PROCEEDINGS OF

VIRTUAL
INTERNATIONAL CONFERENCE ON RESEARCH CONTRIBUTIONS IN MECHANCIAL ENGINEERING
(ICRCME – 2022)

25 - 26 February 2022

Organized by

DEPARTMENT OF MECHANICAL ENGINEERING

SESHADRI RAO GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with permanent affiliation to JNTUK, Kakinada)

Seshadri Rao Knowledge Village Gudlavalleru - 521 356, Krishna Dist.,

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Sri K.Ch. Kishor Kumar,Department of Mechanical Engineering,SRGEC,Gudlavalleru

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Dr. Ravi Kumar Mandava,Department of Mechanical Engineering , MANIT Bhopal
Dr. J.A. Ranga Babu,Department of Mechanical Engineering,SRGEC,Gudlavalleru

Session 4
Dr. T. Karthikeya Sharma,Department of Mechanical Engineering ,NIT Andhra Pradesh
Dr. G. Prabhakara Rao,Department of Mechanical Engineering,SRGEC,Gudlavalleru

Proceedings of Virtual International Conference on Research Contributions in Mechanical Engineering (ICRCME-2022)

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PREFACE

The virtual International Conference on Research Contributions in Mechanical Engineering is organized during 25-26 February 2022 by the Department of Mechanical Engineering, Seshadri Rao Gudlavalleru Engineering College. The objective of the conference is to provide a platform for researchers, academicians and industry experts to present their research outcomes, share their expertise and offer/receive suggestions from their peers. All the individuals doing research on recent trends in Mechanical Engineering and allied interdisciplinary fields are invited to present their research papers in the conference and contribute for the technological advancements in the field of Mechanical Engineering.

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Date: 26-02-2022 AN SESSION – 4 Time: 2:00 PM - 3:00 PM

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MESSAGES BY DIGNITARIES

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ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

(A Statutory Body of the Govt. of A.P.)

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E-mail : chairman.apsche@gmail.com, website : www.apsche.org

Prof. K. Hemachandra Reddy
Chairman

MESSAGE

I am extremely delighted and pleased to know that the *Department of Mechanical Engineering*, *Seshadri Rao Gudlavalleru Engineering College*, *Gudlavalleru* is organizing an International Conference on "**Research Contributions in Mechanical Engineering**" (ICRCME - 2022) on the 25th and 26th of February 2022. I would like to congratulate the principal, faculty, students and the staff for organizing the second international conference in three months. It is a great honor and privilege to share my thoughts in this souvenir.

The Mechanical Engineering field requires an understanding of core areas including mechanics, dynamics, thermodynamics, materials science, structural analysis, and electricity. It is the branch of engineering that involves the design, production, and operation of machinery. George Stephenson, James Watt, Nikola Tesla, Rudolf Diesel, Charles Babbage, Thomas Eddison, and Karl Benz are the seven greatest Mechanical Engineers who contributed to the development of our society. Research is an opportunity to make a difference in society and it thrives on a diversity of approaches and perspectives. Research helps us to discover, innovate and evaluate new ideas, knowledge, and the technologies necessary for our posterity. The science and engineering research conducted in academic institutions, and elsewhere plays a critical role in raising our standards of living, creating jobs, providing for national security, and developing our people. I am very sure that the conference of this type will inculcate the much-needed research culture among the students and teachers, and trigger interactions among researchers to exchange the ideas of recent advances in the area of Engineering in general and Mechanical Engineering in particular.

I take this opportunity to congratulate Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru for organizing this conference and wish this conference to be a grand success where the learnings will pave a way for the development of society. I wish to see this conference transform the budding ideas of students into innovations where they achieve excellence and empower the people. I am very confident that with the kind of commitment to excel and lead by example, this college will achieve greater heights and provide us with great Mechanical Engineers.

PROF.K.HEMACHANDRA REDDY

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

(Eatablished by Andhra Pradesh Act No : 30 of 2008)
KAKINADA -533 003. Andhra Pradesh, INDIA.

Dr. G.V.R. PRASADA RAJU
M.E., Ph.D.
Vice Chancellor

Date: 14-02-2022

VICE CHANCELLOR'S MESSAGE

Dr. G. V. R. PRASADA RAJU
Vice Chancellor, JNTUK Kakinada.

I do congratulate Department of Mechanical Engineering, Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru for conducting **Virtual International Conference on Research Contributions in Mechanical Engineering (ICRCME- 2022)** during 25-26, Feb 2022.

The interactions among Researchers, Industrial experts and Academicians are very much essential to have innovative thoughts and designing technical solutions to the complex societal issues.

I wholeheartedly appreciate the encouragement of the management of Seshadri Rao Gudlavalleru Engineering College for making efforts to realize the vision of the Founder and Edupreneur awardee (late) Sri VVR Seshadri Rao.

I hope the participants gain knowledge through the deliberations of the conference.

I congratulate the Principal and Organizing Committee for their efforts to organize the International Conference and wish the conference a grand success.

VICE CHANCELLOR
Vice Chancellor
JNTUK KAKINADA

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Dr. POTLURI RAVINDRA BABU
B.Tech., M.S., M.Tech., Ph.D.,
FIE, C.Engg, MISTE, MSESI, MASME, MSAE, MSFA
Professor of Mechanical Engineering
Advisor to the Management &
Member - National Executive Council, ISTE, New Delhi
Chairman - SAE (India), Amaravathi Division, A.P.

17th February 2022

MESSAGE

It is my immense pleasure to note that our Department of Mechanical Engineering is organizing virtual International Conference on Research Contributions on Mechanical Engineering (ICRCME-2022) during 25 - 26 February 2022.

I understand that the deliberations on the topics would cover all the domains of Mechanical Engineering. I am confident that the conference will provide a good platform to the participants to deliberate on their areas of work and help the Co-participants to reinforce their work.

I convey my hearty greetings to the organizers of the conference and wish the conference a great success.

(P. RAVINDRA BABU)

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Dr. G. V. S. N. R. V. PRASAD
M.S., M.Tech., Ph.D.,
MISTE, MIETE, MIE, MCSI, MISRS, MIAPR, MCRSI
Principal

16th February 2022

PRINCIPAL'S MESSAGE

The initiative of the Department of Mechanical Engineering to organize Virtual International Conference on Research Contributions in Mechanical Engineering (ICRCME-2022) is highly appreciable. The enthusiasm and efforts of the organizing committee to obtain Research papers from National and International authors is commendable. The presentation of research findings and exchange of thoughts among participants will be much benefit to the researchers to refine and redefine their ideas and to contribute to the creation of new knowledge in their domain of working.

I hope participants deliberate thought provoking presentations in the Conference scheduled during 25 - 26, February 2022.

As the Principal and Head of the Institution of SRGEC, I express my sincere gratitude to the guests and keynote speakers of the conference.

"The Common facts of today are the Products of Yesterday's Research". I hope, some of the deliberations of this conference become the common facts in future period of time.

I do congratulate the organizing team and wish the conference a **grand success.**

SESHADRI RAO GUDLAVALLERU ENGINEERING COLLEGE ★ GDLV

PRINCIPAL

SESHADRI RAO
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Dr. P. KODANDA RAMA RAO
M.Tech., Ph.D., FIE, C.Engg., MISTE,
Professsor of Civil Engineering
Vice Principal - Administration

Message from Vice Principal (Administration)

I am extremely happy to note that Department of Mechanical Engineering, is organizing "International Conference on Research Contributions in Mechanical Engineering" (ICRCME-2022) on 25th and 26th of February 2022.The research in Science and Engineering domains play a vital role in influencing employment scenario, standard and style of living of public, National Security and Societal development. I am sure that the conference of this kind will inculcate the much-needed research culture among the students and teachers and the interactions among researchers by exchange their ideas on recent advances in the areas of Mechanical Engineering Contribute to Research and Development.

I wish the conference a grand success.

P. Kodanda Rama Rao

(P.KODANDA RAMA RAO)
Vice Principal - Administration

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Dr. M. R. Ch. SASTRY
M.Tech., Ph.D., MIE, MISTE,
Professsor of Mechanical Engineering
Vice Principal - Academics

MESSAGE

I am very much pleased with respect to the organization of virtual International Conference on Research Contributions in Mechanical Engineering (ICRCME-2022) by the Department of Mechanical Engineering of our college during 25-26 February 2022 with inclusion of diversified areas of Mechanical Engineering as the themes of the conference. In addition to these themes, emerging and inter disciplinary areas like nanotechnology, green manufacturing and sustainable engineering are also finding place in the conference. This in fact is a testimony to the relevance of the conference that reinforces Research and Development.

I am happy to note that eminent resource persons from international organizations delivering technical talks during the conference. I wish the fruitful deliberations of the conference results in a clear road map of the priority based research areas. I congratulate Department of Mechanical Engineering and organizing team for their efforts in organizing the conference and wish the conference all the success.

(M. R. CH. SASTRY)
Vice Principal - Academics

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Dr. P. NAGESWARA REDDY
M.Tech., Ph.D., FIE, C.Eng., MISTE,
Professsor of Mechanical Engineering
Director - PG Studies, Consultancy & Testing and R&D

MESSAGE

It is quite gratifying to note that the department of Mechanical Engineering of our college is hosting its first virtual International Conference on Research Contributions in Mechanical Engineering (ICRCME 2022) on 25th and 26th February 2022. Organizing such an event at this point of time reinforces our objective of developing an environment for the exchange of ideas towards technological developments. I wish the conference would be able to deliberate on current issues of national and international relevance. I am sure that this conference will provide an opportunity for the researchers and academicians to freely exchange their views and ideas with others. I convey my warm greetings and good luck to the organizing committee and the participants and extend my best wishes for the success of the conference.

P. Nageswara Reddy

(P. NAGESWARA REDDY)
Professor of ME &
Director, PG Studies, Consultancy & Testing and R&D

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Dr. A. JAWAHAR BABU
M.E., Ph.D.,

Processor and Head
Mechanical Engineering

MESSAGE

It gives me great pleasure to welcome all the delegates to the International Conference on "Research Contributions in Mechanical Engineering" (ICRCME2022) organized by Department of Mechanical Engineering, Seshadri Rao Gudlavalleru Engineering College. Role of mechanical engineers in improving the quality of life is commendable. Continuous improvements in the products and better designs are possible only by innovative thoughts and divergent thinking.

I am sure this two day conference deliberations will stimulate the thinking process of participants to come out with novel solutions to problems of Mechanical Engineering.

I appreciate and congratulate the organizing committee of ICRCME-2022 for their efforts and wish the conference a grand success.

(A. JAWAHAR BABU)
Professor & Head

SESHADRI RAO
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Seshadri Rao Knowledge Village, GUDLAVALLERU- 521356

Department of Mechanical Engineering

Virtual

INTERNATIONAL CONFERENCE ON RESEARCH CONTRIBUTIONS IN MECHANICAL ENGINEERING

(ICRCME 2022)

A simple ray of thought may emerge as a note worthy innovation. Presentation of thoughts, discussion on the presentations and exchange of views paves way to think beyond the box. Conferences are the right platforms to have collaboration among people working on various research areas. International conferences provide an opportunity to have interactions among individuals researching at different geographic locations, networking these individuals for better teamwork, which benefits all.

I am very happy in convening this ICRCME-2022. I thank the Resources Persons for their acceptance to contribute expert talks. I am thankful to all the authors presenting their research outcomes in the conference.

My sincere gratitude to the Management, Principal and other officials concerned for their encouragement and support for promoting Quality Education.

I convey my wholehearted thanks and regards to the organizing committee and all other colleagues for their coordinated effort in organizing ICRCME - 2022.

Dr.B.Karuna Kumar
Convener

DEPARTMENT COORDINATORS

Session wise Coordinators

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Sri A. Rajesh

Session 2
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Sri T. Siva Krishna
Sri D. Tarun

Session 3
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Sri N. Premdasu
Sri P. Satyanarayana

Session4
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Sri S. B. Karimulla Reddy

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Certificates Preparation
Sri A. Rajesh
Sri V. Pavan Kumar
Sri K. Nagaraju
Sri G. Ratna Kumar

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PROGRAM SCHEDULE

DAY 1 25-02-2022 FN **Virtual Link :** https://tinyurl.com/ICRCME2022-S1	
9.15 AM to 10.00 AM	**Inaugural Function** **Special Guest** **Prof. (Dr.) G. Ranga Janardhana,** *Vice-Chancellor, JNTUA, Anantapur.* **Chief Guest** **Prof. (Dr.) Marc A. Rosen,** *Ontario Tech University, Canada.*
10.00 AM to 11.00 AM	**Keynote Address** **Prof. (Dr.) Marc A. Rosen,** *Ontario Tech University, Canada.*
11.15 AM to 12.30 PM	**Technical Paper Presentations** **Organizing Chairs:** **1.Dr. D. Nagaraju** *Department of Manufacturing Engineering* *Vellore Institute of Technology, Vellore* **2.Dr. K. Syam Sundar** *Department of Mechanical Engineering* *Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru.*
12.30 PM to 2.00 PM	Lunch Break
DAY 1 25-02-2022 AN https://tinyurl.com/ICRCME2022-S2	
2.00 PM to 3.00 PM	**Expert Talk** **Sri Subba Rao Ganti,** *Trainer and Consultant,* *SVD Machinery Vibrations Solutions, Saudi Arabia.*
3.00 PM to 4.30 PM	**Technical Paper Presentations** **Organizing Chairs:** **1.Dr. T. Srinivas** *Department of Mechanical Engineering* *Dr. B. R. Ambedkar National Institute of Technology, Jalandhar.* **2.Sri K. Ch. Kishor Kumar** *Department of Mechanical Engineering,* *Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru*
DAY 2 26-02-2022 FN https://tinyurl.com/ICRCME2022-S3	
10.00 AM to 11.00 AM	**Expert Talk** **Dr. Sravya Nimmagadda** *Senior Deep Learning Scientist* *Autonomous Vehicles, NVIDIA, California, USA.*
11.15 AM to 12.30 PM	**Technical Paper Presentations** **Organizing Chairs:** **1. Dr. Ravi Kumar Mandava** *Department of Mechanical Engineering* *Maulana Azad National Institute of Technology, Bhopal* **2. Dr. J. A. Ranga Babu** *Department of Mechanical Engineering* *Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru*

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12.30 PM to 2.00 PM	Lunch Break
DAY 2 26-02-2022 AN https://tinyurl.com/ICRCME2022-S4	
2.00 PM to 3.00 PM	**Technical Paper Presentations** **Organizing Chairs:** **1. Dr. T. Karthikeya Sharma** *Department of Mechanical Engineering* *National Institute of Technology, Andhra Pradesh* **2. Dr. G. Prabhakara Rao** *Department of Mechanical Engineering* *Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru*
3.00 PM to 4.00 PM	**Expert Talk** **Prof.(Dr.) T. M. Indra Mahilia** *University of Technology, Sydney, Australia.*
4.00 PM to 4.30 PM	**Valedictory Function** **Chief Guest** **Prof.(Dr.) T. M. Indra Mahilia** *University of Technology, Sydney, Australia.*

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KEY NOTE ADDRESS

Directions in Energy Transitions, Decarbonisation and Sustainability

Prof. (Dr.) Marc A. Rosen
Professor & Editor-in-Chief, Sustainability & Biofuels
Faculty of Engineering & Applied Science
Ontario Tech University, Ontario, Canada.

Energy sustainability is important given the widespread nature of energy use, the importance of energy use in economic development, and the significant impacts that energy processes have on the environment. Factors that need to be considered and appropriately addressed in moving towards energy sustainability are energy resources, efficiency, and environmental stewardship, as well as economics, equity, lifestyle, sociopolitical factors and population. Furthermore, energy transitions and decarbonization of energy are important factors in moving towards energy sustainability and, more generally, sustainable development and overall sustainability.

The speaker will discuss these and a recently published assessment, which identifies the urgent need for a sustained and comprehensive strategy, including energy transition pathways, to resolve the challenges facing sustainable development, including climate change mitigation and energy security and access.

ISBN: 978-1-5136-9400-9

EXPERT TALK

Techno-economic Analysis of Hybrid Diesel and Renewable Energy Systems for a Remote Island in the Indian Ocean

Prof.(Dr.) T. M. Indra Mahila
Centre for Green Technology
Faculty of Engineering & Information Technology
University of Technology, Sydney, Australia

This study is about the electrification of the remote islands in the Indian ocean that was severely hit by the tsunami in the 2004 earth earthquake. The island just got an electricity connection in 2019 by installing two diesel generators with the capacity of 110 kW and 60 kW. This study is about renewable energy substitution and/or addition to these two generators. The renewable energy proposed here includes a 100kW wind turbine, solar PV, converter and batteries. The calculation is based on the current diesel price which is $0.90 per litre (without subsidy). The study found that renewable alone can contribute to 29.7% of renewable energy fractions based on the most optimised systems. The Net Present Cost (NPC) reduced the business as usual to an optimised system from $1.65 Million to $1.41 Million, levelised Cost of Energy (COE) from $0.292/kWh to $0.249/kWh, respectively. The optimised system Internal Rate of Return (IRR) is 14%, Return on Investment (ROI) 10% with a simple payback period of 6.7 years. All the simulations and optimisation for this analysis were conducted using Hybrid Optimisation Model for Electric Renewable (HOMER Pro) software.

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EXPERT TALK

Dr. Sravya Nimmagadda
Senior Deep Learning Scientist
Autonomous Vehicles, NVIDIA
California, United States of America.

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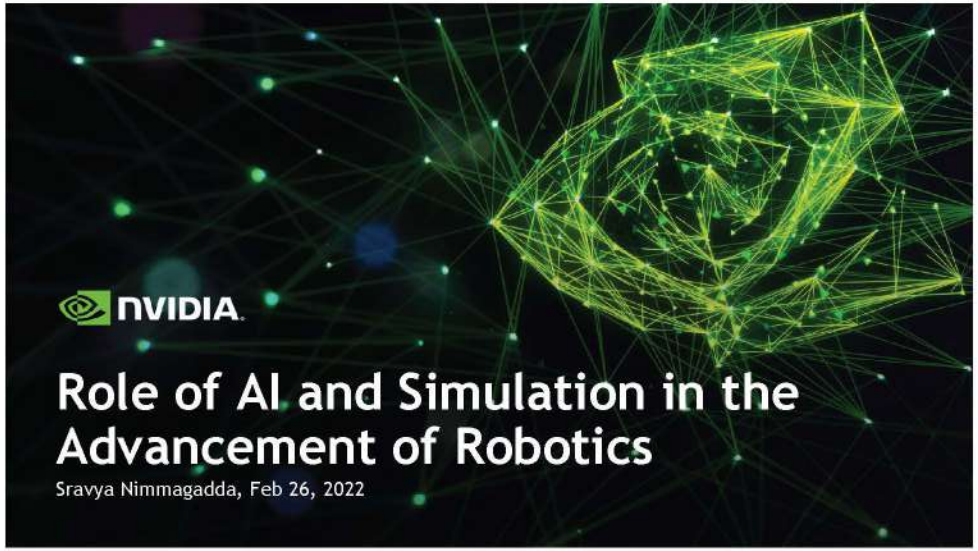


Outline

- Robotics in the Factory of the Future
  - Automated to autonomous
- Robotic use cases in the Factory of the Future and Warehouses
  - AMR (Autonomous Mobile Robots)
  - Robotic Arms
- 3D Pose Estimation in AMRs and Robotics Arms
- Using Deep Learning (AI) to solve 3D Pose Estimation
  - Problem description
  - Neural Net architecture for object detection + pose estimation
- Using simulation for 3D Pose Estimation training and inference
  - Why simulated and not real data?
  - How can we ensure networks trained in simulation perform in real world?
- Results of 3D Pose Estimation in AMRs for factory of the future use-case
- Conclusion

Industrial Factories and Future

- BMW factory plant - 1 new car assembled and come out every minute

ISBN: 978-1-5136-9400-9

Industrial Robots: AMRs and Arms

Autonomous Mobile Robots (AMRs) for transportation

Armed robots (cobots) for assembly

What makes the robot autonomous?

Hardware	Robot Brain (Software)				Actuation
Sensors like camera, LiDAR, Radar	Perception	Prediction	Planning	Control	to move robot (Hardware)
Like human senses eyes, ears etc to perceive the world	Understand the world using the information from sensors	Predict the behavior of the actors around the robot	Localize and plan the route based on the understanding of the world	Send the control commands to follow the planned path	Move the robot based on the control commands

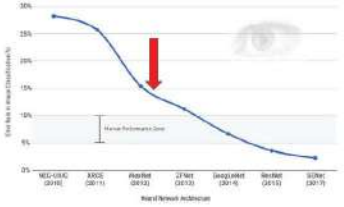
3D Pose Estimation in AMR and Arms

BMW: Factory of Future

Navigation use-case with BMW STR: Dolly Pickup

Manipulation use-case with BMW Sortbot: KLT Box grasping

Artificial Intelligence: Enabler of autonomous robots



AlexNet in 2012 demonstrated the capability of deep learning in the field of computer vision, later used in Natural Language Processing(NLP)

AlphaGo beating leading world champion in 2016 using Reinforcement Learning + Deep Learning. Demonstrates the capability of AI to self-train by past actions

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Hardware Advances: Enabler of autonomous robots

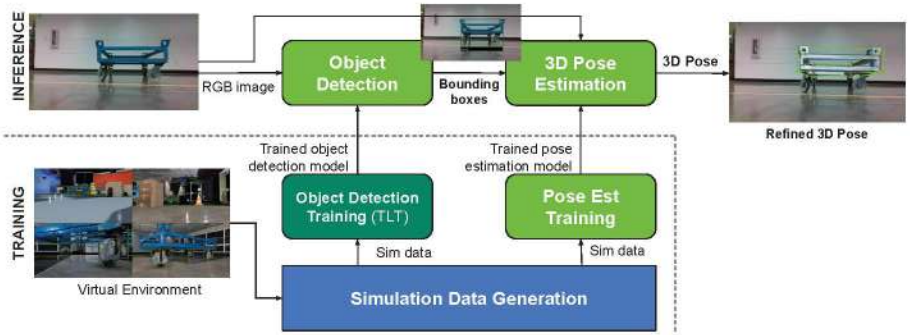
Advances in hardware made the brains of AV powerful enough to handle the computational requirements of the large AI algorithms in real-time.

Moore's law is an observation that the compute power on chip doubles every 2 years.

"A " Petaflop-Day" refers to performing a quadrillion operations per second for a day.

3D Pose Estimation Pipeline

RGB-based object detection, pose estimation.



3D Pose Estimation Training Data

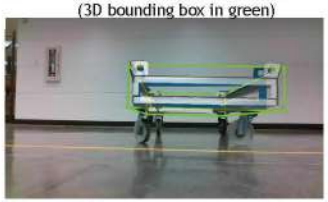
- Training data - RGB image containing the dolly and the label is the corresponding 3D position and orientation of the dolly with respect to the camera on the robot
- For visualization of the 3D pose, a 3D bounding box is used - drawn in green boxes overlaid on top of the image

Input to the network - RGB image from the camera of the robot

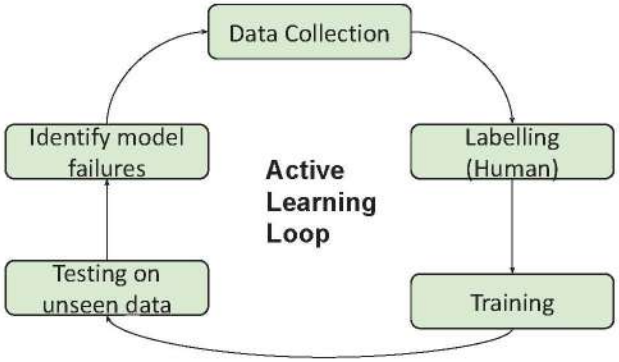
3D Pose label (wrt camera on the robot)

3D Pose wrt camera: (x, y, z): (0.2m, 0.3m, 2.5m)
Rotation angles: (5, 90, 10) deg

Visualization of the 3D pose label (3D bounding box in green)



Robot Software: AI test-train loop



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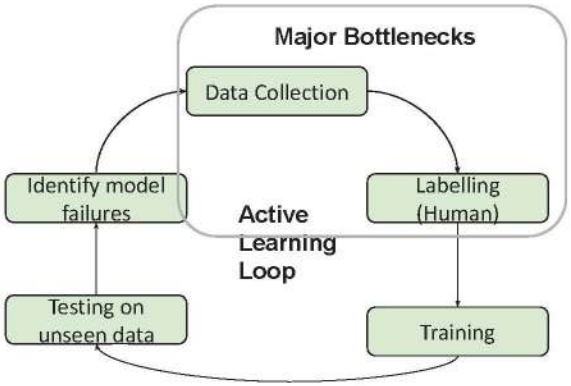
AI Bottleneck: Acquiring labelled data

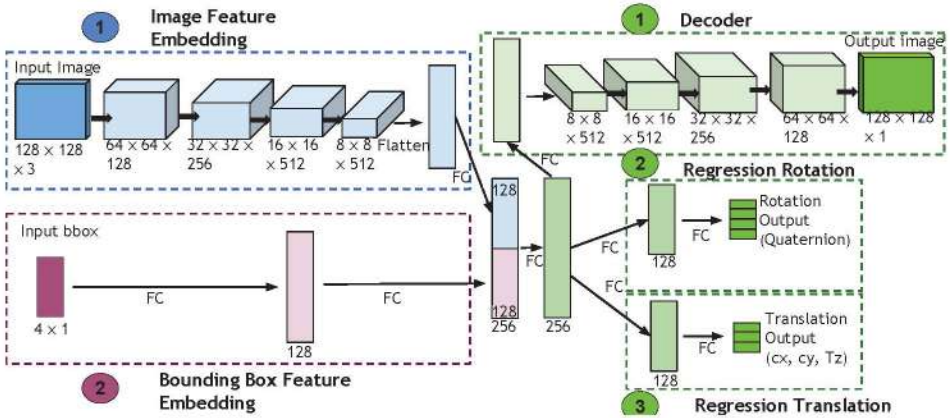


Acquiring human labelled real data for training is

1. Time consuming
2. Prone to labeling errors
3. Not enough data for rare scenarios

Isaac Pose Estimation DNN Architecture

Feature embeddings from 2 inputs. Decodes segmentation mask, pose



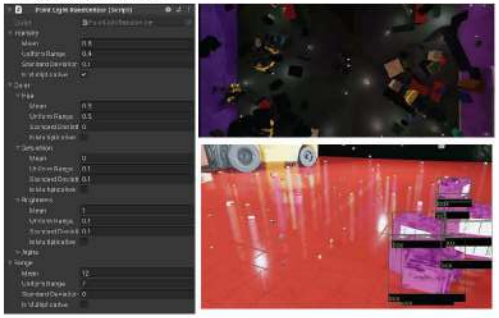
Training on Virtual Datasets

Domain randomization for sim-to-real transfer

Object spawning

Camera position and view randomization

Light randomization



Model Training on Virtual Datasets

Simulating the inference environments: NV BldgK, FoF

Sample Training Data(NV Bldg K)
Object Detection: RGB Image + "2D" Bounding Box

Sample Training Data (Factory of Future)
Object Detection: RGB Image + "3D" Bounding Box

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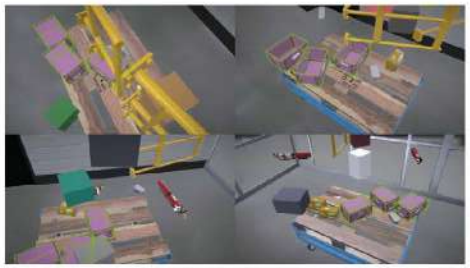
3D Object Pose Estimation: Training

Examples: Industrial Cart and Industrial Boxes

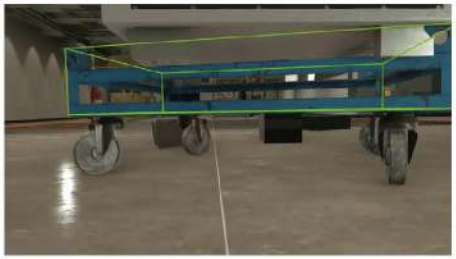
Industrial Cart: Sample Virtual Training Data
Pose Estimation: RGB Image + "3D" Bounding Box



Industrial Boxes: Sample Virtual Training Data
Pose Estimation: RGB Image + "3D" Bounding Box

Pose Estimation: Sim-to-real transfer

Navigation use-case: Dolly pose estimation in NV Bldg K environment

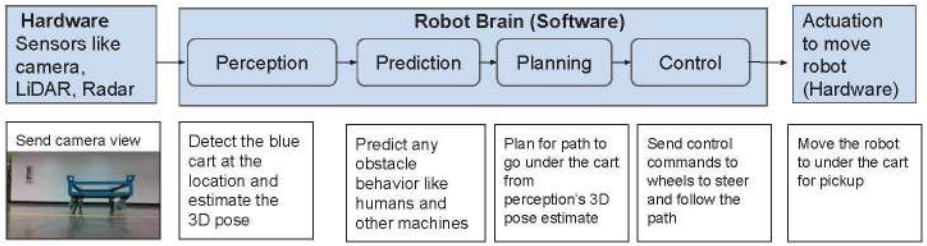


Pose Estimation Sample **Virtual** Training Data in
NV BldgK Environment:
RGB Image + **Ground Truth** "3D" Bounding Box

Industrial Cart: Sim-to-Real Transfer
Pose estimation inference on real logs recorded in test space
Left: RGB Image + "3D" Bounding Box
Right: Dolly Segmentation Mask In Cropped Image

AMR system for cart pickup

Cart pickup

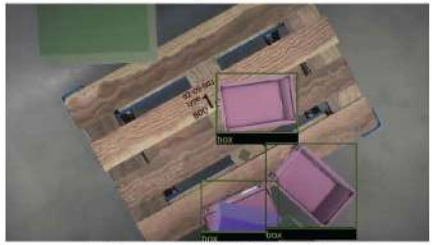


AMR usage in Factory of the Future (Sim)

- Mock-up of factory of the future with AMRs transporting materials and cobots assembling a robot
- Showcases the 3D pose estimation for perception to pick up blue cart + robot navigation with planner to transport goods from place to place
- Enables testing of full autonomous mobile robot software in simulation before deploying in real factories

Pose Estimation: Sim-to-real transfer

Manipulation use-case: KLT box pose estimation



Training Scenario (2D detections)

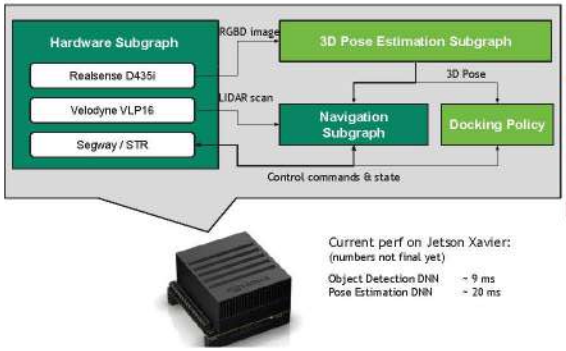
Setup in NV Bldg K

Inference Scenario in Sim

Sim-to-real Transfer Inference in Bldg K

3D Pose Estimation in Navigation

Perception on BMW STR and BMW Sortbot hardware



Real World: BMW STR + BMW SortBot (NV Building K)
Omniverse Visualization on the top

What's next? Factory of the Future

Robots and the future

- Penetration of autonomous robots in industries
  - Use of AI to train robots to perform complex tasks with intelligence
  - Use of simulation to train AI models efficiently in less time and cost
  - Use of simulation to test complex robot systems before deploying in real world
- Digital twins of factories and warehouses to improve efficiency
- Robots with hands performing manipulation tasks still in research phases
  - Allows deploying personal robots performing daily complex tasks in the future
- Explore opportunities to deploy robots in our daily lives

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Robots that helped during Covid

Disinfecting Robots on the frontline
Image Credits: IEEE Spectrum

Service robot doing non-contact delivery of medicines, da[illegible]O

Companion robots for patient care
Image Credits: SoftBankRobotics

Cobots manufacturing PPE, Ventolators
ImageCredits: UniversalRobots

EXPERT TALK

Sri Subba RaoGanti
Trainer and Consultant
SVD Machinery Vibrations Solutions
Saudi Arabia.

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ISBN: 978-1-5136-9400-9

Technical Talk

On

Best Practices in "Vibration Monitoring & Analysis" based Condition Monitoring of Industrial Rotating Machinery"

By

Subba Rao Ganti
SVD Machinery Vibration Solutions

25-02-2022

International Conference on Research Contributions in Mechanical Engineering
(ICRCME 2022)
Organized by
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GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, GUDLAVALLERU- 521356

Purpose of this talk…

To provide an insight into some of the best practices for Condition Monitoring of Industrial Rotating Machinery with special focus on Vibration Monitoring and Analysis.

NAME: Subba Rao Ganti
DESIGNATION: Trainer & Consultant
COMPANY: SVD Machinery Vibration Solutions
COUNTRY: Qatar and Saudi Arabia
PROFESSIONAL WITH GLOBAL EXPOSURE.

A Category IV Vibration Analyst (2008-certified by Vibration Institute, USA) and has 35 years of work experience out of which 30 years exclusively in Rotating Equipment Vibration Analysis, Training & Troubleshooting in Oil & Gas, Power and Petrochemical Industries.
He has a B.Tech (Mechanical -1983) Degree from JNT University, Hyderabad, India.
Has served in reputed organizations like NTPC, L&T, Masibus in India; GE (Bently Nevada) and Qatargas in the Middle East.

A member of the Vibration Institute, USA since 1998.
Presented case studies at IMVAC – Dubai (2017) and BINDT CM-2019 held at Glasgow, UK, ICCM 2021 – TATA Steel in Jan 2021 and ATPS 2021 – Malaysia in February 2021.

Presently he is with SVD Machinery Vibration Solutions and Trainer and Consultant in Machinery Vibration Analysis for:
1. Essex Lloyds Engineering Services - Qatar
2. Industrial Expertise - Engineering Consultations Office - Saudi Arabia
3.Athorized instructor, for Category I to IV Training courses of Mobius Institute, Australia.

AGENDA…..

- CM of industrial rotating equipment covering various sectors
- Failure modes predicted through the most widely used CM tool.. Vibration Monitoring& Analysis
- Various techniques used in the process of identification of the failure modes

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What is Condition Monitoring?

Condition monitoring

From Wikipedia, the free encyclopedia

Condition monitoring (colloquially, **CM**) is the process of monitoring a parameter of condition in machinery (vibration, temperature etc.), in order to identify a significant change which is indicative of a developing fault. It is a major component of predictive maintenance. The use of condition monitoring allows maintenance to be scheduled, or other actions to be taken to prevent consequential damages and avoid its consequences. Condition monitoring has a unique benefit in that conditions that would shorten normal lifespan can be addressed before they develop into a major failure. Condition monitoring techniques are normally used on rotating equipment, auxiliary systems and other machinery (compressors, pumps, electric motors, internal combustion engines, presses), while periodic inspection using non-destructive testing (NDT) techniques and fit for service (FFS)[1] evaluation are used for static plant equipment such as steam boilers, piping and heat exchangers.

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Condition Monitoring

Certification Services Division

What is condition monitoring?

Techniques collectively referred to as condition monitoring (CM) have a common objective of indicating the early signs of deterioration or malfunction, and wear trending in structure, plant and machinery through surveillance, testing and analysis.

The above extracted from:
https://www.bindt.org/Certification/

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Industries that are extensively practicing various Condition Monitoring Techniques

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Some of the industries where condition monitoring of rotating machinery is effectively practiced

- Oil & Gas
- Power (Thermal, Hydro, Wind)
- Petrochemical
- Fertilizer
- Paper
- Cement
- Paint
- Automotive
- Machine Tools
- Textile
- Chemical
- Mining
- Steel
- Aluminium
- Copper

Some of the most widely accepted techniques in condition monitoring of rotating machinery

- Vibration Analysis
- Lube Oil Analysis
- Thermography
- Ultrasonic Analysis

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Most popular Condition Monitoring Techniques

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Vibration Monitoring & Analysis Systems (VMAS) of Rotating Machinery and Why is it required?

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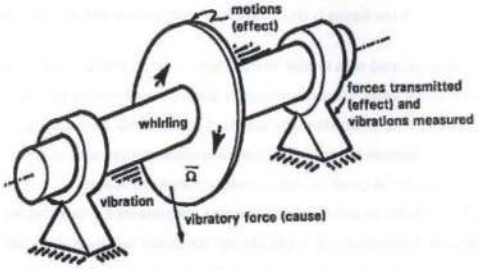
What is VIBRATION ?



Vibration is the "response or effect" of a system to an "excitation or cause" (external or self excited)
Machines & Structures vibrate in response to one or more pulsating forces called excitation.
Example, Mass Imbalance, Misalignment etc.

WHY Vibration Monitoring ?

- Changes in vibration response indicate changes in machine condition
- Most faults increase vibration, indicating degradation in machinery health
- There is a predictable vibration signature for specific faults and machine elements
- So, monitoring vibration gives information about machinery health and enables planned maintenance actions.

Best Practices in Vibration Monitoring & Analysis based Condition Monitoring

- Management commitment to support CM activities by providing necessary resources, training and inter departmental support.
- Define Criticality of the rotating equipment in terms of production impact, plant safety etc. in order to select the most appropriate monitoring system, viz Continuous or Intermittent Online Systems, Offline Potable Systems etc.
- Determine monitoring schedules, alarm limits considering the equipment operation, application, applicable standards etc.
- Create equipment data base and schedule monitoring through Maintenance Management Systems

Best Practices in Vibration Monitoring & Analysis based Condition Monitoring

- Daily planning meeting with Plant Operations for execution of offline vibration monitoring as per predetermined schedule
- Keeping track of equipment that could not be monitored and rescheduling accordingly.
- Periodic reports (weekly / monthly etc.) to highlight equipment health condition
- Exception reports to provide advance information to plan necessary maintenance

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Goals of a VMA System

VMA system must be capable of meeting the following requirements:

- Protect equipment from catastrophic failure due to high vibration
- Provide adequate data through various plots to enable analysts to:
  - 1 - identify the impending problems at early stages
  - 2 - determine whether a high vibration trip is genuine or not ?
  - 3 - Whether it is safe to restart the equipment or not after the high vibration trip?

Strategies in Vibration Monitoring & Analysis based Condition Monitoring of Rotating Machinery

- Online continuous monitoring for highly critical Turbomachinery through proximity sensors
- Online continuous monitoring of critical machinery thorough casing mounted, wired sensors
- Online continuous monitoring of critical machinery thorough casing mounted, wireless sensors (now expanding by leaps & bounds, thanks to IoT, ML, AI etc.)
- Offline Periodic monitoring with portable vibration data collectors

- Understanding the application, advantages and limitations of various available systems (continuous / intermittent / wireless etc.) is of paramount importance in the selection and implementation any VMAS.
- *Improper and (or) inadequate VMAS could jeopardize the very purpose of introducing it.*
- Millions of Rupees could be wrongly invested in the absence of right guidance in selection of the most appropriate VMAS for any plant rotating equipment.

The key elements of a good online system are:

- Proximity or Displacement probes for detecting shaft motion
- Accelerometers or velometers for detecting housing motion
- Key Phasor for vibration phase measurement.
- Data collection and analysis software capable of providing various plots like Vibration Trend, Bode, Polar, Orbit, Shaft Centerline, Waterfall, Spectrum etc.

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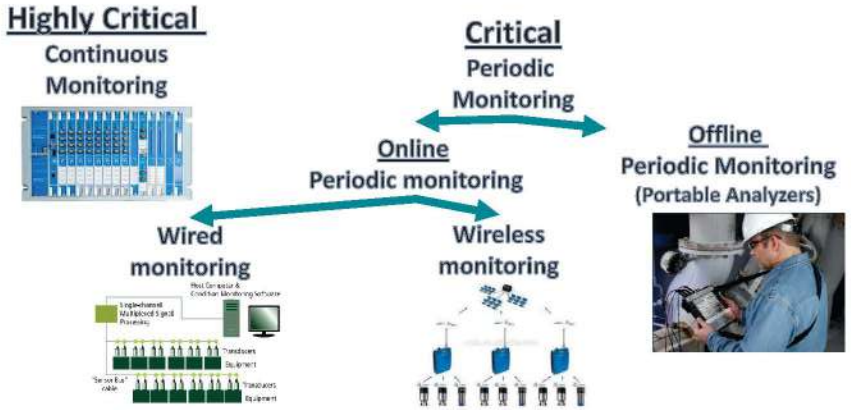
Vibration Analysis Plots:

Typical plots generated from vibration data for analysis are:

- **Trend…** Selected parameter vs time plot
- **Bode…** 1X amplitude and phase Vs speed in two different plots
- **Polar…** 1X amplitude and phase Vs speed in one plot
- **Orbit….** Depicts the way shaft centerline is moving within the bearing clearance under the influence of various loads
- **Shaft Centerline…**Depicts the average shaft center position within the bearing clearance under the influence of various loads
- **Waterfall…** vibration spectra plots between selected time interval
- **Cascade…** vibration spectra plots between selected RPM interval

Selection of VMAS based on Equipment Criticality Strategy



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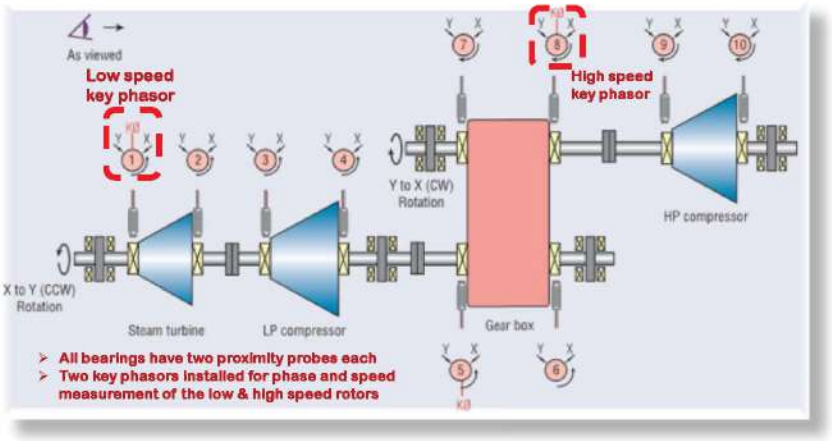
Typical Layout of online vibration monitoring of turbo-machinery



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Pump , FAN & Motor Rolling Element Bearing VMAS

Bearing housing absolute vibration measurement with accelerometers / velometers

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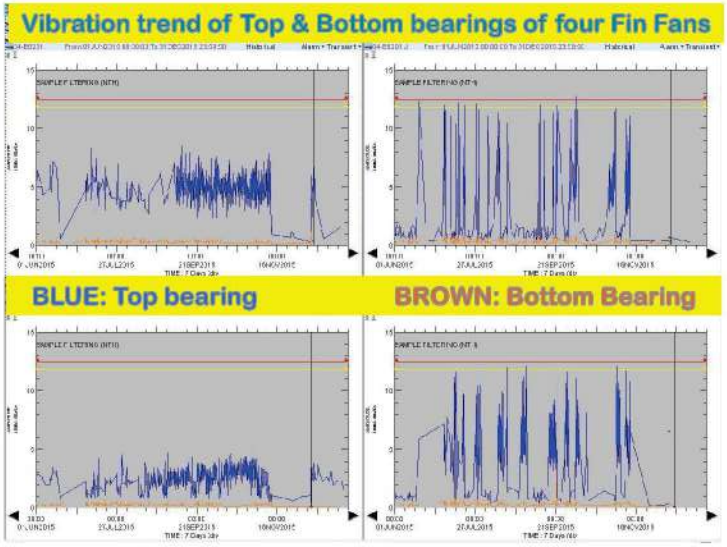
Wireless Vibration Monitoring & Analysis Systems

- Wireless vibration monitoring systems comes with advantages and limitations as well.
- A thorough evaluation to be carried out with respect to the advantages of considering a Smart Wireless VMAS (Utilizing latest AI, ML and IoT technologies)
- A wide variety of WVMAS are available with significant monitoring and analytical capabilities but not without limitations.
- Clarity on our requirements and market offerings is very essential.



Sensor Mounting … Do not completely rely on OEM

- Use inhouse expertise when installing vibration sensors for online monitoring and do not completely depend upon the OEM.
- *Here is an example of installation of a sensor for monitoring vibration of the top bearing of a Fin Fan in an Oil & Gas Facility.*
- Due to improper mounting (as shown in the next slide), top bearing vibration was always high and reaching alarm.

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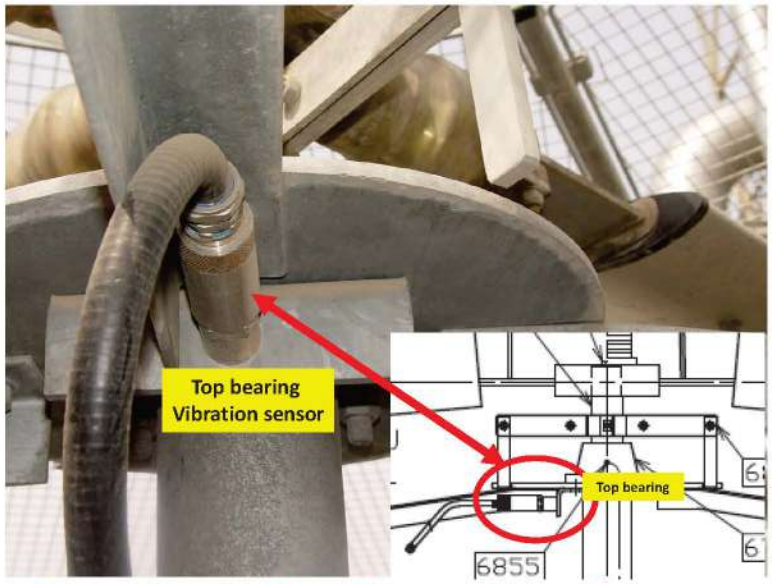

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Is it mandatory to have Online Vibration Analysis Systems, along with Protection Systems?

A real Story.....

- A 200 MW Steam Turbine Generator tripped on LP Turbine high vibration.
- Only Vibration Protection System installed and Analysis System NOT available.
- Is it safe to start the turbine without understanding the reason for the high vibration trip. Only Vibration Trend available from DCS.
- Plant Management called in Vibration Consultant.
- Since no analysis data was available, the Consultant has limited tools.

TWO CASE STUDIES are presented to highlight the importance of having:

1. **Online high vibration protection system for critical rotating machinery & with**

2. **Relevant software to collect, store and provide diagnostic information.**

to help the plant management to make 'quick and appropriate decisions' in achieving production targets safely.

Is it mandatory to have Online Vibration Analysis Systems, along with Protection Systems?

- Consultant reviewed the Online Vibration Trend and based on his experience analyzed that there could be a blade loss in LPT that created sudden vibration spike and tripped the Turbine.
- Consultant advised not to start the turbine and recommended for LPT inspection.
- Management initially did not agree but later agreed for inspection.
- During inspection, it was observed that tip of a blade broke and was found lodged in the next row of blades.

THE PROBLEM WOULD BE IDENTIFIED WITHIN ONE HOUR OF TRIPPING, IF THERE WAS AN ANALYSIS SYSTEM INSTALLED.

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First

The case of Steam Turbine driven Centrifugal, process gas Compressor rotor unbalance due to progressive impeller damage, trended over a <u>period of three years</u>.

Steam Turbine: 44 MW, 5800 RPM
Centrifugal Compressor: 47,000 CuM/hr, 69 Bar DisPr.

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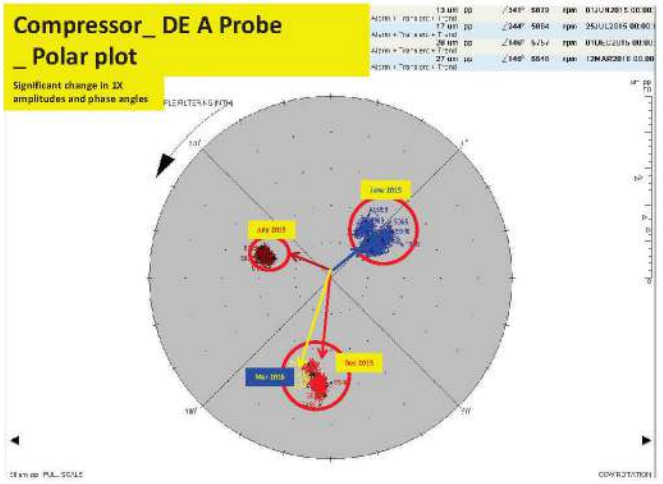
- Change in 1X amplitude and phase, for compressor DE & NDE bearings, observed during various startups and normal operating conditions over a period of three years.
- The problem was diagnosed as change in balance condition due to any mass loss or deposits on the compressor rotor.
- Rotor inspection and replacement calls for a two week equipment shutdown resulting in significant production loss.

One Year Vibration Data
Compressor DE & NDE bearing
1X amplitudes and phase-Polar Plots

- To keep the equipment in operation, alarm and trip levels temporarily increased to 80 and 100 microns PP respectively, based on OEM recommendation.
- Continuous vibration monitoring, regular review of the compressor health with operations, maintenance and engineering teams helped to operate the equipment till the planned major outage and prevented significant production loss.
- During the planned major outage, it was observed that compressor impellers had multiple breakages and confirmed the unbalance diagnosis.



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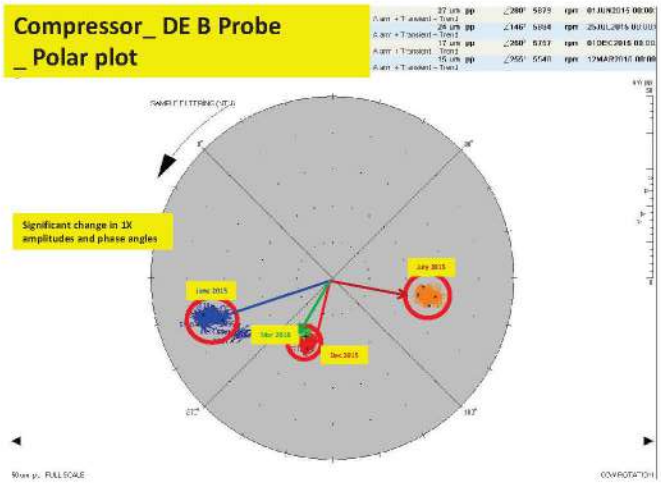

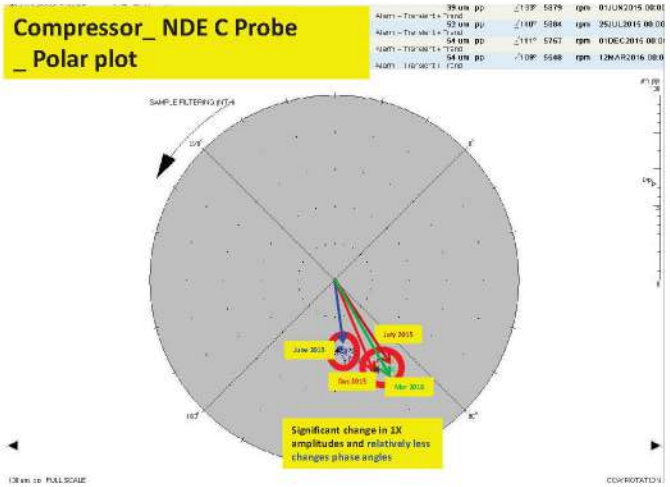

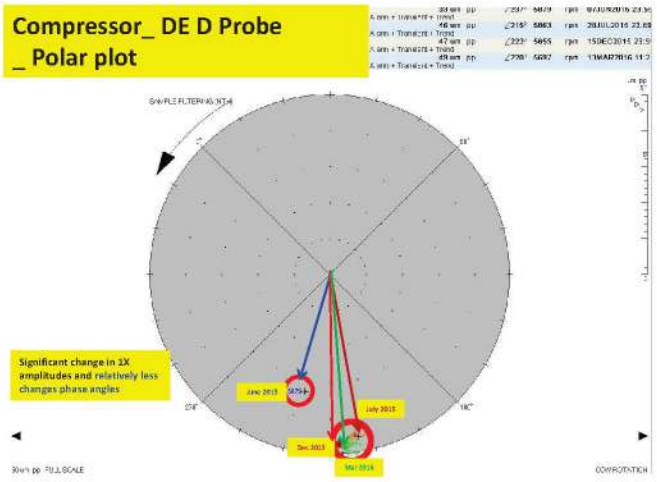

One Year Vibration Data

Compressor DE & NDE bearing

Vibration Trend Plots

1X amplitudes and phase-Polar Plots

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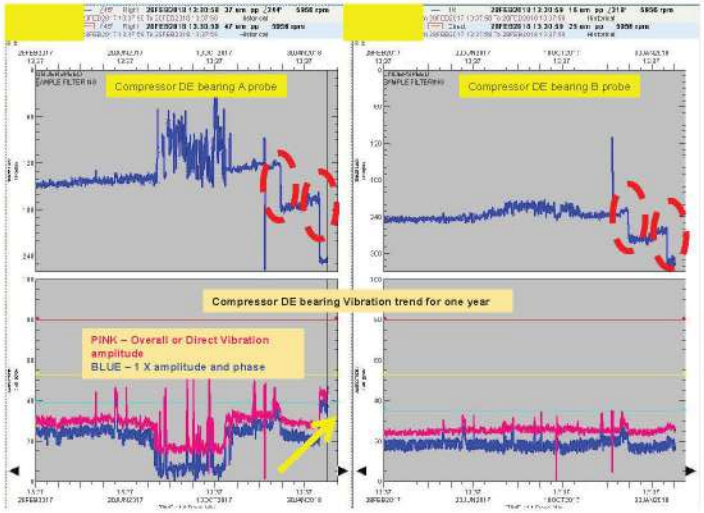

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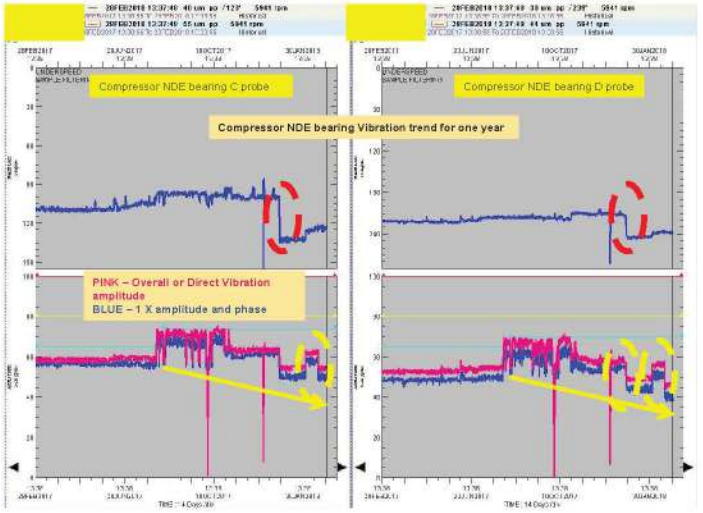

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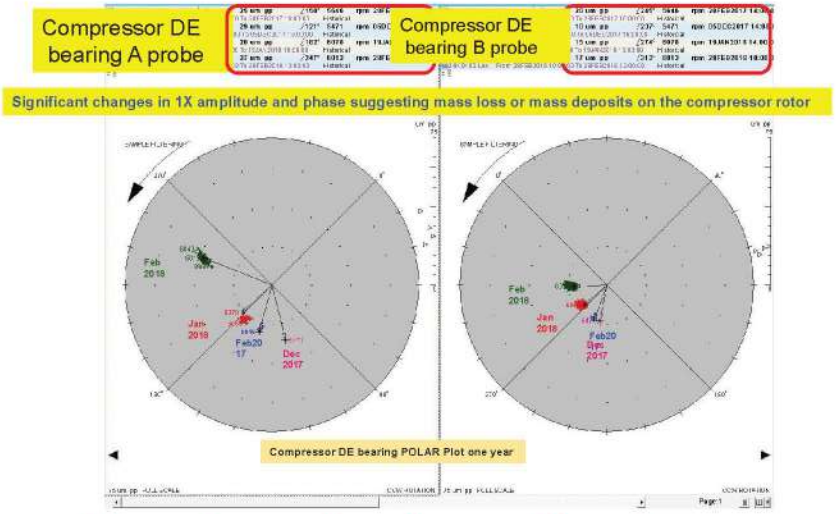

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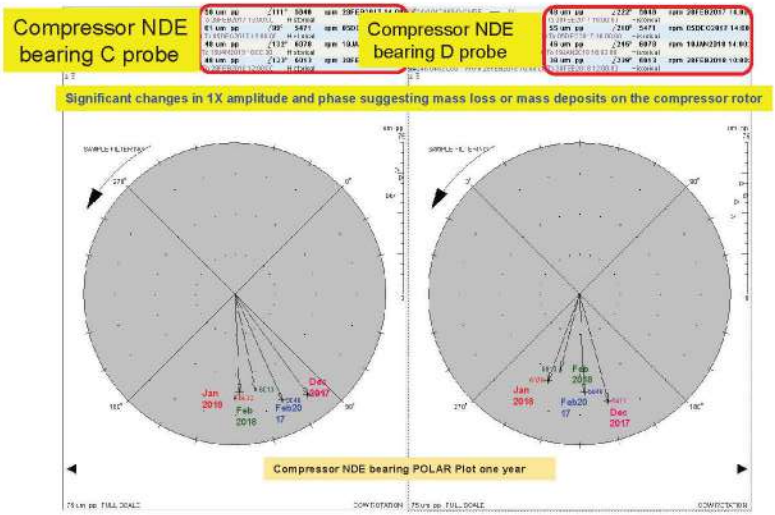

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Compressor impeller Damage

- FD fan of a utility boiler unit was shutdown for bearing lube oil replacement and attending miscellaneous maintenance activities.
- After carrying out the planned maintenance activities, FD fan was started and within about 10 minutes motor NDE bearing vibration and temperature has crossed the danger alarm and the equipment was manually stopped (automated high vibration trip not configured)
- Vibration reached to about 180 microns PP(danger 100 microns PP) and bearing metal temperature to about 200 deg. C.(alarm 100 degC.)
- Probe gap volts trend and shaft centerline plots suggested a downward movement of the journal by about 1000microns, suggesting severe damage to bearing babbitt.

Second

The case of failure of Non-Drive End bearing of an electric motor driving a Centrifugal FD Fan

Electrical Motor: 980 KW, 1480 RPM.
Centrifugal Fan: 214 Kg/hr.

International Conference on Research Contributions in Mechanical Engineering
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- Further evaluation of the vibration data for motor DE bearing and fan both bearings indicated that the they were in good condition.
- Operations were asked to isolate the equipment for maintenance.
- Maintenance was recommended for motor NDE bearing inspection and replacement.
- All recommendations were issued within one hour of the happening of the incident.

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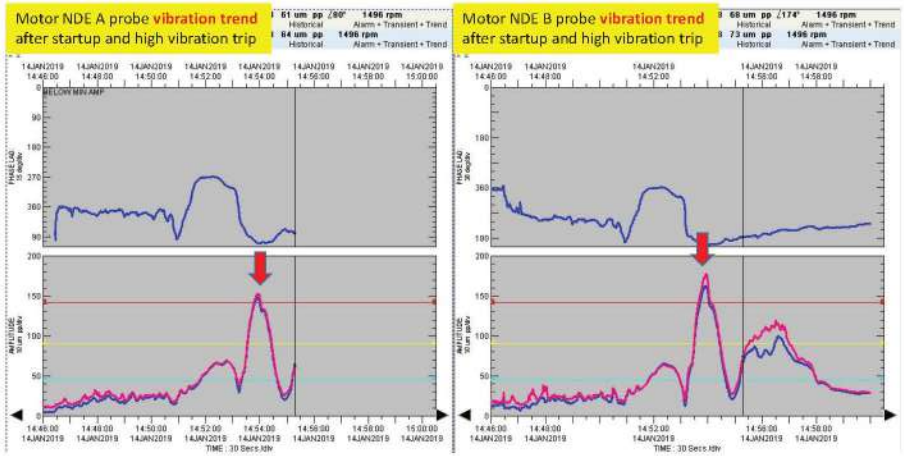

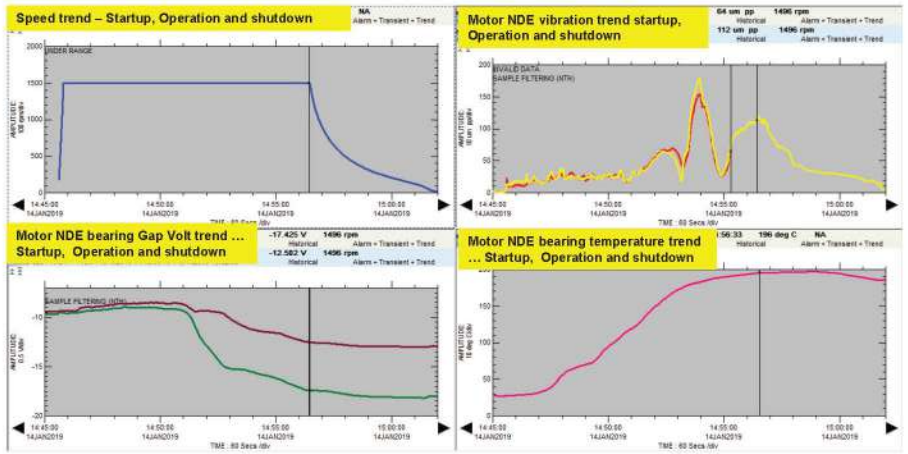

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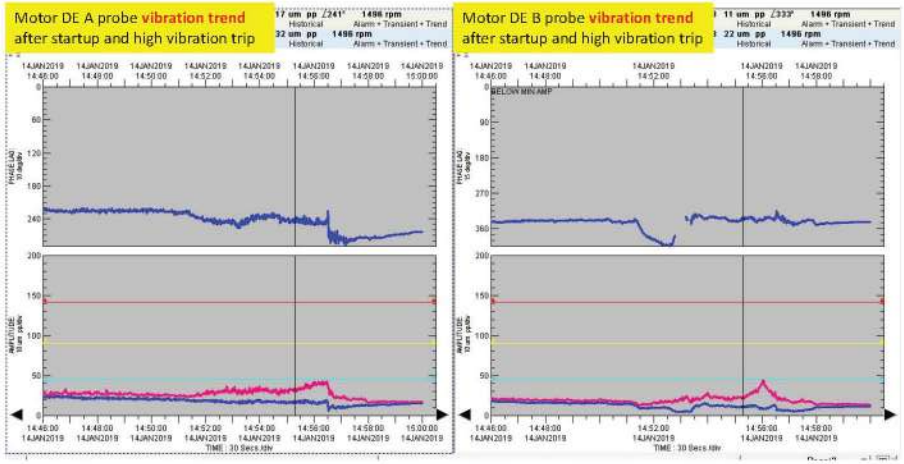

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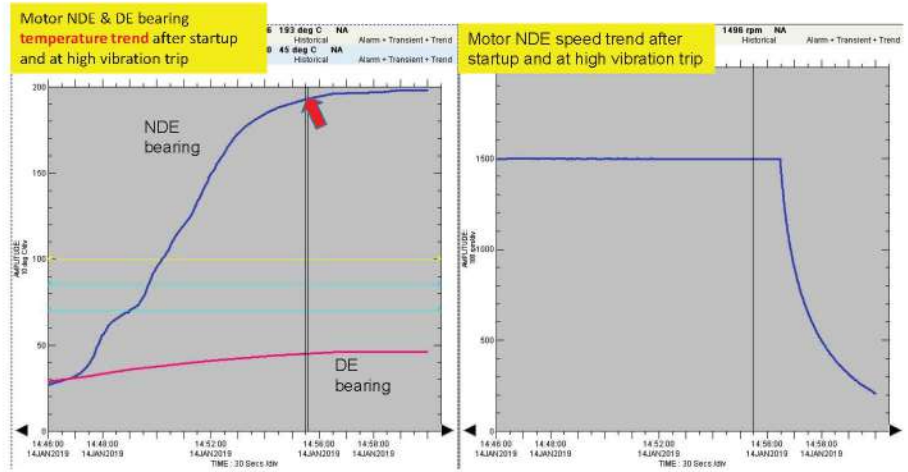

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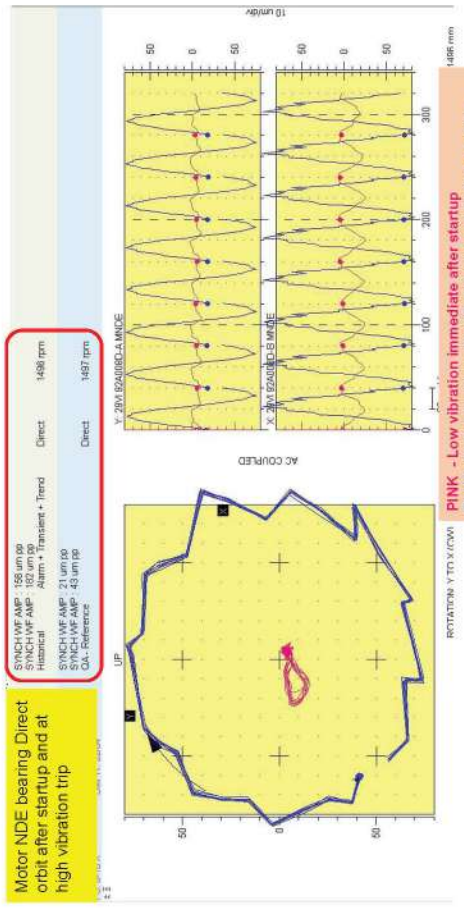

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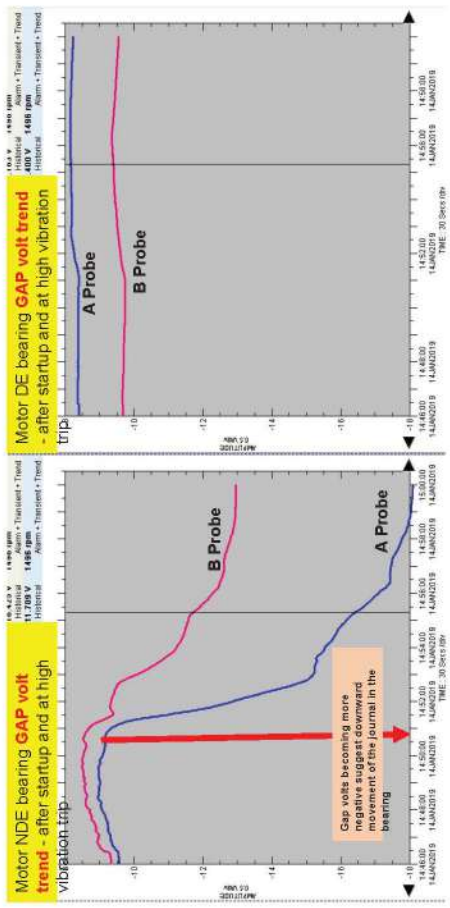

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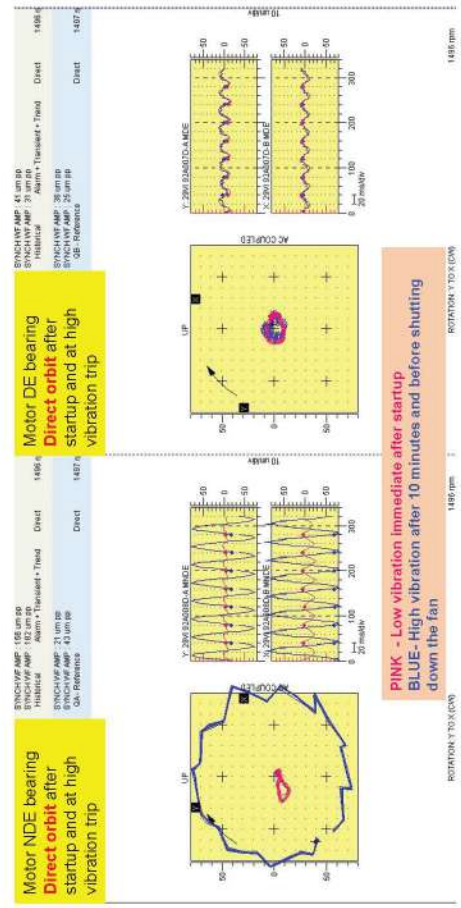

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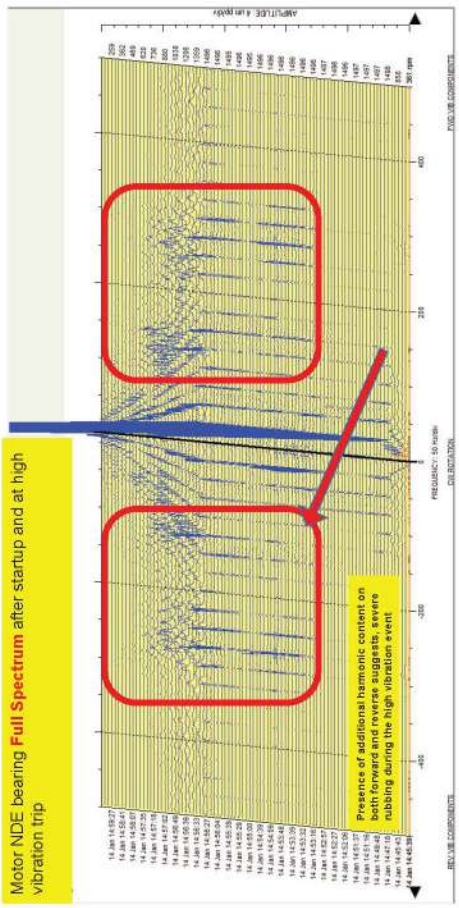

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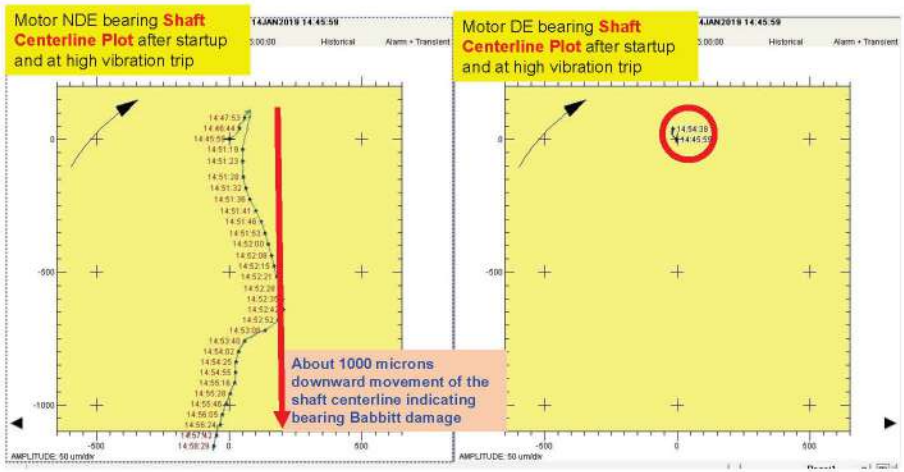

Finally

A properly selected, through industry best practices, and installed online vibration monitoring system helps to:

- **Improve safety of the equipment by preventing catastrophic failure due to high vibration**
- **Facilitates faster and appropriate maintenance decisions**
- **Minimize production loss due to non availability of equipment**

Findings during BRG inspection

Thanks

To the Conference Management For this opportunity to present the Technical Talk

SESSION – 1

25-02-2022 FN

11:15 AM -12:30 PM

Organizing Chairs

Dr. Dega Nagaraju
Vellore Institute of Technology, Vellore.
and
Dr. K. Syam Sundar
Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru

Paper ID	Title and Authors
ICRCME 01	**Modal and Harmonic Analysis of Work Holding Device** Y. Bhagavan Pradeep, Y. Gowtham, Sd. Abdul Kalam
ICRCME 05	**Investigation of Mechanical and Thermal Properties of Bio Polymer using Kenaf Fiber** A. Inbasekaran, R. Ranjith Kumar, R. Manikanda
ICRCME 08	**Study on Effect of Wire EDM Process Parameters in Machining of INCONEL-625** M. Sailaja, Ch. Maheswara Rao, N .Ganesh, R. Pallavi
ICRCME 16	**Role of Heat Treatment on Micro Structure and Mechanical Properties of Al 7075** Y. Sri Harsha, P. Tharun, N. Dileep, Ch. Sai Manikanta, A. Jawahar Babu, B. Kiran Babu
ICRCME 21	**Micro Mechanical Behavior of Lubrication Assisted Particle Reinforced Hybrid Composites** Blane George, Chaitanya Sameer Burra, S. B. K. Reddy, A. Rajesh
ICRCME 22	**The Mitigation of Degradation Rate in Magnesium Alloys for Biomedical Applications** G. V. Jagadeesh. P. Ravindra Babu, D. Kiran Prasad
ICRCME 29	**An Effective Hybrid Approach for Selection of Cold Chain Logistics Leaders for Storage and Transport of Covid -19 Vaccines in India** G. Karuna Kumar, K. Syam Sundar, B. Karuna Kumar

ISBN: 978-1-5136-9400-9

ICRCME 01

Modal and Harmonic Analysis of Work Holding Device

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Abstract

Machining is a vital aspect of the production process because it includes precise metal removal in order to attain quality, precision, and accuracy. In machining, choosing the right cutting tools and work holding devices is crucial. A work holding device is essential in the production process. A mandrel is a work holding device used to grip a component during high-speed, low-feed machining. The current work is about the creation of a Hydraulic Actuated Mandrel, which is a handy work-holding device that grips the work piece tightly. Chromium Vanadium steel is recommended for mandrel manufacturing because it produces homogeneous gripping forces and leaves no residual strains on the work piece.

The forces and pressures imposed by the cutting tool on the work piece and the work holding device are calculated using empirical relationships. The maximal theoretical hoop and longitudinal stresses are calculated using thin cylinder theory. The statistical model is created with ANSYS software. By applying forces and pressures to the mandrel, which causes deformations and stresses, the constructed model was evaluated. The stresses on the mandrel derived from ANSYS are compared to the theoretical stresses. It is determined that the correlation between the two analyses is good. The natural frequencies and mode shapes are obtained via modal analysis.

Keywords: *Work holding device; Chromium Vanadium steel; Thin cylinder; Modal Analysis; Harmonic Analysis.*

ICRCME 05

Investigation of Mechanical and Thermal Properties of Bio Polymer using Kenaf Fiber

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Abstract

In automotive components the usage of natural fibers increased to reduce the weight and increase the strength. The availability of Natural fibers such as kenaf have some advantages over traditional Reinforcement materials such as glass fiber in terms of cost, density, renewability, Recyclability, environmentally harmless and biodegradability. This review however will focus on Kenaf with various resins like polypropylene and epoxy. Investigation of mechanical and thermal properties like Hardness, impact, tensile, flexural, water absorption test, DMA, TG-DTA, HDT etc.

Keywords: *Kenaf; Polypropylene; Epoxy; Mechanical and Thermal Properties.*

ICRCME 08

Study on Effect of Wire EDM Process Parameters in Machining of INCONEL-625

M. Sailaja[1], Ch. Maheswara Rao[1*], N. Ganesh[2], R. Pallavi[2]

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Abstract

Wire EDM machining of high-strength nickel-based super alloys has become a goal for researchers. In the present work, an experimental investigation has been conducted to study the effect of Wire-EDM process parameters on the responses of material removal rate and surface roughness characteristics. Inconel-625, which is commonly used for chemical, nuclear, and marine applications, has been selected as the work material. A number of experiments have been conducted using the L27 orthogonal array and the responses were analyzed using the single objective Taguchi method and ANOVA. The optimal combination for the higher-the-better characteristics is obtained at TON: 130 µs, TOFF: 50 µs, SV: 20 volts, WF: 6 m/min, and WT: 3 kg/f, respectively. Similarly, for the lower-the-better characteristic, it was obtained at TON: 110 µs, TOFF: 55 µs, SV: 25 volts, WF: 6 m/min and WT: 5 kg/f, respectively. An analysis of variance has been employed, and it is found that pulse-on-time (TON) is the predominant factor for both the responses. The regression models prepared were best fit and accurate as the residuals follow normality and constant variance, and hence they can be used for the best prediction of responses.

Keywords: *Wire-EDM; Material Removal Rate (MRR); Surface Roughness; Orthogonal Array; Taguchi Method; ANOVA.*

ICRCME 16

Role of Heat Treatment on Micro Structure and Mechanical Properties of Al7075

Y. Sri Harsha[1], P. Tharun[1], N. Dileep[1], CH. Sai Manikanta[1], A. Jawahar Babu[2], B. Kiran Babu[1*]

[1]*Department of Mechanical Engineering, Usha Rama College of Engineering and Technology, Telaprolu, Andhra Pradesh 521109, India*

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Abstract

Al 7075 alloy is a commonly used commercial material that is manufactured using a wrought manufacturing process and has a high strength. The bulk behaviour of metals and alloys is influenced by the presence of distinct phases and their relative quantities. Hence, Al7075 alloy has been subjected to solution treatment at 450℃with an aim to understand the effect of heat treatment on the mechanical characteristics. After heat treatment the $Al_2Mg_3Zn_3$phases could be disseminated in the Al and a minor amount of Al_2CuMg phases and Al_2Cu phases precipitated at the grain boundaries and the grain size of the base material was reduced from 82.93 µm to 49.29 µm.In comparison to the basic material, the hardness increases, and the average hardness is 153.14 HV.Tensile strength and ultimate tensile strength were both significantly raised as a result of the tensile test.

Keywords: *Al7075; Heat Treatment; Microstructure.*

ICRCME 21

Micro Mechanical Behavior of Lubrication Assisted Particle Reinforced Hybrid Composites

Blane George[1*], Chaitanya Sameer Burra[1], S. B. K. Reddy[2], A. Rajesh[2]
[1]*Otto Von Guericke University, Magdeburg, Germany*
[2]*Department of Mechanical Engineering, Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru - 521 356, Krishna District, Andhra Pradesh, India.*
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Abstract

Lubrication is one of the important considerations for the mechanical components when they are in relative motion. But it is a costly process under the maintenance activity, here the role of self-lubrication plays very important role especially when the mechanical components working for long and continuous hours where the lubrication availability between the contacting surfaces is relatively low. In the present investigation a micro mechanical modeling of hybrid composite was analyzed under a constant strain rate. The lubrication assisted particles like Nickel, Cobalt and Copper which were reinforced along with Alumina of equal proportions in a Al 7075 matrix. Further varying proportions of the reinforcements in the range of 5%, 10%, 15% and 20% in the Al7075 matrix. An RVE of micro size with uniform distribution of constituents with a predefined particle size and spherical shape was tested under uni axial tensile direction with a constant strain rate of 0.03. It was observed that with 5% reinforcement of Al_2O_3 and Nickel each have lower vonmises stresses as compared with remaining variations. The maximum vonmises stress was induced in 10% Al_2O_3 and Nickel each reinforced in Al7075 composite. And it was identified that Al_2O_3 and Cobalt combination did not influence much on stress as increase in the reinforcement percentage. In addition to this a lowest displacement was observed at 10% Al_2O_3+Nickel of each combination. Whereas the displacement was increasing in Al_2O_3+Cobalt reinforced Al7075 matrix hybrid composite as percentage of reinforcement increases.

Keywords: *Particle reinforced composites; RVE; Al7075; Al_2O_3 and Nickel; Cobalt and Copper; Micro modelling; Von-Mises Stresses; Displacement.*

ICRCME 22

The Mitigation of Degradation Rate in Magnesium Alloys for Biomedical Applications

G. V. Jagadeesh[*], P. Ravindra Babu, D. Kiran Prasad
Department of Mechanical Engineering, Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru - 521 356, Krishna District, Andhra Pradesh, India
[*]Email: gvenkatajagadeesh@gmail.com

Abstract

Magnesium and magnesium alloys are the lightest metals, which exhibit high strength to weight ratio, good thermal and electrical conductivity, excellent vibration and shock absorption, high damping capacity and electromagnetic shield performance. The main disadvantage of Mg and Mg alloys is poor corrosion resistance. Magnesium and magnesium alloys are the most electrochemically active metals.

In addition, the wear resistance of Mg and Mg alloys is not very high. As a result, the application range of Mg and Mg alloys is limited despite many advantages. However, there are certain surface modification techniques, which are being employed on Mg and Mg alloys to improve the corrosion resistance, thereby increasing the application range. This study focuses on different surface modification techniques such as mechanical methods, chemical methods and physical methods employed in Mg and Mg alloys.

Keywords: *Magnesium; Magnesium Alloys; Corrosion; Wear; Surface Modification.*

ICRCME 29

An Effective Hybrid Approach for Selection of Cold Chain Logistics Leaders for Storage and Transport of Covid -19 Vaccines in India

G. Karuna Kumar[1*], K. Syam Sundar[2], B. Karuna Kumar[3]
Department of Mechanical Engineering, Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru - 521 356, Krishna District, Andhra Pradesh, India.
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Abstract

The COVID-19 pandemic is causing unprecedented human and economic costs in all countries and societies across the world and it's entails maintenance of necessary refrigeration levels for highly temperature-sensitive coronavirus vaccines across manufacturing, storage, transportation and distribution processes. COVID-19 vaccines must be kept at a low temperature to ensure their quality. In this regard, it is of great significance to evaluate and choose drug cold chain logistics suppliers from different perspectives to ensure the quality of vaccines and reduce the risks of transportation and storage. To solve such a multiple criteria decision-making (MCDM) problem a Hybrid multi-criteria decision-making strategy proposed with fuzzy analytical hierarchy process and combinative distance-based assessment (CODAS) approach is proposed for Selection of Cold Chain Logistics leaders for storage and transport of Covid -19 Vaccine in India. This Fuzzy–CODAS MCDM-based Hybrid approach can be used for alternative selection in real-world applications.

Keywords: *Cold Supply Chain; fuzzy AHP; MCDM; CODAS.*

SESSION – 2

25-02-2022 AN
03:00 PM -04:30 PM

Organizing Chairs

Dr. T. Srinivas
Dr. B. R. Ambedkar National Institute of Technology, Jalandhar
and
Sri K. Ch. Kishor Kumar
Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru

Paper ID	Title and Authors
ICRCME 11	**Design and Testing of Torque Transmission Composite Drive Shaft** Gangadhararao T Boyina, Vijaya Kumar R, Subba Rao VV
ICRCME 23	**Effect of start of injection and compression ratio on DICI Engine using Pongamia Biodiesel Blend** Kashyap Babu Chowdary Putta, Prabhakara Rao Ganji, Nagaraju K, Nageswara Reddy P
ICRCME 17	**Design and Analysis of a Transmission System for an All Terrain Vehicle** Ratna Prasad Paladagu, V. Nagaraju, Deepak Adari
ICRCME 31	**Experimental Investigation on NACA 2415 Airfoil Designed and Fabricated with Different Joining Techniques** T. J. Prasanna Kumar, B. Chaitanya Naresh, B. Avinash Bhargav, M. Hemalatha, B. Sai Krishna
ICRCME 02	**Burnback Analysis of 3-D Propellant Grain for Large Solid Rocket Motors** P. Sunitha, K. Madhumurthy, V. V. Rao
ICRCME 04	**Experimental Study on CI Engine Fueled with Cotton Seed Oil and Diesel Blends** N. Srinivasa Rao, V. Lakshminarayana
ICRCME 26	**Computational Investigation of Diesel Injection Strategies in Hydrogen-Diesel Dual Fuel Engine** Prabhakara Rao Ganji, P. Durga Naveen, P. Nageswara Reddy, B. Karuna Kumar

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ICRCME 11

Design and Testing of Torque Transmission Composite Drive Shaft

Gangadhara Rao T Boyina[1*], Vijaya Kumar R[2] and Subba Rao V. V[3]
[1]*Hindustan Aeronautics Limited, Balanagar, Hyderabad-500042*
[2]*Hindustan Aeronautics Limited, Vimanapura, Old HAL Airport Road, Bangalore-560017*
[3]*Jawaharlal Nehru Technological University, Narasaraopet-522601*
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Abstract

Polymer composites are today widely used for aerospace components in view of their outstanding specific stiffness and strength to weight ratio. Substituting composite structures for conventional metallic structures has many advantages because of higher specific stiffness and strength of composite materials. This work explores with the replacement of conventional drive shafts with a high strength carbon/epoxy and high modulus carbon/epoxy composite drive shaft for an aerospace application. The design parameters were optimized with the objective of minimizing the weight of composite drive shaft. The design optimization also showed significant potential improvement in the performance of drive shaft. The study has indicted possibility of using composites for typical aerospace component like a torque transmission tube with weight benefits without compromising on the shaft dynamics. The effort has provided enough confidence level in attempting the replacement existing metallic shaft by composite shaft for airborne application.

Keywords: *Polymer Composites; Filament Winding; Torsional Stiffness; Bending Stiffness.*

ICRCME 23

Effect of start of injection and compression ratio on DICI engine using Pongamia biodiesel blend

Kashyap Babu Chowdary Putta[1], Prabhakara Rao Ganji[2], K. Nagaraju[2], P. Nageswara Reddy[2]
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[2]*Department of Mechanical Engineering, Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru - 521 356, Krishna District, Andhra Pradesh, India.*
*Email:kbcputta.1994@gmail.com

Abstract

This study targets to determine the effect of the engine design parameters viz. Compression ratio (CR) and the start of injection(SOI) jointly on the performance and emission characteristics indicated specific fuel consumption (ISFC) and emissions with (PB20) Pongamia biodiesel (20%) and (80%) mineral diesel as fuel. The SOI 23 bTDC is kept constant when the effect of CR is analyzed, and 17.5 CR is kept constant when the effect of SOI is assessed. A comparison of performance and emission was made for different compression ratio values and the start of injection timing to find optimum engine operation with PB20. ISFC is decreased from 300 to 270g/KWh as the SOI is advanced from 17 to 26 bTDC. As the compression ratio CR is decreased from 18 to 12, BSFC is increased from 290 to 375 g/KWh at full load. Thus PB20 can be effectively used in a diesel engine without any modification.

Keywords: *Start of Injection; Compression Ratio; Pongamia; Biodiesel.*

ICRCME 17

Design and Analysis of a Transmission System for an All-Terrain Vehicle

Ratna Prasad Paladagu*, V. Nagaraju, Deepak Adari
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Abstract

A transmission system in automobile consists of a gear box and differential. A differential is a component used to distribute torque and helps while turning. It also provides better drivability. Vehicles need a transmission to transfer the power from the engine to the drive shaft and the differential to let the wheels turn. The transmission varies the torque, the speed and the direction by changing the transmission ratios and enables the car to start with a high torque. This paper will provide you with detailed information on performance, design considerations and statistics analysis of the transmission system of all-terrain vehicles. In this paper our main objective is to inform you of the importance of transmission system across the in all-terrain vehicles. Our focus is to design a transmission system that will provide maximum power low-yield output and low cost. This paper will also assist you in selecting and distinguishing between manuals automatic transmission and transmission. It will give you details about the different resistance found on atv and how to look at this resistance during the construction of the transmission. Our selection options will depend on availability and reliability of the component.

Keywords: *Transmission System; Gear Box; All Terrain Vehicle; Tractive Effort; Vehicle Resistance; Grade Ability.*

ICRCME 31

Experimental Investigation onNACA2415AirfoilDesigned and Fabricated with Different Joining Techniques

T. J. Prasanna Kumar*, B. Chaitanya Naresh, B. Avinash Bhargav, M. Hemalatha, B. Sai Krishna
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Abstract

Optimization of aircraft structural components plays a prominent role in improving aerodynamic performance. To predict aerodynamic performance, a regular check is needed for aircraft structuralcomponentsatregularintervalsofflyinghoursunderproperinspection.

Drag coefficient plays an important role in aircraft optimum requirement. Drag occurs due to various factors. Drag is the enemy of flight at any cost. Major forces that are influencing aircraft motions were briefly introduced. One group of those is aerodynamic forces that split into two categories: Lift force or lift, and Drag force or drag. A prerequisite to aircraft performance analysis is the ability to calculate the

aircraft drag at various flight conditions. One of the jobs of a performance engineer is to determine drag force produced by an aircraft at different altitudes, speeds and configurations. These forces are function of several parameters including aircraft configuration and components. Determining the value of drag coefficient includes multiple sources of drag namely form drag, Skin friction drag, wave drag & induced drag respectively. Among the above mentioned drags the skin friction drag depends directly on paints applied and types of exterior joints made to join structural component and skin of the aircraft such as (solid, blind riveting and spot resistance welding). The present paper focused on experimental investigation on drag due to joining techniques used to join skin to the wing section of an aircraft. AScalemodelofaircraftstructuralcomponentwillbedesignedfabricatedandtestedusingwindtunnel techniques. The effect of exterior joints and its contribution to drag component increment will be studied practically. The obtained coefficient of drag will be validated with the theoretical results. This study will decide optimum method of joint to join skin and aircraft structural components such that reduced skin friction drag coefficient has been obtained for the best performance.

Keywords: *Coefficient of lift; Coefficient of Drag; Skin Friction; Angle of Attack; Rivets.*

ICRCME 02

Burnback Analysis of 3-D Propellant Grain For Large Solid Rocket Motors

P. Sunitha[1*], Dr. K. Madhumurthy[2], Dr. V. V. Rao[1]
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Abstract

The main objective of a solid propulsion system is to deliver the required thrust time profile as per the aerospace vehicle mission. The critical step while designing of a large diameter Solid propellant Rocket Motor (SRM) is the propellant grain geometry. As propellant grain geometrical properties play a vital role in the prediction of performance of SRM. To have high volumetric loading to meet the thrust requirement, 3-Dimensional (3D) propellant grain geometry (FINOCYL) is selected for the studies.

This paper brings the case study which involves the geometric modeling in CAD/ Solid works software, burn back analysis for 3D grain geometry, a software code development for performance prediction and a static test of solid propellant rocket motor is carried out for validation.

The CAD/Solid works software is used for parametric modeling of the complex grain geometry using the dynamic variables. Initial geometry is modeled in the form of a surface which describes the grain configuration. At each burn step, the propellant grain burn back analysis is carried out by creating a solid model for new surface of propellant grain for each web increment and the geometrical properties are calculated. This process is repeated till the end of the web of the propellant to be burned out completely. By analyzing these parameters, the burn surface area and volumetric change of the grain is obtained. Using the equilibrium pressure method internal ballistics and the performance parameters in terms of motor pressure of the SRM is achieved. The experimental test results are compared with theoretical ballistic parameters in order to validate the SRM performance prediction shows that they are in good agreement.

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If the burn back steps of the grain are known, then the performance of the SRM can be easily achieved at the preliminary design stage. This approach of burn back analysis is relatively simple and fast for modeling and burn surface area evaluation for 3D propellant grains and also can be adopted to any complex geometry of the propellant grain for large rocket motors.

Keywords: *Solid Propellent; 3D Grains; Finoyl; Burnback; Thurst; Pressure; CAD Modelling.*

ICRCME 04

Experimental Study on CI Engine Fueled with Cotton Seed Oil and Diesel Blends

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Abstract

Increase in stringent emission norms and depletion of oil resources led to find alternative fuels for internal combustion engines. Many alternative fuels like alcohols, bio-diesel, liquid petroleum gas (LPG), compressed natural gas (CNG)etc., have been already commercialized in the transport sector. In this context cotton seed oil renewed interest. The cotton seed oil can be converted in bio diesel using a process called as transesterification. The cotton seed oil is blended with diesel and used as an alternate fuel for CI engines. In the present work performance characteristics and emissions are evaluated on single cylinder four stroke diesel engine fueling with 10%, 15%, 20%, 25% of cotton seed oil with diesel blends at two different pressures 200 bar, 225 bar. Due to high viscosity and soot formation, above 25% was not taken in cotton seed oil- diesel blend. Experiments are carried out on a diesel engine, which is single cylinder four stroke engine capable of developing a power output of 7HP at 1500 rpm. Performance parameters such as Brake Power, Specific Fuel Consumption, Brake Thermal Efficiency, Mechanical Efficiency, are calculated based on the experimental analysis of the engine. Emissions such as Carbon Monoxide, Hydro Carbons are measured.

Keywords: *Compressed Natural Gas; Transport Sector; Transesterification; Specific Fuel Consumption; Hydro Carbons.*

ICRCME 26

Computational Investigation of Diesel Injection Strategies in Hydrogen-Diesel Dual Fuel Engine

Prabhakara Rao Ganji[*], P. Durga Naveen, P. Nageswara Reddy, B. Karuna Kumar
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Abstract

One of the greatest challenges of automobile manufacturers is to produce vehicles with lesser amount of emissions. Many researchers have been conducted experiments to find an alternative fuel which exhaust lesser emissions. Hydrogen is the one of the alternate fuel which has the similar combustion characteristics to fossil fuels. CONVERGE CFD a numerical tool which simulates IC engines combustion phenomena. This study presents the effect of compression ratio and start of ignition on

Hydrogen-diesel dual fuel engine. The study was performed on 4 stroke direct injection compression ignition engine. SAGE solver has been used for the detailed chemistry kinetics. The performance and emission characteristics of hydrogen-diesel dual fuel engine is analysed by varying compression ratio ranging from 13 to 16.8 and start of ignition from 6 to 15 bTDC.

Keywords: *Start of Injection; Compression Ratio; Hydrogen; Dual Fuel.*

SESSION – 3

26-02-2022 FN

11:15 AM -12:30 PM

Organizing Chairs

Dr. Ravi Kumar Mandava
Maulana Azad National Institute of Technology, Bhopal
and
Dr. J. A. Ranga Babu
Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru

Paper ID	Title and Authors
ICRCME 03	**3D Printing for Implant Applications: A Review** K. Ramakanth, B. Karuna Kumar, S. Raju
ICRCME 07	**Optimal Setting of Wire-EDM Process Parameters by Assignments of Weights Method** B.B. Ashok Kumar, G. Karuna Kumar, B. NitishBharadwaj, G.Dilip Kumar
ICRCME 06	**Investigation and optimization of four layered Aluminium based functionally graded material reinforced with copper, Nickel and Zinc stearate** P. N. S Srinivas, P. Srinivas Rao, Mukul Srivasatav, P. Ravindra Babu, P. Ramakrishna
ICRCME 09	**Application of Taguchi's Quality Loss Function Analysis during Machining of AA6061-T6 Alloy** K. Gowri Shankar, Ch. Maheswara Rao, D. Laxman, Ch. Sandeep
ICRCME 15	**Experimental study on Rotary Assisted EDM of PH 17-4 Steel Using Response Surface Methodology** Murahari Kolli, Seelam Pichi Reddy, Sankara RaoVinjavarapu
ICRCME 20	**Cycle Time Reduction and Line Balancing in Gear Shifter Fork Manufacturing** Saketh Kopparthy, M. Ujwal Teja, P. Yugandhar
ICRCME 27	**Influence of bagasse Ash Particles on Mechanical Properties of Al 6082 Metal Matrix Composites** J. B. L. V. Ganesh, G. Praveen, D. Tarun, K. Ch. Kishor Kumar, K. Syam Sundar
ICRCME 28	**Experimental investigations on Mechanical and Tribological Properties of Al6101- SiC Metal Matrix Composite Fabricated Through Stir Casting** Nazeer Basha Shaik, K. Ch. Kishor Kumar, D. Kiran Prasad, D. Tarun, M. R. Ch. Sastry

ISBN: 978-1-5136-9400-9

ICRCME 03

3D Printing for Implant Applications: A Review

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Abstract

Additive Manufacturing is becoming best practice for organ replacement and tissue regeneration to replace the mutated, diseased bones and tissues such as knee, femur. The tissue replacement treatment relies on location of malfunctioning tissue or dislocation causing tenderness is witnessed due to altering of physical orientation or misrun from standard functioning. Thus to serve the requirement scaffolding of implants was introduced. Biomimicking capability of 3-D printing offers potential fabrication technique on personalized organs. This review, emphasizes on various factors those influence femur replacement and different techniques for hip replacement. This study also covers surface modifications of 3D printed implants and provides an key parameters of 3D tissue regeneration.

Keywords: *Additive Manufacturing; 3-D printing; Tissue Regeneration.*

ICRCME 07

Optimal Setting of Wire-EDM Process Parameters by Assignments of Weights Method

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Abstract

Manufacturers are increasingly switching from mild steel to medium carbon steel, which has superior strength and wear resistance. Because of its outstanding machinability and high tensile strengths under heavy working loads, EN24 steel was chosen for the current project. Axles, shafts, gears, bolts, studs, spindles, and other automotive components are all often made of this material. Using the Assignments of weight approach, the impact of various Wire-EDM process parameters such as Flushing pressure (FP), Pulse-on-time (T_{ON}), Pulse-off-time (T_{OFF}), Wire Feed (WF), Wire tension (WT), and Servo voltage (SV) on several criteria was investigated. Taguchi's typical L18 orthogonal array was used to conduct the research. On the values of the multi-response performance index (MRPI), Taguchi's higher-is-better characteristic was used. The optimal setting of process parameters was obtained at a Flushing Pressure:$level_2$-8kg/cm^2; Pulse-on-time:$level_3$-125µs; Pulse-off-time:$level_1$-55µs; Wire Feed:$level_3$-6mm/min; Wire Tension:$level_3$-4Kg-f and Servo Voltage:$level_1$-20 Volts, respectively. The

MRPI, ANOVA results revealed that the most critical parameter in achieving larger multiple responses is Pulse-off-time.

Keywords: *EN24 Medium Carbon Steel; Orthogonal Array; Taguchi Method; Assignments of Weight Method, Multi-Response Performance Index.*

ICRCME 06

Investigation and Optimization of Four Layered AluminumBased Functionally Graded Material Reinforced with Copper, Nickel and Zinc Stearate

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Abstract

Today the manufacturing of product is of very competitive in nature as per the present industrial and societal requirements. The previous technologies are always focused on the available manufacturing process but today the focus is shifted to applications point of view in a very tough and rigid manner. The present research work is mainly focused on development of the functional graded material which serves as a crucial material for the automotive cylinder and its internal parts. The research works emphasis on the importance of aluminum in automotive components thereby layer wise deposition of matrix and the reinforcements are been deployed. The pure aluminum is considered in 100,95,90 and 85% weight proportions and the reinforcement vary from 0 to 15% of the weight proportions of considered materials as copper and nickel. In order to facilitate in free flow compaction process zinc stearate is utilized in all proportions. The compacted specimens are characterized for different mechanical and micro structural properties. The research depicted that at 85%Al,7.5%copper and 7.5% nickel the an ultimate compressive strength of 290 MPa and 75BHN is attained. The perfectness in bonding shows the compatibility and compactness of the matrix and inclusions which is depicted through SEM, EDAX and XRD. The optimization of the process parameters are been performed by Taguchi optimization which depicts that the compaction pressure and sintering time plays a major role in the material manufacturing and characterization process.

Keywords: *FGM; Compaction; Sintering; Material Characterization; Electron Microscopy; Molecular Structure; Inter planar Distance.*

ICRCME 09

Application of Taguchi's Quality Loss Function Analysis during Machining of AA6061-T6 Alloy

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Abstract:

The purpose of this research is to identify how different turning process factors affect specific compound criteria's. The work piece is made of tempered aluminium graded alloy AA6061-T6, which has a wide range of applications in the marine, aircraft, chemical, and electrical industries. Several tests were carried out using the L18 orthogonal array and tungsten carbide tools. The responses were

analysed using Taguchi's quality loss function analysis. The optimal combination of process parameters was determined at A1-B2-C2-D2. Feed had the highest influence over the multi-responses, according to the Response Surface Method (RSM) and Analysis of Variance (ANOVA) data.

Keywords: *AA6061-T6 alloy; Orthogonal Array; Taguchi Quality Loss; Function Analysis; RSM and ANOVA.*

ICRCME 15

Experimental study on Rotary Assisted EDM of PH17-4 Steel Using Response Surface Methodology

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Abstract

The present investigation examined the material removal rate and surface roughness of PH 17-4 stainless steel (SS) using rotary tool assisted with the EDM process. 17-4 PH SS was widely used in aerospace, marine, nuclear, and chemical processing due to their characteristic high strength to weight ratio and corrosion resistance properties. This paper mainly focuses on enhancing the flushing efficiency of dielectric fluid in the EDM and to improve the machining performance characteristics. A self-designed rotating electrode setup is fabricated and attached with the EDM process. The experiments are planned and conducted using response surface methodology in a box-Behnken approach; four factors with three levels are considered in this study. Current, pulse on time, pulse off time and electrode rotation speed are input factors. ANOVA test is conducted to find out the significance of input factors and their percentage contribution on the performance characteristics. Regression equations are developed to correlate for the MRR and SR values. Rotary tool lower-level values are obtained at better surface finishing and higher levels values are higher MRR. The results found that maximum MRR and minimum SR indicated in the rotary tool assisted EDM process compared to the without rotary assisted tool.

Keywords: *Rotary Electrode; RS; Box Behnken; MRR and SR.*

ICRCME 20

Cycle Time Reduction and Line Balancing in Gear Shifter Fork Manufacturing

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Abstract

Method of manufacturing plays a vital role in varying the final product cost. Recent advancements that are happening in Cutting Tools industry are phenomenal, even un convectional machining process which have developed some cutting-edge technologies are considered Secondary when compared to

traditional machining processes, Considering millings and turning operations. A practical problem form an auto ancillary Industry is considered, to reduce the overall cost by reducing the cycle time of a bottle neck process. Radius milling operation in Gear Shifter fork is considered for cycle time reduction project. By eliminating this bottle neck operation line balancing is also achieved. Further reducing the overall manufacturing cost. An endmill (Ø14mm) is used for interpolation of radius milling operation that has cycle time more than half a minute. Various methods for cycle time reduction are tried and on a final approach it is found that the plunging operation with an un standard milling cutter with a standard insert from the one of the cutting tool vendors is developed.

Keywords: *Cycle Time; Line Balancing.*

ICRCME 27

Influence of Bagasse Ash Particles on Mechanical Properties of Al 6082 Metal Matrix Composites

J.B.L.V. Ganesh, G. Praveen, D. Tarun*, K. Ch. Kishor Kumar, K. Syam Sundar
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Abstract

The composites have emerged as the solution for the materials used in automobile, aircraft and aerospace industries during the past two decades. Metal matrix composites are performing well in strength and also reducing the weight of the component thereby increasing the efficiency of the system. The objective of this investigation is to observe the effect of Bagasse Ash as reinforcement in Aluminum Metal Matrix composite (AMCs) in order to improve its mechanical properties. To achieve this objective, three specimen having different compositions Al-0% Bagasse, Al-1% Bagasse, Al-2% Bagasse and Al-3% Bagasse were prepared by stir casting method. The Aluminum used in the composite was of the grade Al6082. The prepared composite was subjected to tensile test, compression test, Vickers micro hardness test, and Impact Test. The experimental result revealed that the addition of BA Powder enhances the mechanical properties of the reinforced Al alloy owing to its uniform distribution on the base metal.

Keywords: Aluminum Metal Matrix Composites; Bagasse Ash; Stir Casting; Mechanical Properties.

ICRCME 28

Experimental Investigations on Mechanical and Tribological Properties of Al6101- SiC Metal Matrix Composite Fabricated Through Stir Casting

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Abstract

Aluminium MMC's are chosen over other conventional materials in aeronautics, automobiles and in oceanic areas because of their enhanced abilities such as high strength to weight ratio, stiffness, corrosion resisting nature, and tribological properties. The stir casting technique is one of the promising and economical routes for producing Al MMC's. The composite under study contains Aluminium as Matrix element and SiC as reinforcement. The aluminium 6101 alloy is stirring cast and in the molten Al6101, 2%, 4%, 6%, and 8% SiC powders are added. The obtained composite castings are tested for mechanical properties like tensile strength, compressive strength and hardness and enhanced properties are exhibited by the composite. The microstructure of these samples is studied and grain size was measured. The tribological behavior of the composite was analyzed using pin-on-disc tribometer in order to find the impact of load, velocity and distance on wear, coefficient of friction. Taguchi, ANOVA and regression analysis was used for the optimization of tribological parameters.

Keywords: *Aluminium Metal Matrix Composites; Stir Casting; Wear Test; Hardness & Micro structural Study; ANOVA.*

SESSION – 4

26-02-2022 AN
2:00 PM -3:00 PM

Organizing Chairs

Dr. T. Karthikeya Sharma
National Institute of Technology, Andhra Pradesh
and
Dr. G. Prabhakara Rao
Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru

Paper ID	Title and Authors
ICRCME 12	**Microalgae Biofuels Production- A summary of Cultivation, Harvesting, Extraction of Liquids, Energy Conversion from Microalgae to Bioenergy, and Various Applications: A Review** Bikkavolu Jogarao, Pullagura Gandhi, Vadapalli Srinivas, Chebattina Kodanda Rama Rao
ICRCME 13	**Performance Evaluation of Solar Collector using Different PV Panel Materials** P. Bhargava Kumar, J. A. Ranga Babu
ICRCME 30	**Selection of Peltier for Medical Storage - A Step by Step Methodology** Sree Vishnu Shanthanu Katakam, Jaya Krishna Devanuri
ICRCME 24	**A Novel PCM-Cold Energy Storage System for Air Conditioning Energy Saving and Shifting of Daily Energy Peaks to Off-peak Hours** Nageswara Reddy Pereddy, Narasimha Suri Tinnaluri, Prabhakara Rao Ganji
ICRCME 14	**Numerical Analysis on performance evaluation of Microchannel heatsinks using ANSYS** Ramesh Babu Bejjam, J. A. Ranga Babu
ICRCME 25	**Experimental Study on Computer Aided VCR DI Diesel Engine Operating with Fuel Derived from waste Plastics** Premdasu Nalluri, P. Premkumar, M. R. Ch. Sastry

ISBN: 978-1-5136-9400-9

ICRCME 12

Microalgae Biofuels Production- A summary of Cultivation, Harvesting, Extraction of Liqids, Energy Conversion from Microalgae to Bioenergy and Various Applications: A Review

Bikkavolu Jogarao[1*], Pullagura Gandhi[2], Vadapalli Srinivas[2], Chebattina Kodanda Rama Rao[2]
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Abstract

Continued overconsumption of fossil energy and carbon pollution problems urged steadily increasing research efforts on the utilization of renewable energy sources as an alternative to fossil fuels. Biofuels include substances extracted from or residues from biomass, such as biogas, biodiesel, bioethanol, biomethanol, synthetic biofuels, biohydrogen, and bio-oil. All of these can be used in traditional engines as prepared or mixed with fossil fuels, because of their properties. Biofuels of the first and second generation can be generated from a wide variety of feed stocks, including food crops such as sunflower, sugar cane, peanut, soybean, cotton, palm, etc., and energy crops such as lignocellulosic masses, and waste such as municipal solid waste organic fraction, or landfill leachate. The third generation of biofuels, i.e. those produced from microalgae, has gained importance in recent years. While their yield is higher and their greenhouse gas impact is lower than previous generations, they still require new technologies that are to be adopted to produce biofuels and other value-added products to reduce the cost of biofuels. Fourth-generation biofuels (solar fuels) are also introduced as they are inexpensive and their feedstock is easily accessible to fulfill the global energy requirements. In this article, the most common biofuels (biogas, syngas, biodiesel, bioethanol, and biobutanol) that are produced from microalgae in addition to various applications of microalgae, and current trends and future of the bioenergy sector centered on algae are discussed and analyzed.

Keywords: *Fossile Fuel; Solid Waste; Biodiesel.*

ICRCME 13

Performance Evaluation of Solar Collector using Different PV Panel Materials

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Abstract

Energy and its utilization is an integral part of mankind. The natural energy sources like fossil sources are depleting and reaching to verge at rapid rate. In this scenario, it is inevitable to depends on alternative energy sources. A vast evolution is going-on on conversion and utilization of various renewable energy resources, particularly with more emphasize on solar energy. It is one of the viable option for alleviate the poverty in developing countries, where majority of the people do not have

access to conventional forms of energy. Due to their inherent decentralized nature of renewable energy resources, they can large contribute to resolve the many energy problems. Amid of various techniques the photovoltaic conversion is the one, which can be directly generate electricity from the photon energy associated with the incident solar radiation. But, the power generation capabilities are highly depending on the energy conversion material. In the current study, investigations are conducted to the influence of PV panel materials and other ambient and realistic conditions imposed to investigate the feasibility and break even for the large carpet incident area like college building. Individually, PV panels can generate electricity by converting the incident solar radiation. However, when the incident solar radiation is more, temperature of the panel also rises which lowers the performance of the PV panel. By hybridizing the Phase Change Material with PV panel one can reduce the temperature of the panel and that heat can have transferred to PCM. The objective of the work is to study theoretically and experimentally the hybrid (PV/PCM) Collector. To conduct the theoretical analysis a mathematical model is used to study the enhanced panel performance.

Keywords: *Solar Energy; PV module; PCM; hybrid (PV/PCM) Collector.*

ICRCME 30

Selection of Peltier for Medical Storage - A Step by Step Methodology

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Abstract

The most crucial exercise of a country's medical cold chain is to ensure the potency of its containments until it reaches the most remote part of the country. Thermoelectric refrigerators, also known as Peltier Chips, have come into prominence for their refrigerant free, light in weight and precise control of temperature. But the application specific selection of Peltier chips is mostly under emphasised by many researchers. This paper highlights on the intricate selection of Peltier chips based on the thermal design parameters such as heat load, desired temperature, power supply along with variables such as the heat leakages, exposure to radiation and On/Off condition. Firstly, desired storage temperature, hot and cold side temperatures were obtained with the upper and lower temperature limits of potency. Next, the steady, transient, radioactive and miscellaneous heat loads were calculated along with the input power supply conditions. By referring to vaccine cold box, the design parameters along with the variables mentioned are addressed to work under the available conditions of medical storage. The study is expected to decrease the failures in thermal management for medical storage.

Keywords: *Peltier Module; Medical Cold Chain; Peltier Effect; Thermoelectric Refrigeration; Temperature Regulation.*

ICRCME 24

A Novel PCM-Cold Energy Storage System for Air Conditioning Energy Saving and Shifting of Daily Energy Peaks to Off-peak Hours

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Abstract

The peak-hour air-conditioning energy demand poses problems to power generation plants and transmission/distribution networks. During day time, outdoor air temperatures are higher than at night. Because of this, day time cooling load on the air conditioning unit is comparatively high. Further, the coefficient of performance (COP) of an air-conditioner is low during day operation because of increased outdoor coolant air temperatures. These two factors increase the energy demand on the power grid during peak hours. To tackle this problem, a novel method of cooling the outdoor air initially by an air washer and then by a Phase Change Material (PCM), that retains night time ambient cooling and releases the same during day time, to enhance the COP of air conditioning unit, and storing the cold energy of air conditioning unit during night time in a PCM and releasing the same during peak hours to shift peak-hour electrical energy demand to off-peak hours is proposed. Two types of Bio-PCMs, one at the outdoor unit with a melting range 34-35 ^{o}C and another at the indoor unit with a melting range 13-14 ^{o}C is considered to achieve the above task. The improvement in performance of the proposed air-conditioning system and the percentage saving in electrical energy consumption for Jaipur weather conditions in peak summer are estimated. An overall saving of 7% to 17% in energy consumption during peak summer months and shifting of about 5% to 10% of energy demand from peak hours to off-peak hours is possible with the proposed system.

Keywords: *Air-Conditioning; PCM; Cold Energy Storage; Energy Saving.*

ICRCME 14

Numerical Analysis on Performance Evaluation of Microchannel Heat sinks using ANSYS

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Abstract

Advancement of computational technology intensifies the heat generation rate in electronic gadgets. Thermal management of such devices is become a technical challenge to the researchers. Microchannels are one of the viable option proposed for effective working of those gadgets. Though the conventional mini and micro channels are able to improve the heat transfer rates, they are not able to match with the advanced requirements. Heat transfer coefficient and pressure drop of two new

configurations include: microchannel with semi-circular ribs (MC-SCR), microchannel with semi-circular ribs and filleted corner (MCSCR-FR) are numerically studies and presented. A commercial CFD package – ANSYS-2020 is used for the current study. Thermal and hydraulic performance of these configurations are evaluated by comparing temperature, velocity and pressure variations. It is observed from the numerical results that, the ribs corner curvature design possesses significant improvement in heat transfer coefficient, at the cost of minor increase in pressure drop. Compared to MC-SCR, MC-SCR-FR microchannel enhances the heat transfer rate by 19–22%, with 2.5-4% pressure drop. By adopting these microchannel in advanced electronic and computational devices may improve their performance.

Keywords: *Microchannel; CFD; Heat Transfer Coefficient; Pressure Drop.*

ICRCME 25

Experimental Study on Computer Aided VCR DI Diesel Engine Operating with Fuel Derived from Waste Plastics

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Abstract

In the recent years handling of Plastic waste in an eco friendly manner is the topic of interest for all over the world. Few handling methods such as incineration and land filling have been already tried however they cause Sevier impacts on environment. Pyrolysis of waste plastic is the environment friendly method of handling the waste plastics. The plastic waste can be reformed into hydrocarbon fuel through the pyrolysis process and utilized in Internal combustion engines to produce power and heat. Previous research works revealed that plastic oil produced from pyrolysis process has similar properties to that of conventional Diesel oil therefore CI Engines can be operated with plastic oil blends without any engine modifications. The objective of present work is to extract oil from waste plastic and investigate the combined effect of blending ratio and compression ratio on performance and emission characteristics of Direct Injection Compression Ignition Engine.

Performance and emission tests were performed on a constant speed (N=1500 r.p.m) VCR DI Diesel Engine by changing the blending ratio and compression ratio together. Results showed that, the average Brake Thermal Efficiency of a D80PO20 test fuel was found to be 27% which is more than all other test fuels. Furthermore, the highest Brake Thermal Efficiency was recorded for the test fuel D80PO20 at a CR of 21.5:1 under Full load condition. Similarly, Emission test results showed that, the CO_2, CO and HC emissions were slightly more for the D70B30 test fuel compared to straight diesel fuel. By performance and Emission analysis, the test fuel D80PO20 was found to be an optimum blend for maximum thermal Efficiency and minimum pollution levels.

Keywords: *VCR DI Diesel Engine; Waste Plastic Oil; Catalytic Pyrolysis.*

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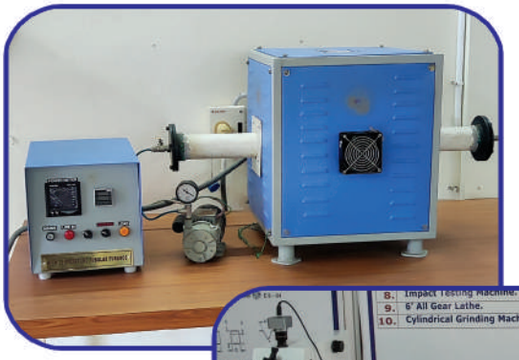


KEY NOTE SPEAKERS

Topic: Directions in Energy Transitions, Decarbonisation and Sustainability

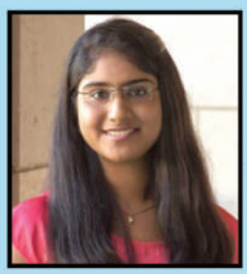
Dr. MARC A. ROSEN

Professor, Faculty of Engineering and Applied Science
Ontario Tech University, Ontario, Canada.

Topic: Optimisation of hybrid diesel and renewable energy systems for a remote island in the Indian ocean

Dr. T. M INDRA MAHLIA

Distinguished Professor,Centre for Green Technology, Faculty of Engineering & Information Technology University of Technology Sydney, Australia



Topic: Role of AI and Simulation in the Advancement of Robotics

Dr. SRAVYA NIMMAGADDA

Senior Deep Learning Scientist
Autonomous Vehicles, NVIDIA, California, United States of America

Topic: Best Practices in Vibration Monitoring & Analysis based Condition Monitoring of Industrial Rotating Machinery

Sri. SUBBA RAO GANTI

Trainer and Consultant, SVD Machinery Vibrations Solutions
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