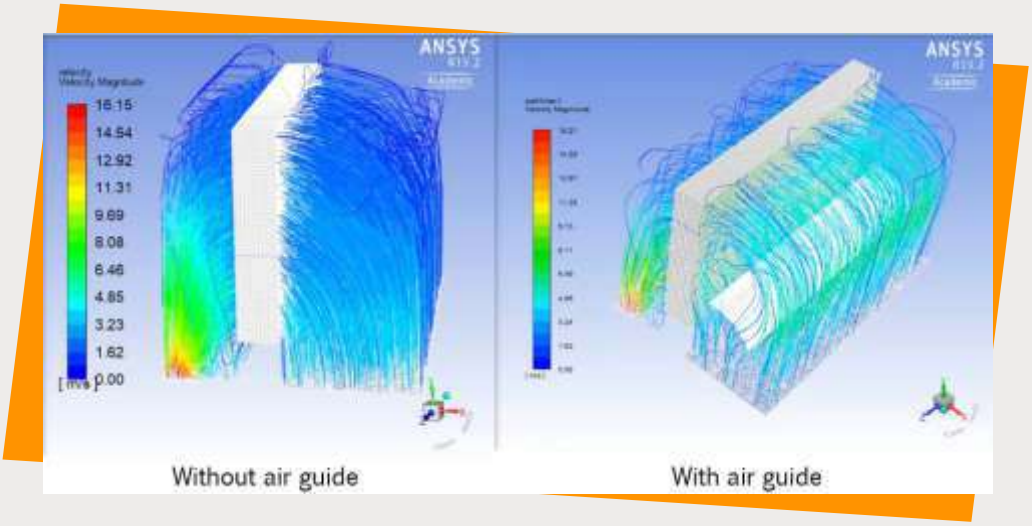
Detailed finite element analysis to estimate the static strength, response due to time-dependent loads, drop tests (including the angled drop) and the fatigue life estimation of the Advanced Prosthetic Foot provided by Z-Strand as a Consultancy project is carried out at PMR lab. The simulations included both implicit and explicit using Ansys® research license. The results obtained from all these simulations were validated experimentally on both Pyro and Prostancer foot. Both Pyro and Prostancer have a composite layup with various fibre orientations. Material nonlinearity with the inclusion of Elasto-plastic behavior is addressed during the analysis. The fatigue life estimated based on SN and εN approaches passed the fatigue tests as predicted from the numerical simulations

Flow Analysis in Heat Exchangers

Customer: Mysore Engineering Enterprises

Professors Involved: Dr. KN Seetharamu (Chair Professor, Thermal Engg.) and Mr. Babu Rao Ponangi (Assistant Professor, Mech Engg. Dept.)

In this project, a typical cross-flow heat-exchanger used in power generators is simulated with and without air guides. Based on the inputs from the client, the operating conditions (both initial and boundary conditions) are set in ANSYS-Fluent®. The flow uniformity over the heat exchanger with and without air guide is investigated in terms of velocity and pressure distribution across the face.



Eventscape

recent events

ICTES 2019 Conference - Session Chair

Dr. K N Seetharamu delivered a plenary lecture on "Development in the Analysis of Heat Exchangers using FEM" at ICTES 2019 conference organized by BNMIT Bangalore which was held on 27th and 28th December 2019. Dr. V Krishna chaired a session during this event.

Summer course on Computational Fluid Dynamics and its applications using ANSYS

Mr. Babu Rao Ponangi of PMR Lab along with Mr. Rajendra Prasad, Assistant Professor, Department of Mechanical Engineering offered a 1 week course on Computational Fluid Dynamics and its applications using ANSYS during the summer (15-19 July 2019). Students from PES University and other colleges attended the course. Course included theory on CFD and hands on training on ANSYS Fluent software.

Extending the experts portfolio in PMR Lab Team

We are very happy to share that **Prof. PERUMAL NITHIARASU**, Head of Zienkiewicz Centre for Computational Engineering and Dean of Academic Leadership, Swansea University, UK and **Dr. C. RANGANAYAKULU**, Sc. H / Outstanding Scientist, Associate TD(GS) & Group Director (ECS), Aeronautical Development Agency have been kind enough to join the PMR Lab team as Distinguished Adjunct Professors.

FEATherSol

Take Your Ideas Beyond Research

FEATherSol (Finite Element Analysis with Thermal Solvers) is a numerical computing software based on Python language developed by PMR Lab. It comes with pre built pre and post processor where customized research oriented Finite Element Analysis can be carried out. Additional to that many useful modules have been incorporated to help out engineering students, research faculty, colleges and industries.

P L U G I N S

SALOME — *Pre-Processor*

ParaView — *Post-Processor*

jupyter — *iPython Interface*

F E A T U R E S

- *1D, 2D, 3D and Axisymmetric Thermal Analysis (Steady and Transient)*
- *1D, 2D and Axisymmetric IHCP - Inverse Heat Conduction Problem (Genetic Algorithm Based)*
- *Prediction of 1D, 2D and 3D Case Depth during Case Carburization*
- *Heat Treatment Simulation*
- *Option to develop customized solver for all type of FEA problems*
- *Customizable Genetic Algorithm Module for Optimization Problems*
- *Customizable Artificial Neural Network based on Tensorflow Python Library*
- *Regression Analysis and visualization*
- *Inbuilt python libraries such as Numpy, Scipy, Matplotlib, Tensorflow, Sklearn etc.*
- *Interactive documentation and video tutorials on FEA, Python, Salome, Paraview*

H I G H L I G H T S

Geometrical modeling (CAD)

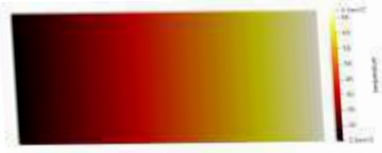
Mesh generation

Definition of analysis data

Customization of solver

Postprocessing operations

Visualization of results



For more information and to purchase license, contact

PMR Laboratory, B703B, B Block, PES University, Bangalore - 560085
Contact Person: Abhaya Simha N R
Email: abhaysimha@pes.edu
Mobile: 9738111380

LAUNCHING SOON

PES UNIVERSITY

Chief Patrons

Dr. MR Doreswamy
Founder Chairman, PES Institutions
Chancellor

Prof. D Jawahar
CEO , PES Institutions
Pro Chancellor

Key Office Bearers

Dr. Suryaprasad J
Vice-Chancellor

Dr. K S Sridhar
Registrar

The PMR LAB Team

Dr. V Krishna,
Professor & Head, PMR Lab
Dean, Student Affairs

Dr. N. Rajesh Mathivanan
Professor & Chairperson
Mechanical Engineering

Dr. K N Seetharamu
Chair Professor
Thermal Engineering

Dr. T R Seetharam
Chair Professor
Thermal Engineering

Dr. B Rammohan
Associate Professor
Mechanical Enginerering

Dr. Jyothiprakash K H
Assistant Professor
Mechanical Engineering

Mr. Babu Rao Ponangi
Assistant Professor
Mechanical Engineering

Mr. Abhaya Simha N R
Research Associate

Mr. Akshay
Research Associate

Mr. Darshan S P
Junior Research Fellow

Mrs. Rajashree D
Junior Research Fellow

Distinguished Adjunct Professors

Prof. Perumal Nithiarasu
Head of Zienkiewicz Centre for Computational Engineering
Dean of Academic Leadership
Swansea University, UK

Dr. C. Ranganayakulu
Sc. H/Outstanding Scientist, Associate TD(GS) & Group Director(ECS)
Aeronautical Development Agency