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From the Editor's Desk



PES University completed 5 years this year and Pro Chancellor Prof. D Jawahar heralded 'PESU 2.0' with a host of new initiatives which will take the University towards the cherished goal of being in the top 10 Universities in India by 2022, a significant year, when India completes 75 years of freedom and PES completes 50 years of fruitful existence. Knowing Prof. Jawahar's keen acumen for making things happen, exciting times are ahead. Significantly PES University has been ranked 6th in the top 50 State Private Universities in India in the Outlook-ICARE rankings released in July 2019. A moment to cherish indeed!!

It was heartening to see a very encouraging response from our readers for the earlier editions of the Newsletter. This has prompted opening a "Readers' Response" section from the present edition. We have not been able to accommodate all the responses for want of space. The request to the readers is to kindly provide us pointed and pertinent observations on the Newsletter, which can further enhance the quality of the reading experience, besides any feedback on the latest happenings in the technical sector. We have incorporated some of the suggestions made by our readers, such as including the DOI of the publications, mentioning the grant amounts of INR in lakhs etc. We look forward to more.

Dr. KN Seetharamu, one of the 'founding fathers' of PMR Lab is completing 80 years (on August 22), of an extraordinary life of unstinted service to the cause of research and teaching, besides

empowering hundreds of students across the world, towards research and higher thinking. The PMR Lab team offers its salutations to Dr. KNS with reverential awe and wishes him the best of health and happiness in his single-minded pursuit of empowering the student community. In this connection an International Symposium on Heat Transfer was organised at PES University by the students and well-wishers of Dr. KNS.

Another person who never ceases to amaze is Dr. TR Seetharam, another one of the PMR-Lab-founding-fathers. His zeal for academics and the passion he brings to his class room teaching is archetypal. His never-ceasing-drive for 'organised-academics', resulted in a book 'Applications of Thermodynamics', which he has co-authored, along with his guru Dr. Vedanth Kadambi, former Professor, IITK and Mr. Subramanya Kumar, Associate Professor (Retd.), NIE, Mysore. We wish him many more years of good health, happiness and 'endless drive'.

Courses by Dr. Tom Bruce (Dean - International Students, University of Edinburgh, UK) and Dr. Juan de Dios Calderón (Director, Department of Mechatronics, Tecnológico de Monterrey, Mexico) brought an international flavour to the students of Mechanical Engineering Department.

A National Skill Competition conducted by NSDC, Govt. of India, organised at PESU Campus due to the concerted efforts of Dr. N Rajesh Mathivanan, Professor, Mechanical Engg. Dept., was another of the highlights.

The Lab continues to encourage and empower undergraduate students towards research in areas such as battery thermal management, dynamic instability analysis, numerical studies and optimisation of heat exchangers, fatigue life estimation, design of advanced prosthetic devices etc.

Wishing all our readers a great new season as India gears itself to newer challenges on all fronts!!

- Dr. V Krishna
Editor, Head, PMR Lab

Readers' Response

what we've heard from you

Dear Professor,

Firstly, my heartiest congratulations on the release of the second edition of PMR Lab Newsletter!

The motive of keeping everyone updated regularly on achievements / contributions of Professors and faculty members of the Department and motivating & guiding youngsters indirectly to move in a right direction is really appreciating. The column /article 'Professor with a View - Inspiration Indeed' a space highlighting the 'who is who' of the academics has attracted me the most. Certainly it encourages budding Engineers and young faculty members to dream big and dream boldly with a message that 'successful career is all about sincere but consistent efforts of an individual'. (Professor TRS sir had spent half an hour with my son Samarth G K, a Mechanical Engineer from NITK Surathkal for a career guidance. His advice helped my son to chase his own dream and now he is pursuing his PhD in TIFR, Mumbai). No wonder that PESU is progressing aggressively. Networking with Industry in establishing Industry established laboratory/labs may also be one of the features of the newsletter. An extension in future may also highlight the achievements of students as well, if it fits in. Thanks for sharing the e-Newsletter and wishing PMR Lab Newsletter to be filled with many more justouts, eventscapes..etc.

Thanking you once again and All the Best.

Thanks & Regards,

Bharathi Ganesh

Professor, Dept of Civil Engineering
NMIT, Bangalore

Hearty congrats!

Dr. Shankar H N

Dean - Academics & Research
CMR Institute of Technology

Greetings and good day from DMG MORI India.

It was nice to see the newsletter and found interesting.

Mr. Srinivasan Krishnaswamy

Sales Manager - Educational Institutions
DMG MORI INDIA Pvt Ltd

It is great sir. Nice newsletter. I wish all the best for future news letters to carry more and more news on innovations and developments. Thank you very much for sharing.

With Best Regards

Dr. V. Sambasiva Rao

Professor, ECE, & Director, CORI

Very impressed with the focus on research and type of activities, good to see the erudite folks coming to PES and sharing their knowledge in University and Tech companies, was happy to see Arun C from Intel attending this too.

Regards,

T R Sreedhara Murthy

Director, Embedded and Post Si
Tessolve Semiconductor

I am not sure if this mail on feedback for the 2nd issue of PMRL e-newsletter is intended to me. However, I had a look through the same and it looks "NEAT". You might consider the following in the next issue

(i) including DOI of publications

(ii) giving the amount of project grants in Lakhs

(iii) Mathematical modeling... - the content also appears to involve experimentation. So, it would be great to include this too in the title of the sub-topic.

Wish you pleasant times ahead.

Thanks and best regards,

Dr. A S Krishnan

Associate Professor, Dept of Mechanical Engineering
Coimbatore Institute of Technology

Congratulation. Great start

Dr. B S Jai Prakash

Vice president, ACHMM-India Chapter

Congrats and All the best

Dr. K Narasimha Murthy

Professor and Head, Dept of Mechanical Engineering
Atria Institute of Technology, Bangalore

Congrats! Great reading. I went through some of the updates. Very impressive

Anup Vittal

Managing Director and Member of the Board, India, BMT

Professor With a View

inspiration indeed



Dr. Suresh Nagesh

**Chair Professor
Computational Mechanics**

Dr. Suresh Nagesh holds a Ph.D in computational mechanics from Drexel University, Philadelphia, USA (1992). For his Ph.D, Dr. Suresh worked under the guidance of renowned Professor Albert S D Wang a renowned guru in composites, finite elements and delamination. The project was a Boeing sponsored NASA ATCAS (Advanced Technology Composite Aircraft Structures) program. From India Dr. Suresh is an IIT Kanpur alumnus (graduated out with a Master's in Solid Mechanics in 1987).

Currently Dr. Suresh is working at PES University as a Chair Professor in Computational Mechanics and Head - CARE (Center for Automotive Research and Engineering). Dr. Suresh's main responsibilities include developing the Crucible of Research and Innovation (CORI), a multi-disciplinary research center instituted to enhance the academic industry relationship, in the areas of training, consulting and research along with academics. Currently various projects related to computational mechanics including experimental validation are being carried out for customers such as Siemens, Mann Hummel, GE, Ingersolrand (India), Intel, Alten, Triveni, Shanti Gears, Safran, Stryker, Quantum, DRDO labs to name a few. Focus is also on state-of-the-art digital twin development for rotor dynamic applications, data sciences, multi-disciplinary projects, automation (AI and ML) and medical applications. Dr. Suresh also has developed an electric and hybrid vehicle lab especially for two wheelers along with EKO vehicles who were pioneers of EV two wheeler technology in India. He is currently also supporting Quantum USA to develop state-of-the-art 16 seater vehicle from concept to build.

Prior to joining PESU in May 2012, Dr. Suresh was the Managing Director of Voith Engineering Services India (a division of Voith GmbH). Dr. Suresh developed teams working on stress and advanced light physics activities. Before joining Voith, Dr. Suresh worked as a Vice President Engineering at CADES and as Director at Geometric Bangalore, Dr. Suresh developed advanced engineering teams to support Aerospace, Automotive, Indian defence labs and some high end engineering companies. Before this, Dr. Suresh headed key advanced engineering groups at DaimlerChrysler Research and Technology India, GE Global Research and Development at JFWTC Bangalore. Prior to coming back to India in 2001, Dr. Suresh worked in the US for more than a decade with Ford R&D and DaimlerChrysler R&D on next generation low cost light weight vehicles for the automotive industry. Dr. Suresh also worked with the prestigious India Space Research Organization from 1987 through 1988 in structures division. Dr. Suresh has many publications in international journals and conferences, has been a keynote speaker in many international conferences, has 8 US patents in addition to guiding UG, Master's and Ph.D students. Dr. Suresh is a founding member of the SAE Bangalore chapter and has been associated with SAE for over two decades.

Eventscape

recent events

IMTEX 2019

PMR Lab participated in Academia Pavilion of IMTEX 2019 exhibition from 24-30 January 2019 and presented a project titled "Hardness Prediction during Heat Treatment of Steels". The project was selected in the top 10 by the judges.

Mr. Abhay Simha presenting research findings to the judges panel at IMTEX 2019



Certificate Course by Prof. Tom Bruce, University of Edinburgh



Prof. Tom Bruce, Professor, School of Engineering & Dean, International Students, College of Science and Engineering, University of Edinburgh conducted a certificate course on "Sustainable Energy – Drivers and Changes", organized by the Department of Mechanical Engineering, PES University from 31 January to 2 February, 2019. This course was offered to the students of 6th Semester of the B.Tech program in Mechanical Engineering, and widely appreciated by the student-participants.

Dr. K S Sreedhar & Dr. V Krishna with Prof Tom Bruce following the completion of the certificate course "Sustainable Energy - Drivers and Chnages "

Program on Industry Institution Interaction in association with Confederation of Indian Industries (CII)

PES University organized an Industry Institution Interaction on "Manufacturing Operations and People Excellence as a Profession for Graduating Engineers" in association with CII on 7 February 2019. The latest edition of the Bi-annual newsletter of PMR lab was released during the event.

A Speaker Session at the CII Industry Institute Interaction in progress



Eventscape

recent events

Speakers during the event included representatives from CII such as Mr. Krishna Mohan (Head Quality- Engineering, India Development Centre, Harman International), Mr. Amul Chander (Co- Convenor, CII Karnataka Manufacturing & Operational Excellence Panel, JMT Expert Corporate Trainer & Mentor at Ace Micromatic Group), Mr. Vikas Manral (Board Member, SolutionBuggy) and Mr. Dorai Arasu (Managing Director, InfoSree Technologies Pvt Ltd.) represented the CII for the event. Dr. KNB Murthy, the Vice-Chancellor - PESU presided over the event.



(L-R) Dr. V. Krishna, Mr. Amul Chander, Mr. Krishna Mohan, Dr. KNB Murthy, Mr. Dorai Arasu

Release of book on ‘Applications of Thermodynamics’



(L-R) Dr. V Krishna, Dr. V Krishnamurthy, Dr. TR Seetharam, Dr. KNB Murthy, Dr. Pradeep Dutta, Dr. MR Doreswamy, Mr. K B Subramanya Kumar, Dr. KS Sridhar

PES University organized a book release event of “Applications of Thermodynamics” published by Wiley India Pvt. Ltd. on 27 April 2019 at 11AM. The book was authored by Dr. V. KADAMBI (Former Professor, Mechanical Engg., IIT Kanpur & Former Visiting Professor, Mechanical Engg., IIT Gandhinagar), Dr. T. R. SEETHARAM (Chair Professor in Thermal Engineering, Mechanical Engg. Dept., PES University & Former Principal, NIE, Mysore) and Mr. K. B. SUBRAMANYA KUMAR (Former Associate Professor, Mechanical Engg. Dept., NIE, Mysore). Dr. PRADIP DUTTA (Professor & Chair, Department of Mechanical Engg., IISc, Bangalore) released the book on this occasion. The event was presided over by DR. M. R. DORESWAMY Ex-MLC, GOK (Founder Chairman - PES Institutions, Chancellor – PES University). The function witnessed the large gathering of students

Course on ‘Die Design and Manufacture’, by Prof. Juan de Dios Calderon Najera, Tecnologico de Monterrey, Mexico

Prof. Juan de Dios Calderon Najera from Tecnologico De Monterrey (ITESM), Mexico was invited as a Visiting Professor in the Summer term of 2019. He conducted a two-credit course on ‘Die Design and Manufacture’, from 3 – 8 June, 2019. This was conducted for the students of Mechanical Engineering Department – lateral entry students of 6th and 8th semester B.Tech program and 2nd semester students from M.Tech program. The total number of students for the program was 62, which included from 28 students from M.Tech program and 34 are from B.Tech program.



Prof. Juan Calderon with Chanceller MR Doreswamy, Vice Chanceller Dr. KNB Murthy and others

International Symposium on Heat Transfer as part of 80th Birthday Celebrations of Prof. K. N. Seetharamu

Prof. K N Seetharamu felicitations committee organized an International Symposium on Heat Transfer as part of 80th Birthday Celebrations of Prof. K. N. Seetharamu on 22 June 2019 at PES University. Prof. M V Krishna Murthy (Former Professor, Department of Mechanical Engineering, IISc, Bengaluru) was the chief guest for the event and Prof. T Sundarrajan (Chair Professor, Department of Mechanical Engineering, IIT Madras) was the Guest of Honour. Students, colleagues and well-wishers of Prof. K N Seetharamu attended the event in large numbers.

Prof. KN Seetharamu lighting the lamp during the inauguration of the Symposium. Others (L-R) Prof. T Sundarrajan, P Nithiarasu, V Krishnamurthy, MV Krishnamurthy, V Krishna



Prof. T Sundarrajan (IIT Madras), Prof. P Nithiarasu (College of Engineering, Swansea University, UK), Prof. Madhu Ganesan (PSG Institute of Technology), Dr. C Ranganayakulu (Aeronautical Development Agency, GOI), Dr. V Prashanth (Applied Materials Pvt. Ltd.), Prof. Rama Narasimha (KS School of Engineering and Management), Prof. V Krishna (PES University) gave lectures on this occasion. Prof. K N Seetharamu and his wife were felicitated during this event.

Felicitations to Prof. K N Seetharamu

National Level Selection of Final Candidate for World Skills, Russia M-CAD Competition 2019

The National Skill Competition is conducted by National Skill Development Corporation (NSDC), Govt. of India, New Delhi, along with Capital Goods Skill Council (CGSC). This year, to choose the candidate for World Skills 2019, the final selection competition was held at PES University from 23rd - 25th May, 2019. The Department of Mechanical Engineering, PES University, Bangalore, conducted the Mechanical Engineering-CAD competition for selecting the candidate who will represent India at the World Skills, Kazan in Russia, during 2019. The event was inaugurated by the Dr. K S Sridhar, Chairperson, Mechanical Department. The technical support was rendered by NTTF, Bangalore. Dr. N. Rajesh Mathivanan, Professor, PES University coordinated the activity and also was on the judging panel along with Mr. Marshal and Mr. Prashanth, Asst. Prof. NTTF. The participants underwent three modules of exercises, Modeling, Designing and Reverse Engineering. Prof. K. Venugopal, Former Director NTTF and Nominee from NSDC visited the competition.



Prof. K Venugopal observing candidates at work

Just out

for the world to see

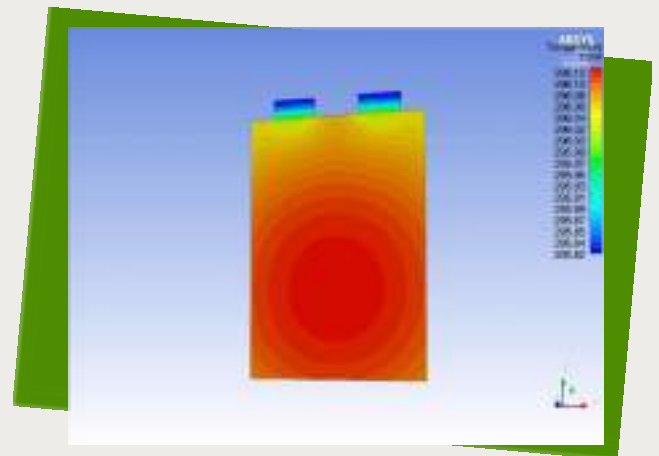
Journal Publications

A Comparative Study on Battery Thermal Management Using Phase Change Material

Authors : Ashima Verma, **Sumanth Shashidhara**, Dibakar Rakshit

Publisher : Thermal Science and Engineering Progress, Elsevier Publication, Volume 11, June 2019, Pages 74-83,
DOI: <https://doi.org/10.1016/j.tsep.2019.03.003>

The present study aims at battery thermal management of Electric Vehicles (EV). Li-ion battery used in EVs has an optimum operating range of 25°C to 60°C beyond which battery doesn't perform efficiently. Thus, thermal management of EV is catching importance in the industry. There are two ways in which Thermal management of EV's can be done. First is from inside by controlling the dimensions of Electrode and reducing the resistance. This helps in reducing the Power dissipation and hence preventing the Electrolyte explosion which can result in overall battery damage. Second is from outside by employing various methods (i) by Air (ii) by liquid (iii) by PCM which is called the battery thermal management of the vehicle System. The first two methods of cooling are active cooling methods and involve lot of auxiliary parts which calls for balancing of the system. Moreover, active cooling method also lowers the vehicle's efficiency. The heat generation is closely dependent upon the discharge rates and the ambient condition. Therefore, current study is focused on passive methods of cooling through the use of PCM (Capric acid) which has been placed around the periphery in the battery pack. Different thickness of PCM layer 3 mm, 7 mm, 9 mm and 12 mm have been taken. Two ambient conditions of 294 K and desert condition (323 K) has been explored in this study and the effect of Capric acid as a PCM has been tested and compared with the traditionally used paraf ns. PCM layer of 3 mm thickness proves to be optimum and lowered the maximum temperature in the battery to 305 K.



Dynamic Instability Analysis of Multifunctional Composite Structures

Authors : Yashwantha Kumar, **B. Rammohan**, P. R. Budarapu, D. K. Harursampath, **K. N. Seetharamu**

Publisher : AIAA Journal, Articles in Advance, February 2019

DOI: <https://doi.org/10.2514/1.J057479>

A dynamic instability analysis of fiber reinforced composite cantilever beams has been carried out in this study. Both experimental and numerical studies are performed to estimate the flutter speeds. Three different types of composite beams [namely, glass fiber reinforced plastics, aluminum fiber reinforced (glass reinforced aluminum), and multifunctional carbon fiber reinforced composites] have been considered in the analysis. A graphite fiber reinforced polymer matrix composite laminate with dimensions of 320×75×12 mm is used in the experiments. The fibers are oriented along 0 deg: that is, along the direction of major dimension of the laminate. The experiments are conducted on three such beams by clamping one end of the beam to a heavy steel frame and leaving the other end free. The natural frequencies, mode shapes, and structural damping characteristics of each beam are estimated using the modal analysis through the fast Fourier transform analyzer. Variation of the damping and the frequency with wind velocity for each beam is illustrated through the v–g and v–f plots. The modal assurance criterion is also verified. Experiments are further continued to perform a dynamic instability analysis by clamping the beam inside the test chamber of a low-speed suction-type wind tunnel. The beam response at various wind speeds is captured through an accelerometer mounted at the tip. Based on the experiments, the flutter speed of the tested beams is estimated to be around 32 m/s. A numerical analysis framework is developed using the ZAERO code to perform the modal and flutter analyses. Numerical results are compared to the experimental results and are found to be in excellent agreement. Therefore, the numerical framework has been further extended to carry out the flutter analysis of the multifunctional composite beams, such as glass reinforced aluminum and plastic lithium– ion battery embedded composite beams. The multifunctional laminated composite beams are observed to have better dynamic stability as compared to the glass fiber reinforced polymer composite beams.

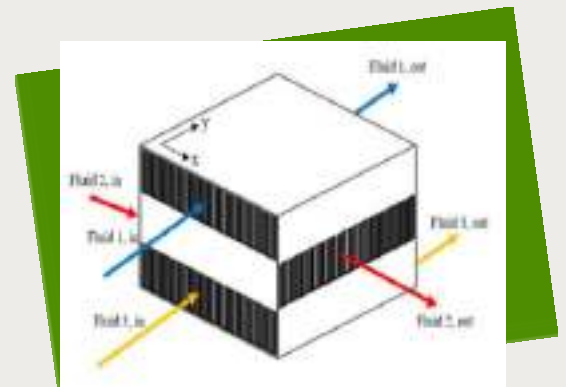
Thermodynamic Optimisation of Three-Fluid Cross-Flow Heat Exchanger using GA and PSO Heuristics

Authors : **K. H. Jyothiprakash**, J. Harshith, Abhimanyu Sharan, **K. N. Seetharamu**, Y. T. Krishnegowda

Publisher: Thermal Science and Engineering Progress, Elsevier Publication, Volume 11, June 2019, pages 289 - 301,

DOI: <https://doi.org/10.1016/j.tsep.2019.04.009>

Optimization technique for a three-fluid cross-flow plate-fin heat exchanger with offset strip fins is developed, considering significant variables subjected to given constraints. The objective of optimization is focused on maximizing the hot fluid effectiveness and minimizing the number of entropy generation units in the three-fluid cross-flow plate-fin heat exchanger. Governing equations for a cross-cocurrent flow arrangement of a three-fluid heat exchanger are solved using finite element method for given boundary conditions.



The obtained mean exit fluid temperatures from FEM are used to determine the rate of entropy generation and hot fluid effectiveness of the heat exchanger. Results obtained from the optimization of a reduced model of two-fluid cross-flow heat exchanger is compared with previously published results, thus serving as a validation of the optimization technique. Geometric parameters of the heat exchanger are varied to get the optimum results. The present investigation uses two different heuristics, namely Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) to find the optimum design values based on the objectives. Minimization of number of entropy generation units is treated to be a single objective function and optimum solutions are determined using both GA and PSO, both giving a function value of 0.0534786. Similarly, considering maximization of the hot fluid effectiveness, the optimum function value from both techniques is found to be 0.99997095. The results obtained from both the methods are compared and provides almost identical design values, with PSO taking lesser time for execution. Also, considering minimization of number of entropy generation units and maximization of hot fluid effectiveness of the heat exchanger as objective functions, multi-objective optimization is performed using GA alone and the multiple results obtained has been illustrated as a pareto-front.

Heat Transfer in a Side Heated Trapezoidal Cavity with Openings

Authors : B. M. Krishne Gowda, M. S. Rajagopal, Aswatha, **K. N. Seetharamu**

Publisher : Engineering Science and Technology, Elsevier Publication, Volume 22, Issue 1, February 2019, Pages 153-167,
DOI: <https://doi.org/10.1016/j.jestch.2018.04.017>

A control volume based numerical study has been carried out on trapezoidal cavity which has formed by inclined left heated wall and insulated bottom horizontal walls. The calculations are performed for Rayleigh numbers varying from 103 to 107 and orientation of heated wall is and . The results are compared for cases without opening and with different openings of the vertical wall as functions of isotherms, stream functions, local and average heat transfer rates. It has been observed that the case having vents at extreme ends exhibits highest heat transfer compared to other cases. The power law correlations have been developed between average Nusselt numbers and Rayleigh numbers.

Numerical Studies on natural Convection in a Trapezoidal Enclosure with Discrete Heating

Authors : B. M. Krishne Gowda, M. S. Rajagopal, Aswatha, **K. N. Seetharamu**

Publisher : Heat Transfer Engineering, Taylor & Francis Publications, February 2019, Pages 1-12
DOI: <https://doi.org/10.1080/01457632.2018.1546948>

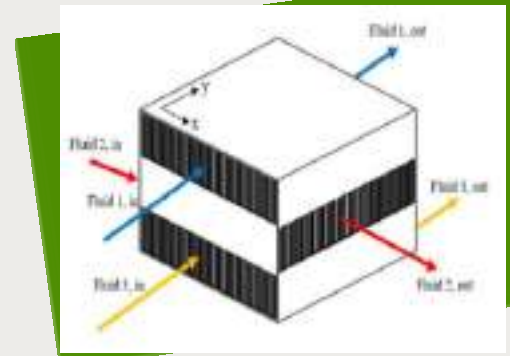
A control volume based numerical study has been carried out on trapezoidal cavity which has formed by inclined left heated wall and insulated bottom horizontal walls. The calculations are performed for Rayleigh numbers varying from 103 to 107 and orientation of heated wall is and . The results are compared for cases without opening and with different openings of the vertical wall as functions of isotherms, streamfunctions, local and average heat transfer rates. The overall Nusselt number increases with increase of Rayleigh number, but decreases with increase in angle of orientation. The transition region between conduction to convection is existing almost at $Ra = 5 \times 10^3$. It has been observed that the case having vents at extreme ends exhibits highest heat transfer compared to other cases. The heat transfer is better for the orientation angle of 60° . As compare to uniformly cooled wall, the heat transfer is enhanced by 23%, 39%, 56% and 74% at $Ra = 104, 105, 106$ and 107 respectively. The power law correlations have been developed between average Nusselt numbers and Rayleigh numbers.

Inlet Flow Maldistribution Effect on Three-Fluid Cross-Flow Heat Exchanger Arrangements

Authors : K. H. Jyotiprakash, Y. T. Krishnegowda, K. N. Seetharamu

Publisher: 4th Thermal and Fluids Engineering Conference (TFEC), Las Vegas, USA, 14-17 April 2019, pages 221-230, DOI: [10.1615/TFEC2019.che.028439](https://doi.org/10.1615/TFEC2019.che.028439)

Investigations on the effect of uniform inlet flow and inlet flow maldistribution in two types of three-fluid cross-flow heat exchanger arrangement is carried out. Type of heat exchangers being selected are the cross-cocurrent flow arrangement (C4), and the cross-counter current flow arrangement (C3). The central hot fluid is assumed to exchange heat with two cross-flow cold fluids in both the arrangements. The governing equations are derived based on the conservation of energy principle and solved by finite element method.



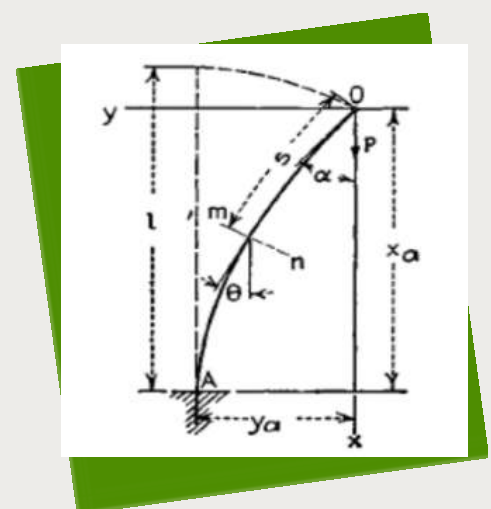
The results are presented in terms of overall effectiveness and number of transfer units for different values of governing parameters. Deterioration factor is used to compare the effects on two types of arrangements. The results indicate that when there is flow maldistribution effect, the thermal performance of a three-fluid heat exchanger will be degraded more than the performance of the uniform inlet flow effect in all cases. Also cross-cocurrent (C4) flow arrangement is superior to the cross counter current (C3) flow arrangement in both the uniform or maldistribution inlet flow effects.

Symbolic Techniques to Assess the Stability of Structures using Maple

Authors : Kartik Nadiger, Vatsal Mehta, Savan Vachhani, **Rammohan B.**

Publisher: INCAM 2019 Conference, 3-5 July 2019, IISc Bangalore, ISSN 0256-2499

This paper focuses on the assessment of the critical issue pertaining to the stability of structures using a symbolic solver like Maple. The post-critical behavior of a fixed-free column with an applied load exceeding the critical value is examined. An exact differential equation formulation is employed and the resulting expression for the coordinates of the deflection curve in terms of an elliptical integral is obtained. This integral is evaluated for a range of deflection values (200 to 1800) and the deflection curve is plotted. The symbolic approach is extended to solve problems arising due to fluid-structure interaction in commercial aircrafts namely divergence and flutter. Divergence analysis is done on a cantilever beam model by solving the differential equation to get the critical divergence values. For the analysis of dynamic instability in an aircraft wing, V-g method is employed. In this method, Theodorsen's function in terms of second-order Hankel function is used. The flutter determinant is evaluated and parameters such as flutter speed and frequency are extracted. The results of divergence and flutter code are validated for the examples in [4][5]. Lastly, the effects of replacing isotropic metallic structures with laminated composite on the postponement of instability are addressed.

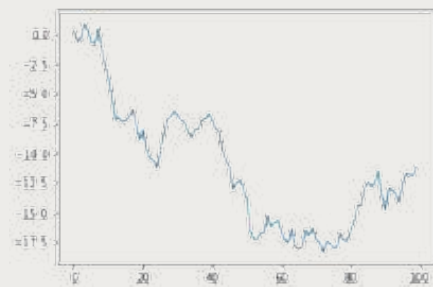


Algorithm Optimisation and Machine Learning in Fatigue Life Estimation

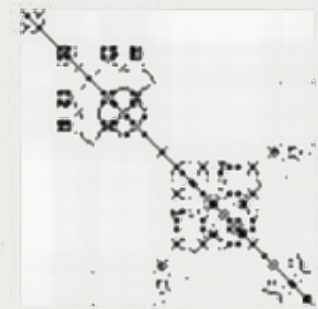
Authors : Kapotaksha Das, Anupama Jayaraman, Harish Krishnan, **Rammohan B.**

Publisher : INCAm 2019 Conference, 3-5 July 2019, IISc Bangalore, ISSN 0256-2499

Fatigue life estimation requires the use of damage accumulation models, multiple of which are in use in the industry. One of the more popular models used is the Coffin-Manson Equation which gives a relationship between the strain amplitude and the number of cycles to failure. Studying the nature of the equation shows that normal iterative based solvers do not perform well to find a solution, and hence a more efficient algorithm is developed based off the behaviour of the equation itself which improves solve times. Machine learning (ML) performs very well on labeling data given a large dataset of previously recorded labels and is also capable of identifying different types of data that have no labels. Building a model that can predict life expectancy requires the creation of a convoluted neural network (CNN) which can then be translated into a general prediction model for other vibration based data. Further potential and practical applications will be discussed for ML in these use cases.



Original Vibration Data



Recurrence Plot applied



Projection applied

Projects

in the pipeline

Government Projects (Ongoing)

| Sl. No | Title | Funding Agency | Amount In INR (Lakhs) |
|--------|--|----------------|-----------------------|
| 1 | Optimisation of Blending Winglets for Trapezoidal Wings | AR&DB | 8.03 |
| 2 | Centre for Design, Analysis and Development of Heat Exchangers | KCTU, PESU | 100.00 |
| 3 | Thermal Design Optimisation of Printed Circuit Boards (PCB's) | ISRO | 28.60 |

Consultancy Projects (Ongoing)

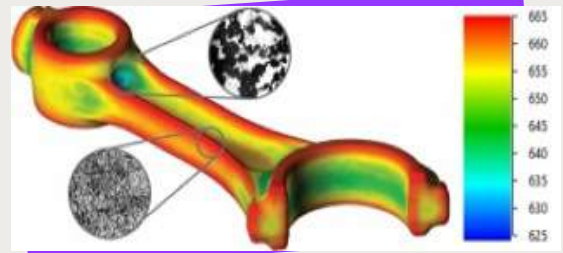
| Sl. No | Title | Organisation/ Client | Amount In INR (Lakhs) |
|--------|--------------------------|----------------------|-----------------------|
| 1 | Advanced Prosthetic Foot | Dr. Haripriya | 3.00 |

Happening Now

its all in the works

Heat Treatment Simulation using Genetic Algorithm

Hardness and Microstructure are the key variables in heat treatment. There are many models available in general to predict them. We are developing a Genetic Algorithm in Python to predict hardness and microstructure.



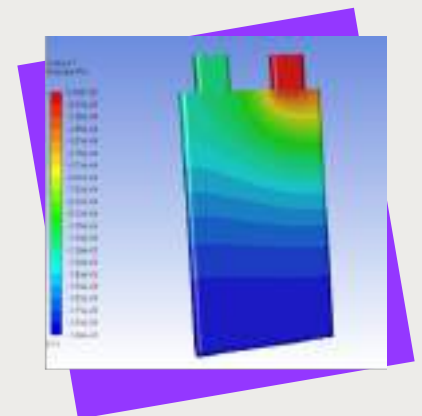
Development of Finite Element Software for Researchers with Python Solvers



We are developing Finite Element Software for Researchers with python solvers called FEATherSol using SALOME preprocessor and ParaView postprocessor. The advantage of this package is any academic or industrial researcher can write their own solver code in python as per their requirement and run the analysis. Currently 2D steady and transient thermal analysis conducted successfully using triangular elements.

Thermal Management of EV Batteries

Li-ion batteries have a profound importance in today's world due to their use in powering the future vehicles. Volumetric and packing efficiency is better for prismatic cell when compared with cylindrical cell, whereas heat generation will be higher for prismatic cell. In this work an attempt is made to study the effect of various mini-channel configurations on prismatic cell thermal management by including the effects of C-rate, coolant flow rate and coolant inlet temperature on temperature gradient and maximum cell temperature are studied using MSMD-ECM Module in ANSYS-FLUENT.

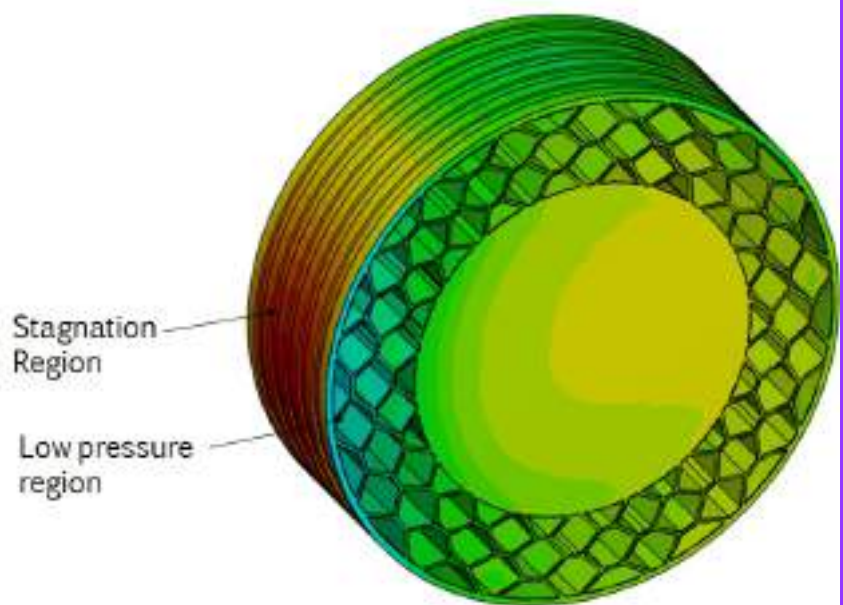
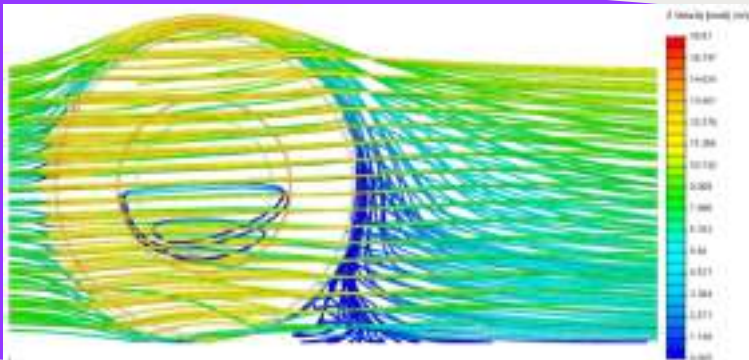


Happening Now

its all in the works

Aerodynamic Analysis of Non-Pneumatic Tires

Tyre is a prominent part of any vehicle, contributing 33% of total aerodynamic drag of vehicle and is the only part in contact with road. In this work, an attempt is made to study the aerodynamic characteristics of non-pneumatic tyre with hexagonal spokes in rotating condition using SimScale®-CFD. Effect of various parameters like 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 rotating wheel on aerodynamic performance. Results show that the increase in camber angle or steering angle results in reduced drag and lift coefficients.



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