ENGINEERING EXCELLENCE AWARDS 2020

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INDEX

INAE LIFE TIME CONTRIBUTION AWARD IN ENGINEERING 2020

INAE LIFE TIME CONTRIBUTION IN ENGINEERING AWARDEE 2020

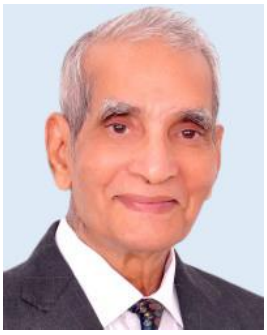
Prof KA Padmanabhan

Prof. K.A. Padmanabhan, Professor of Eminence, Anna University, Chennai and former Director, IIT Kanpur has made outstanding contributions to Engineering Education and Materials Research. He received the "Forschungspreis" (Career Research Prize) of the Humboldt Foundation, Germany and the higher 'Sc.D' degree of University of Cambridge, UK, for highly original research. His models for Optimal Superplasticity and Inverse Hall-Petch Effect in different classes of materials are described as "break-through from India" by "Nature Materials." His papers with H Gleiter on the structure of interfaces and grain boundaries are pioneering. His research on mechanical behaviour of stainless steels for Fast Breeder Programme, development of alloy equivalent for AFNOR 7020, establishing a facility for superplastic forming for Indian Space Programme and development of multi-stage forging technology for undercarriage base plate fitting for supersonic aircraft for Indian Defence Research have benefited mission- oriented programmes. He has been a consultant to SAIL, Tata Steel, Tata Motors, ISSDA, Aditya Birla Group and several MSMEs, which has resulted in new technologies for forging microalloyed steel crankshafts, 1% nickel stainless steels and sub-stoichiometric TiNx thin films. With him as mentor, TCS has patented an ICME platform, "PREMAP", for Energy, Resources and Manufacturing industries. He has authored 3 books, 5 book chapters and 300 research publications.

Prof. KA Padmanabhan is awarded the INAE Life Time Contribution Award in Engineering for the year 2020 in recognition of his outstanding contributions to the growth of Engineering Education in the country, as an institution builder and pioneering research in Materials Engineering.

INAE LIFE TIME CONTRIBUTION IN ENGINEERING AWARDEE 2020

Dr TSR Prasada Rao



Dr. TSR Prasada Rao, Formerly Director, Indian Institute of Petroleum, Dehradun has made outstanding contributions in developing mission-critical technologies that substitute processes available solely from multinational companies. His distinguished service to India is unique and notable because of his passionate and unrelenting efforts to go beyond the laboratory and apply science and engineering to develop and commercialise indigenous technologies for India's industrial development. His Key Word is Develop and Commercialise. He used his science and engineering achievements to develop and commercialise more than 10 technologies in collaboration with leading Indian companies including Bharat Petroleum, Indian Oil, GAIL, Indian Petrochemicals, Reliance, and Cadila Pharmaceuticals. Similarly, Dr. Rao led Indian Petrochemicals to acquire catalyst manufacturing capabilities, expanding India's position in the global catalyst manufacturing industry. Besides being an accomplished technocrat, Dr. Rao is widely recognised as a successful leader of Indian R&D institutions. As Director of CSIR - IIP during 1990-1999, he combined his passion for science and engineering with his experience in industry to transform the institute from a sick laboratory to a vibrant, world-class innovation centre. Since retiring from Government sector in 1999, Dr. Rao has passionately championed science-based entrepreneurship in India.

Dr TSR Prasada Rao is awarded the INAE Life Time Contribution Award in Engineering for the year 2020 in recognition of his outstanding contributions in developing indigenous mission - critical technologies and transforming of Indian Institute of Petroleum as a world-class innovation centre.

PROF JAI KRISHNA MEMORIAL AWARD 2020
&
PROF SN MITRA MEMORIAL AWARD 2020

PROF JAI KRISHNA MEMORIAL AWARDEE 2020

Dr. V Ramaswamy

Dr. V Ramaswamy, Professor, Department of Metallurgical Engineering, PSG College of Technology, Coimbatore obtained his Ph.D degree from Imperial College of Technology, University of London in 1967. He then joined Imperial College as a member of academic staff and carried out in - situ phase transformation studies in the high voltage electron microscope and carbide precipitation in Nickel- based and Cobalt -based superalloys. He joined research and development centre for Iron and Steel, SAIL, Ranchi in 1974 and was instrumental in setting up a well-equipped laboratory for research in Iron and Steel. He initiated a number of new steel products which have been commercialised including Dual phase Steel Duplex Stainless Steel, Heat resistant Steel for Indian Railways API quality X65, X70grade lion pipe steel through LD and Concast route followed by controlled rolling. He also contributed to development of Ultra high strength steel. He rose to the position of Executive Director R&D in 1991 and was transferred to Salem Steel Plant SAIL, as the Chief Executive in 1993. He successfully commissioned Coin blanking line and commissioned the Hot rolling steckel mill, without any cost and time overruns. He contributed to the development of special steels for Navy, as an expert member and suggested a cost-effective method of producing this Steel, meeting all stringent property requirements. The Steel was used in the building of indigenous Aircraft Carrier INS Vikrant. At PSG College of Technology, he was involved in setting up of Centre of Excellence in Welding, Engineering and Technology for developing several welding Consumables, Special purpose welding machines and welding robots.

Dr. V Ramaswamy is awarded the Prof Jai Krishna Memorial Award for the year 2020 in recognition of his outstanding research contributions in the field of Ferrous Metallurgy, for applications to Indian Railways and strategic sectors, such as Atomic Energy and Defence.

PROF SN MITRA MEMORIAL AWARDEE 2020

Prof LM Patnaik

Prof. L.M. Patnaik, Adjunct Professor and INSA Senior Scientist, National Institute of Advanced Studies, Bangalore was a faculty member of the Indian Institute of Science, Bangalore during 1971- 2011. He was also the Vice Chancellor of the Defence Institute of Advanced Technology (DIAT), during 2008 - 2011. He has played a pivotal role during the initiation of a strong graduate academic program in Computer Science and Engineering at Indian Institute of Science. He has made seminal contributions to parallel and distributed computing, soft computing, high performance computing, and mobile computing. One of his papers on adaptive genetic algorithms has been cited over 3600 times by Google Scholar. He has made significant contributions to the design of controllers, algorithms, simulators and computer architectures for space, defence and atomic energy applications; and fertilizer and steel industries. As Vice Chancellor of the DIAT, he initiated several new programs of relevance to defence technologies, particularly cybersecurity and nanotechnology applied to defence. He is a Fellow of all the four leading Science and Engineering Academies of India, the IEEE, and the TWAS. He was involved in the formation of three of India's premier establishments, CDAC, NBRC, and DIAT. He has over 1300 publications; has won 27 Awards. Currently his research is in machine cognition at the NIAS. His training and research activities are entirely indigenously based.

Prof. LM Patnaik is awarded the Prof SN Mitra Memorial Award for the year 2020 in recognition of his outstanding research contributions in the field of Computer Science for applications in strategic areas, such as Satellite Technology and Nuclear Reactors.

INAE OUTSTANDING TEACHERS AWARD 2020

INAE OUTSTANDING TEACHERS AWARDEE 2020

Prof Ranjit Kumar Ray

Prof. Ranjit Kumar Ray, AICTE-INAE Distinguished Visiting Professor; and Formerly Head, Advance Centre for Materials Science, Department of Materials and Metallurgical Engineering, IIT, Kanpur holds B.E., M.E. and Ph.D. degrees in Metallurgical Engineering from Calcutta University. He also holds a second Ph.D. degree in Physical Metallurgy and Science of Materials from University of Birmingham, U.K. He taught at Bengal Engineering College, Shibpur (now IIEST Shibpur) for little over 11 years, followed by teaching at IIT Kanpur for 28 years. Thereafter he worked for more than 10 years in the R&D Division of Tata Steel Jamshedpur as a Visiting Scientist. The next five years he was a Visiting Professor in IIEST Shibpur. Last year, Professor Ray has been made an AICTE-INAE Distinguished Visiting Professor. Throughout his entire teaching and research career, spanning over more than five decades, Professor Ray's teaching has been based on two beliefs, namely, 'nobody can teach anything to anybody, everybody learns himself or herself', and 'there is never a bad student, but there are bad teachers'. He always considers that, as a teacher, his job is to motivate the students and kindle their imagination. Throughout his career, he has been endeavouring to do just that. He is overwhelmed by the love and affection shown to him by his many students, and this he considers his biggest achievement and award as a teacher.

Prof. Ranjit Kumar Ray is awarded the INAE Outstanding Teachers Award for the year 2020 in recognition of his outstanding contributions to teaching and research in the area of Materials and Metallurgical Engineering and for mentoring students in innovation and research activities.

INAE OUTSTANDING TEACHERS AWARDEE 2020

Prof Bhim Singh

Prof. Bhim Singh, CEA Chair Professor, Department of Electrical Engineering, Indian Institute of Technology Delhi has demonstrated a high level of leadership for more than 41 years in innovative teaching, research, development, consulting and administration. He has introduced individual numerical assignments, computer simulation assignments, seminars, term papers, and mini projects for each student in most of courses to improve the communication skills, hand on experience and to build individual personality. He has organized more than fifty short term courses, workshops and dozen conferences. He has delivered more than hundred keynote addresses, invited specialized talks including several memorial lectures and tutorials in conferences. In first step, he has filed patents, published these inventions in top level journals and then developed advanced experiments of these technologies. He has also co-authored a unique book on: *Power Quality Problems and Mitigation Techniques* published by John Wiley & Sons Ltd. 2015, which consists of 175 solved design and simulation problems. He supervised 88 Ph.D. and 168 M.E./M.Tech./M.S.(R) students as one of the highest in Engineering and Technology. Prof Singh has published more than 2185 research papers (919 Journals and 1266 Conferences) and 59 patents. Prof Singh has executed more than 85 sponsored/constancy projects from industries around world and Government agencies.

Prof. Bhim Singh is awarded the INAE Outstanding Teachers Award for the year 2020 in recognition of his outstanding contributions in innovative teaching, research, development and consulting and for inspiring students to develop creative and communication skills and carry out novel research activities.

INAE WOMAN ENGINEER OF THE YEAR AWARD 2020

INAE WOMAN ENGINEER OF THE YEAR AWARDEE 2020

Academia Category

Prof. Sanghamitra Bandyopadhyay

Prof. Sanghamitra Bandyopadhyay, Director, Indian Statistical Institute, Kolkata has made outstanding research contributions in the intersection of computational intelligence, data analytics and bioinformatics. She has published papers in reputed journals that are well cited. She is acclaimed for her contributions in clustering and multiobjective optimization. Her pioneering proposal of centre-based encoding in genetic algorithm-based clustering significantly reduced the representation size, speeding up convergence. She followed it up with a number of innovations, finally developing a method that identified the model order, converged to the optimal score, and identified symmetric clusters of any shape/size/overlap. Development of AMOSA, the first multi-objective simulated annealing with non-greedy selection is her pioneering contribution. She has also made contributions in many-objective optimization. Over the past decade, she designed techniques in computational biology, demonstrating that innovative computational methods are essential for making biological discoveries. She developed TargetMiner, a machine learning based microRNA target prediction algorithm using tissue-specific negative samples. It provided the best specificity-sensitivity trade-off. She made important computational contributions in HIV1 pathogenesis and Alzheimer's progression. She is currently working on a systems medicine approach to understanding oral and cervical cancer, and also on algorithms for aligning short, noisy reads to a reference genome.

Prof. Sanghamitra Bandyopadhyay is awarded the INAE Woman Engineer of the Year Award 2020 in recognition of her outstanding research contributions in the intersection of computational intelligence, data analytics and bioinformatics and for designing techniques in computational biology for vital healthcare systems.

INAE WOMAN ENGINEER OF THE YEAR AWARDEE 2020

R&D Category

Dr Lalithambika VR

Dr Lalithambika V.R., Distinguished Scientist and Director, Directorate of Human Space Programme, ISRO has taken the lead in defining the directions for Indian human spaceflight. She was instrumental in enabling the materialization of India's Gaganyaan Programme, and establishment of new Human Spaceflight Centre. She identified and interfaced with national stakeholders and international collaborators for Gaganyaan and evolved astronaut selection criteria and end - to - end crew management activities for Gaganyaan. She also enabled selection of Indian Astronaut trainees. In the earlier role as Deputy Director, Vikram Sarabhai Space Centre, she led the Control, Guidance and Simulation Entity to meet the challenges of ISRO launch vehicle missions. She played a key role in the success of PSLV, GSLV and GSLV MkIII, both as autopilot designer and team leader for design of guidance and autopilot, flight software, and validation of Navigation, Guidance and Control systems. Dr Lalithamika also played a major role in conceptualizing and operationalizing day of launch wind biasing, enabling all-season launch. She was instrumental in devising innovative mission management and design strategy for India's first winged re-entry vehicle RLV-TD and steering it to success and developed real time trajectory simulation software RSITARA. For Chandrayaan-II lander mission, as NGC committee chairperson, she steered NGC system evolution across ISRO centres. She also expanded integrated simulation facility of VSSC for diverse missions through new test beds including iron bird for actuator-in-loop simulation.

Dr. Lalithambika V.R. is awarded the INAE Woman Engineer of the Year Award 2020 in recognition of her outstanding contributions to the Indian Space Programme, including defining the directions for Indian human spaceflight and for design of Navigation, Guidance and Control systems for Satellite Launch Vehicles.

INAE WOMAN ENGINEER OF THE YEAR AWARDEE 2020

Industry Category

Dr Dheepa Srinivasan

Dr Dheepa Srinivasan, Chief Engineer, Pratt & Whitney R&D Center, Indian Institute of Science, Bangalore has over 20 years of experience in developing advanced materials and manufacturing technologies for gas turbines. She is the inventor of several new technologies having over 34 patents and has developed more than 50 technologies/process applications that are now running in several gas turbines. She is a pioneer in the area of Additive manufacturing (AM) and has developed several applications for metal laser AM as a unique technology enabler for aerospace, automotive and space sectors. She has made outstanding contributions in new technology areas such as Additive Manufacturing, Cold Spray Coatings and Component Lifing, from ideation to prototyping to production, in an accelerated manner, for gas turbine progress. She has played a key role in developing and qualifying over 25 Indian suppliers, in casting, forging, and fabrication for turbo machinery components. One of her key strengths has been to identify and collaborate with industries as well as academic institutions seamlessly, to accomplish accelerated technology development. She has been active in teaching and training and has been very successful in imparting an industrial edge to engineering education, by continuously sharing and teaching her practical engineering experience with academia and motivated several student interns.

Dr Dheepa Srinivasan is awarded the INAE Woman Engineer of the Year Award 2020 in recognition of her outstanding research contributions and development of indigenous technologies and processes in the areas of advanced materials and manufacturing technologies, for gas turbines for industrial applications.

INAE YOUNG ENGINEER AWARD 2020

INAE YOUNG ENGINEER AWARDEE 2020

Dr NM Anoop Krishnan
Assistant Professor, Department of Civil Engineering,
Indian Institute of Technology Delhi

Dr. Krishnan's research focusses on physics- and data-driven modeling and design of materials. His areas of interest include developing realistic multiscale models for cementitious and glassy materials, accelerated design of glasses for optical, automobile, biomedical, and nuclear applications. His group, in collaboration with his colleagues at IIT Delhi, has developed a package namely Python for Glass Genomics (PyGGi, see: http://pyggi.iitd.ac.in), which uses advanced machine learning algorithms for the discovery of novel glasses for practical application. Specifically, PyGGi hosts: (i) a huge experimental database of glass compositions with their properties, (ii) machine learnt composition–property models using neural networks and scalable gaussian properties for nine properties with up to 34 components, and (iii) an optimization module which predicts optimized glass compositions with targeted properties subjected to various constraints. Other areas where he has contributed include the radiation damage in cement aggregates and gel, glass transition in two-dimensional materials, design of glasses for nuclear waste immobilization, and the hydration kinetics of cementitious gels.

INAE YOUNG ENGINEER AWARDEE 2020

Swatantra Pratap Singh

Assistant Professor, Department of Environmental Science and Engineering, Indian Institute of Technology Bombay

Dr. Swatantra Pratap Singh is an environmental engineer with experience in membrane technology (desalination and wastewater recycling), environmental nanotechnology, fate, and transport of pollutants and emerging contaminants in the environment. He has developed key technologies to fabricate the membranes for water purification and a single step graphene printing on polysulfone polymers and membranes. He has four US patents (two granted and two provisional) on membrane and laser-based graphene fabrication techniques. The developed technologies are based on nanotechnology and laser to address the pressing challenges of current membrane technology, such as biofouling control, selectivity, and the efficient removal of emerging contaminants. He has 19 journal articles (18 research articles and one review) in high impact journals such as ACS Nano, Applied Materials and Interface, Carbon, Chemical Communication, and Journal of Membrane Science. He also has experience in fate, transport, and remediation of organic pollutants by nanotechnology and biodegradation. He has six journal articles on the fate, transport, and faster remediation of organic contaminants by nanotechnology and biodegradation and two book chapters on the related field. At present, his research interests are membrane technology (water-energy-health nexus), nanotechnology (application in environmental remediation), quantum chemical modeling, and fate & transport of the emerging pollutants.

INAE YOUNG ENGINEER AWARDEE 2020

Dr Pawan Goyal

Associate Professor, Department of Computer Science and Engineering, IIT Kharagpur

Dr Pawan Goyals's primary interests are in the field of Computational Linguistics, where he has made many contributions in the field of Sanskrit Computational Linguistics. During his post-doctoral fellowship at INRIA with Prof. Gerard Huet, he worked on the Sanskrit Heritage Reader tool developed at the INRIA site and added various functionalities that helped the tool reach a wider audience. Since the process to select a unique solution from all the possible segmentations was still manual, after joining IIT Kharagpur, he continued working on statistical methods to automatically identify the unique solution. He developed a structured prediction framework to solve the segmentation problem, which could make use of the free word order nature of the language. The method achieved highly accurate results using only 10% of the task-specific training dataset used by the most competing baseline. Segmentation being the first basic component for most of the NLP tasks, this work is of immense help for computational processing of Sanskrit text. The proposed framework is generic and he has been able to extend this to solve a variety of NLP tasks such as morph analysis, dependency parsing, and poetry to prose conversion for Sanskrit.

INAE YOUNG ENGINEER AWARDEE 2020

Dr Neeldhara Misra

Assistant Professor, Indian Institute of Technology, Gandhinagar

A unifying theme of most of her research contributions is that they all deal with the issue of coping with NP-hardness. Specifically, she has worked on designing exact algorithms for NP-hard problems that are provably efficient when the input exhibits certain structural properties. Her work involves applying this paradigm to several problems motivated by a variety of practical questions. These include constraint satisfaction, preference aggregation, firefighting, motif finding in graph structures, graph colouring problems motivated by requirements of wireless sensor networks, determining winners of elections, fairly allocating resources, and solving combinatorial games. Broadly speaking, her work often involves proposing and exploring more general models that mimic real-world applications more closely on the one hand, and also imposing additional structures on the inputs which may reflect the special nature of a particular practical situation on the other. As an example of the former, her work on manipulation incorporates the fact that manipulators may not have perfect information about the system at hand. As an example of the latter, many of the investigations in the context of elections are on single-peaked domains, which accounts for the special nature of voting profiles instead of modeling them as a generic collection of rankings.

INAE YOUNG ENGINEER AWARDEE 2020

Dr Prosenjit Das
Principal Scientist, CSIR-Central Mechanical Engineering Research Institute, Durgapur

The present work discusses the development of process technology of Rheo pressure die casting (RPDC) of Al alloys. A cooling slope made of stainless steel has been employed for semi solid slurry generation, followed by isothermal holding of the generated slurry in a resistance heating furnace and transferring it in metered quantity to the shot sleeve of high pressure die casting machine, to develop automotive knuckle housing (for Mahindra SUV) as a prototype component. Rigorous experimental studies on cooling slope slurry generation process have been performed using A356 and A380 Al alloys to investigate formation and growth mechanism of primary Al particles during slurry generation and isothermal holding stages. Pseudo plastic flow behaviour of the slurry is determined experimentally and a mathematical model is developed to express the same. Afterwards, an Eulerian multiscale, multiphase flow numerical model is developed for simulating the transport phenomena associated with the cooling slope slurry generation process. Experimental validation confirms a reasonable capability of the multiphase model to predict slurry morphology and, in turn, to establish process control. Further insight into the morphological evolution of primary solid grains during slurry generation and isothermal holding stages has been obtained by employing a phase field code.

(Technology know how is transferred to Sona Koyo Steerings Limited) (Funded by DST-Technology Systems Development Board & CSIR) (Role: Co- Principal Investigator & PhD student)

INAE YOUNG ENGINEER AWARDEE 2020

Dr Ravi Kumar Arun

Assistant Professor, Department of Chemical Engineering,
Indian Institute of Technology Jammu

Dr. Ravi Kumar Arun has worked in the area of microfluidics largely focusing on energy technologies such as Fuel Cells, Batteries; Lab on chip devices for nanoparticle laden fluids, microfluidic mixing and Paper based microfluidic technologies for healthcare and environment. His research has been published in reputed journals like *Lab on a Chip*, *Electrochimica Acta*, *RSC Advances*, *Journal of Micromechanics and Microengineering* and *Analyst*. He has filed four patents as a first inventor and One as Co-Inventor. One technology (Micro Fuel Cell) has been transferred to industry for its commercialization. Overall, the nominee's contribution is in the area of paper microfluidics based technologies for energy conversion and storage devices i.e. membraneless fuel cells and energy harvesting, lab on a chip development for malaria diagnosis and detection. The nominee's efforts in microfluidics research and its application in collaboration with industry for potential applications such as portable power sources and sensors and systems for contaminated water purification are impactful.

INAE YOUNG ENGINEER AWARDEE 2020

Dr. Rahul Mangal

Assistant Professor, Department of Chemical Engineering,
Indian Institute of Technology Kanpur

Dr. Rahul Mangal has contributed noticeably through his research in the area of Polymers, Soft Matter and Active matter. As a graduate student, he worked on fundamentally investigating the structural and dynamical properties of polymer nanocomposites (PNCs). His work provided useful insights related to the synthesis and performance of different PNCs. Later, he investigated the motion of artificial active colloids at the nematic liquid Crystal - water interface. The results were useful in understanding how the anisotropy in viscosity offered by nematic liquid crystals can be used to guide the motion of active colloids for their effective use as drug delivery agents. Presently, he is investigating the motion of active colloids/emulsions in different complex surroundings. These efforts will significantly advance the area of artificial colloids which is critical to their potential use as cargo carriers/drug delivery agents in microscopic domains. He is also working on investigating the impact of shock waves on polymer nanocomposites. Results from these experiments will lay the foundation for the synthesis of composites capable to offer maximum resistance against shock waves which can be very useful in defense applications.

INAE YOUNG ENGINEER AWARDEE 2020

Dr. Swaroop Subhash Gajare

Lead Engineer, Eaton Research Labs, Eaton India Innovation Center, Pune

Dr Gajare has worked with corporate research groups of Eaton and ABB, since August 2016 and has five filed patents from his industrial contributions. At Eaton, he has developed a new control architecture for reactive power compensation and active harmonic filtering in power systems using voltage regulators. He has also developed a new algorithm for allowing network protector operation during reverse power flow conditions due to renewable energy sources in the distribution grid. At ABB, he worked on power system protection and fault location solutions for multiterminal power transmission lines and has four patents. In his PhD work, his contributions were towards analysis and protection of series compensated lines in power systems. He has proposed solutions for online parameter estimation of series compensated line and model verification of series compensation devices. He has also developed methods for protection, auto-reclosing and fault location in series compensated lines which are compensation model independent. He has 4 IEEE transactions and 5 conference publications from his PhD thesis. He has developed solutions for real problems reported by power system industry. Overall, he has 5 transaction papers, 5 conference publications, 4 published patents and 2 filed patent application to his name.

INAE YOUNG ENGINEER AWARDEE 2020

Dr Sumit Kumar Pramanick

Assistant Professor, Department of Electrical Engineering,
Indian Institute of Technology, Delhi

Dr Pramanick's contribution has been towards performance enhancement of variable speed induction motor (IM) drives. In the IM drive, the variable voltage variable frequency supply to the IM is generated by a voltage source inverter (VSI). At high speed operation of the motor, the VSI feeds a voltage supply with low order harmonics to the motor leading to undesirable torque ripple. To suppress the low order harmonic in the voltage bulky passive filters are used, thus increasing the size and weight of the drive. His research established a novel method to eliminate the low order harmonics for the full speed range of the IM using switched capacitor filter. The theoretical study led to the establishment of an operating condition in which a capacitor fed converter eliminates the low order harmonic from the voltage supplied to the IM without contributing any active power. Due to this active filtering technique passive filters can be avoided, making the drive compact and less bulky. The developed method can eliminate low order harmonics from the phase voltage even at low switching frequency operation of the main VSI. The high switching frequency is shifted to reduced voltage rated capacitor fed converter stage (switching loss reduction).

INAE YOUNG ENGINEER AWARDEE 2020

Dr Digbijoy N Nath

Assistant Professor, Centre for Nano Science and Engineering,
Indian Institute of Science, Bangalore

Dr Digbijoy Nath has made contributions in wide bandgap semiconductor devices including indigenous GaN power transistors on silicon (5 A, 100 V) and spearheading research on dielectrics, interfaces and breakdown of GaN transistors. He has also helped develop record-performing deep-UV photodetectors for solar blind applications based on GaN and Gallium Oxide. In the area of indigenous GaN power transistors, he has enabled the device development, overcoming several challenges in design, process, fabrication and layout development over multiple generations of GaN transistor architectures. He is also leading an effort for developing C-band RF GaN transistors under an ISRO-funded as well as an IMPRINT program for use in SATCOM/strategic applications.Various critical aspects of GaN power devices such as dielectrics, interface traps, carbon doping, leakage and breakdown which present several challenges toward enabling a reliable and robust GaN power device technology, are being investigated by him in national and international collaborations.He has also helped achieve state-of-art performance in deep-UV solar blind photodetectors based on AlGaN and gallium oxide (Ga_2O_3) including demonstration of record-high zero-bias quantum efficiency (92%) in the former. Such exceptionally high-performing, battery-free detectors are promising toward enabling focal plane arrays for space-borne deep-UV imagers and wearable UV sensors.

INAE YOUNG ENGINEER AWARDEE 2020

Dr Raghvendra Kumar Chaudhary

Assistant Professor, Department of Electronics Engineering,
Indian Institute of Technology (Indian School of Mines), Dhanbad

Dr. Raghvendra Chaudhary has contributed significantly in developing compact multifunctional antennas for mobile communications. His work is credited to achieve compactness in design without sacrificing the antenna properties. The specialty of his technical innovation lies in handling multiple challenges of small-antenna designs which include maintaining bandwidth, gain, and efficiency to their acceptable levels. He has made efforts to meet critical demands of the rapidly advancing mobile communication such as multi-band and circularly-polarized (CP) compact antennas. This industry related development enables the system engineers to integrate these new antennas to the wireless system very efficiently. Compact antenna with circularly-polarization is another significant contribution of Dr. Chaudhary. The inclusion of CP concept into a metamaterial - based geometry is the most novel aspect of his innovation. Furthermore, he has extended his expertise to designing compact antennas for 5G mobile communication where cognitive radio is going to play a huge role in the sub-6 GHz 5G network. He has claimed a new development of 5G terminal antenna for the first time, which integrates interweave and underlay cognitive radio technologies with MIMO technique. His continuous effort has resulted in a tunable smart 5G antenna with MIMO and cognitive radio. The focus of his work has always been towards the state-of-art technologies and their immediate applications.

INAE YOUNG ENGINEER AWARDEE 2020

Dr Pooja Devi

Senior Scientist, CSIR-Central Scientific Instruments Organisation, Chandigarh

Dr. Pooja's research expertise is in the domain of materials engineering, techniques, and associated affordable and portable devices development for water pollutants detection, degradation, solar hydrogen production, etc. She has established methods for synthesis of varied categories of materials such as metallic nanostructures, transition metal oxides, semiconductors, carbonaceous nanostructured materials, 2D materials, MXenes, etc. She has 01 patent, 01 technology, 61 high impact research publications, 04 books, 09 book chapters, 84 conference papers, and 42 invited/oral talks to her credit. Dr. Pooja is also recipient of several awards/fellowships including SERB Women Excellence Award (2020); Associateship, Indian Academy of Science (2019-22); ISCA Young Scientist Award (2019), ISEES Young Scientist Award (2019); BRICS Young Scientist Award (2018); MRSI GC Jain Memorial Thesis Award (2020); ACS PITTCON- Travel Grant (2018); Indo-US WARI fellowship (2017); Canadian Commonwealth Fellowship and GATE Fellowship. She is also elected member of Indian Young National Academy of Science, INSA, New Delhi. She is also a passionate science communicator and is coordinating various science outreach activities.

INAE YOUNG ENGINEER AWARDEE 2020

Dr Mudrika Khandelwal

Associate Professor, Department of Materials Science and Metallurgical Engineering, Indian Institute of Technology Hyderabad

Dr Mudrika Khandelwal has been working to develop scientific solutions for societal problems including antimicrobial materials for food packaging and controlling infectious diseases, materials for energy storage, and environmental remediation, using sustainable nanofibrous cellulosic materials. Her group has developed active food packaging material which can prevent microbial decay of fruits and vegetables for over 30 days. They have also developed a modern drug delivery formulation of herbal antimicrobials such as essential oils derived from Tulsi, Oregano, and Clove. They were able to achieve a double barrier drug delivery system with controlled release with intended applications in the treatment of fungal infection in women, soldier's feet. Her group has developed a unique hierarchical amphiphilic material using simple fermentation which has been proven to be useful for oil-water separation and tissue scaffold. Further, her group is making efforts towards designing precursors for carbon to be used as an anode in lithium-ion batteries to address the requirement of higher power and greater energy storage. Overall, she has made a significant contribution in the development and application of nanofibrous materials.

INAE YOUNG ENGINEER AWARDEE 2020

Dr M Sathish

Scientist, CSIR-Central Leather Research Institute, Chennai

Dr Sathish's area of interest includes "Enhancing Water/Chemical Economy" in leather manufacturing and also to develop eco-benign leather auxiliaries. He developed a "Waterless Tanning Process" which reduces 90% water consumption and 70% of chemical consumption in leather manufacturing. Besides, the processing time reduced from 70 to 8 hrs. For the first time, he developed a solvent selection tool that enables the selection of green solvents for leather manufacturing and the same has been published as CSIR-CLRI solvent selection tool in Green Chemistry journal (RSC). Besides, he also fundamentally studied the interaction between green solvents and skin protein which helps to understand the role of water in leather manufacturing. He was also involved in development of various technologies and some of them are commercially successful. For the first time, he has developed a path-breaking "Preservation-cum-Unhairing" technology which completely eliminates the salt and toxic sodium sulfide. The technology was highly appreciated by the leather fraternity and commercialization of the same is under the pipeline. He is also developing an "Environmental Efficiency Index Model" as a common language for leather manufacturing. The awardee had published 13 papers in internationally peer-reviewed journals and also filed 5 Indian patents.

INAE YOUNG ENGINEER AWARDEE 2020

Dr Josephine Selvarani Ruth D

DST INSPIRE faculty fellow, Robert Bosch Centre for Cyber Physical Systems, Indian Institute of Science, Bangalore

Dr. Ruth has done major research in designing smart materials-based sensors, actuators, self-sensing actuators and while so doing, in her doctorate work she evolved with the new concept of shared sensing and actuation technique, which gave her a major breakthrough in human-machine interaction systems. Most of her publications are published in reputed scientific citation indexed journals. Some of her major contributions include:Design and development of a novel self-sensing circuit for the shape memory alloy-based systems, which made it handy, plug and play module for even underactuated systems; The identification of a linear region in the phase transformation of shape memory alloy wires by using the active or passive biasing as an inverse hysteresis element to make the system output to be linear; Designing of a cantilevered force sensor with the shape memory alloy wires under shape memory effect was her major funding which leads to evolving with the concept of shared sensing and actuation (SSA^{+}); Application of shared sensing and actuation technique took the shape memory alloys to a new domain of using in a Master-slave system and also with this it has been able to integrate for a human-machine interaction systems; The application of the concept leads to the sensaptics module for advanced driver assistance systems (ADAS) which was tested in an automotive company to test its performance and it is found to be a validated system and The design and development of sensaptic based robotic gripper by integrating the factors of Collocation, Coupling and Compliance to employ in human –machine interaction systems

INAE YOUNG ENTREPRENEUR AWARD 2020

INAE YOUNG ENTREPRENEUR AWARDEE 2020

Mr. Akshay V. Singhal

Founder & CEO, Log 9 Materials Scientific Private Ltd., Bengaluru

Log 9 is on its mission to provide a 100% clean, safe and circular energy economy solution to the world using Aluminum. It has enhanced Aluminum fuel cell technology using the core expertise of the company around the wonder material Graphene, which generates energy using Aluminum as a fuel rather than hydrogen. This makes it completely safe, >5x cheaper and scalable as compared to Hydrogen Fuel Cells. Log 9 has filed for 16 patents around Graphene materials and Aluminium Fuel Cells and has gone from proof-of-concept to a working full stack prototype of a stationary power generator and a vehicle powered by Aluminium fuel cells in under 10 months. Aluminium fuel cell technology is not only more cost effective than Hydrogen fuel cells, but also solves basic challenges of electrification of vehicles by Li-Ion including that of range anxiety, charging time, charging infrastructure and scarcity of raw materials. Log9's subsidiary Log 9 Spill Containment Pvt. Ltd. has also commercialized a range of Spill Containment products under the brand name of 'Sorbene'. These products are 5 times more efficient than the incumbent products in the market for containment of oil and chemical spills. Recently, 10,000 of Sorbene Pads were airlifted to Mauritius by IOCL and Government of India for containment of the large spill that is still unfolding there. (www.sorbene.com)

A short video on our Aluminum Fuel Cell technology is available at the link**:** https://youtu.be/ByejM9jLTZs

INAE YOUNG ENTREPRENEUR AWARDEE 2020

Dr Anuya A. Nisal

Principal Scientist, CSIR-National Chemical Laboratory, Pune

BiolMed Innovations is an innovation driven tissue regeneration products company. The flagship product of BiolMed is a bone replacement material called as Serioss. Serioss can be used to plug cavities or defects in the bone. Cavities and defects in bone are formed due to accidents, infection, cancer, etc. Serioss is based on a patented technology platform. It provides the appropriate mechanical, chemical and structural cues for new bone formation. It can be made in a variety of shapes and forms for the surgeon to choose appropriately depending on the fracture site and cavity size. In laboratory and animal studies, Serioss has been demonstrated to be safe/nontoxic as well as promoting bone healing and actively depositing new bone. Serioss out-performs all other alternative products in the market by atleast 100% in bone growth and deposition studies. With these outstanding results, BiolMed is gearing up for clinical trials on Serioss. Serioss, therefore, promises to be strong contender for capturing the global synthetic bone replacement materials market that is worth 2 billion USD.

INAE YOUNG ENTREPRENEUR AWARD SPECIAL COMMENDATION 2020

Dr Sundararajan Krishnan

Founder and CEO, Aptener Mechatronics Private Limited, Bengaluru

This recognition is being awarded for the following innovations:A miniaturized and portable cooling technology that has enabled the creation of a class of wearable coolers that can be attached to (amongst other things) motorcycle helmets. The cooling technology also provides the capability to de-fog the helmet's visor and the rider's glasses. Simultaneous support for Bluetooth Classic and Bluetooth Low Energy (BLE) that allows the rider to listen to music/navigation directions while having smart control for the cooling that auto-adjusts based on his riding speed. Using contextual awareness (through the BLE data link that keeps the phone and the device in sync) to reduce the number of buttons on the device to 1) and Delivering a car-like CarPlay/Android-Auto experience for two-wheeler riders by using the BLE data link to get the most out of the rider's smartphone. These innovations have been commercialized successfully through the BluArmor range of two-wheeler accessories.

INAE YOUNG ENTREPRENEUR AWARD SPECIAL COMMENDATION 2020

Mr Jayant Sitaram Karve

Founding Director and CEO, RCupe Life sciences Pvt Ltd, Bengaluru

'Ozyn-D', an indigenously developed, novel Intraosseous (IO) device for pre-hospital and hospital critical care in resuscitation of patients in medical emergencies. The lifesaving 'Ozyn-D' is manually operated, pre-sterile device which gains access to circulation through long bones in less than 10 seconds and infuses fluids and medications. The disposable device is ready to use at the point of care without need of sterilization/preparation. The device can be used by paramedics, nursing staff in resource-poor settings and requires minimal training. During medical emergencies, establishing access to circulation is critical. In patients with sudden cardiac arrest (SCA), trauma, dehydration, obstetric and pediatric emergencies, due to low blood volume and pressure lead to vein collapse. Precious time is lost in trying to gain peripheral IV access during the "golden period" of patient care. Lack of access results in considerable morbidity and mortality. In India, estimated 1.3 million patients per year require an alternative to IV access to prevent substantial morbidity and mortality. Globally 250 million patients need IO access. This lifesaving innovation has application not only in domestic markets but also addresses unmet need of medical emergencies of the Military/ Defence.

INNOVATIVE STUDENT PROJECTS AWARD 2020

INNOVATIVE STUDENT PROJECTS AWARD 2020

DOCTORAL LEVEL

Dr Stefie J. Stephen

Engineering College/Institution: Indian Institute of Technology Madras

Title of Thesis: Incorporation of time-dependent fracture behaviour in the structural design of fibre reinforced concrete elements

Summary of Thesis: The characterization of fracture properties under long-term loading conditions is crucial for any material to be used in a structure, designed for long service life. It was found in this research, that the tetralinear fracture model is a more robust model for concrete with high dosage of fibres and the model was found to be influenced by duration of loading and hence a rate-dependent fracture model was developed. Earlier, the concrete pavements were believed to have high service/fatigue life. However, this research rationalizes that incorporation of low dosage of steel fibres in concrete can tremendously improve fatigue performance. In addition, in this research, the relevance of using number of cycles to reach the critical crack opening is explained and the corresponding fatigue model was developed. The development of long-term static and dynamic testing procedures and models for concrete elements is a breakthrough in the design industry that aims to construct a safe and low-maintenance structure. These models are based on extensive experimental work, which is so far not conducted for fibre reinforced concrete elements and hence has the patent potential. Researchers and design engineers can use the same methodology to characterise the time-dependent response of any quasi-brittle material.

Dr. Asha Das

Engineering College/Institution: Cochin University of Science and Technology, Kochi

Title of Thesis: Automated Nuclear Pleomorphism Scoring in Histopathological Breast Cancer Images.

Summary of Thesis: Breast cancer grading or nuclear pleomorphism scoring, forms a significant factor in determining individualized treatment plans and also for the prognosis of the disease. The prevailing manual microscopic examination and grading is highly dependent on the opinion of the pathologist, which may be subjective, and suffers from lack of repeatability, inconsistency and observer-based variations, thereby affecting the prediction of the disease outcome and the adopted treatment modality. This has motivated the awardee in exploring automated mechanism for grading over a non-Euclidean Riemannian framework, which can provide more reproducible and objective prognosis of the disease. She has proposed two algorithms: kernel-based discriminant analysis (KFDAR) and kernel-based sparse coding and dictionary learning (KSCDL) over the Riemannian manifold for the three geodesic Riemannian distance metrics: log-Euclidean metric and the two Bregman divergences - Stein and Jeffrey divergences. To mitigate the need of manual annotation in supervised classifier models and to reduce the labelling cost, she has proposed a batch mode active learning over the Riemannian framework, that adaptively and dynamically identifies the apt batch size along with the batch of instances to be queried, taking into account the complexity and informativeness of the tissue samples and the cost of labelling the data. Experimental results show a remarkable improvement in the cancer discrimination accuracy for all the kernelized variants of the proposed methods when compared with the state-of-the-art algorithms.

Dr. Kuppuraj Rajamanickam

Engineering College/Institution: Indian Institute of Science Bangalore

Title of Thesis: Studies on Flow Dynamics and spray swirl Interactions in Gas Turbine Combustor

Summary of Thesis: In this thesis work, high fidelity laser diagnostic tools are employed to quantify the stochastic momentum coupling between air and liquid flows, in air-blast atomizer, and, in this way, understand better, the underlying physics. For the first time, the awardee has depicted the synchronization of gas-phase instability modes with the liquid sheet breakup in the primary atomization zone of swirl atomizers. Next, how the droplets interact with the coherent structures/vortices are meticulously analyzed with the help of time-resolved simultaneous two-phase measurements. Subsequent, data reduction using POD, highlighted the correlations between the local aerodynamics of flow and droplets. Besides, the transient nature of breakup mechanisms associated with the droplets injected into the vortices is delineated through a modified weber number coined based on the circulation strength of the eddies. This enabled the awardee to examine the spatial dispersion of droplets, good and bad atomization operating regimes. In the last part, sensitivity analysis is performed in the realistic injector geometries (i.e. swirl cup) to identify the critical parameters governing the resultant spray. This is the unique analysis, which provides the quantitative link between injector design parameter, spray morphology, droplet size, and uniformity in dispersion. The emerged operational regime map will serve as the design guidelines for next-generation atomizers.

Dr. Akshay Modi

Engineering College/Institution: Indian Institute of Technology Bombay

Title of Thesis: Tailored Polymer Nanocomposite Hollow Fiber Membranes for Biomedical, Gas Separation and Water Treatment Applications

Summary of Thesis: The research work was aimed at providing efficient hollow fiber membrane (HFM)-based solutions to the socially relevant biomedical applications (bioartificial organ assist devices) and industrially relevant separation applications (gas separations and water treatment). The tailored novel carbon/metal-based nanomaterials incorporated HFMs were indigenously developed by phase inversion technique. The membrane material composition and synthesis parameters were tuned to achieve physicochemical properties according to the target application. Therefore, these HFMs demonstrated excellent performance when tested with the close-to-real systems of biomedical engineering and separation applications. Notably, biomedical research has shown that the primary functions of a natural kidney, i.e., blood purification and its enrichment with essential metabolites, can be accomplished in one-step using a specially tailored hollow fiber membrane-based extracorporeal device. For the gas separation application, high-performing mixed matrix membranes were developed, which exhibited high permeability and selectivity for CO_2/CH_4 and O_2/N_2. For the water treatment, the specially tailored polymer nanocomposite HFMs were developed, which showed excellent performance in terms of removal efficiency towards harmful contaminants from the naturally contaminated water, permeation flux, antifouling property, and long-term performance stability. Overall, the tailored polymer nanocomposite HFMs prepared in the thesis work have translational potential for bioartificial organ development, separation of industrially relevant gases, and removal of emerging toxic contaminants from water, which would benefit society to a large extent.

Dr Priyank Mukeshkumar Shah

Engineering College/Institution: Indian Institute of Technology Delhi

Title of Thesis: Adaptive Control Strategies for Resilient Operation of Grid Interfaced Solar Energy Conversion System Enabling Power Quality Improvement.

Summary of Thesis: In this research, the four most challenging issues on the renewable power generations are addressed; 1) Virtual-inertia support distributed power generation, 2) Leakage current suppression in solar photovoltaic (PV) array system, 3) Resilient operation of the renewable energy system, and 4) Low-voltage ride-through operation of renewable energy sources. In the first aspect of the work, the virtual induction machine is proposed to emulate inertia to the distributed power generation. To facilitate this, the dependency on proportional-integral controllers and synchronization toolbox regulators are completely eliminated, and adapt the system scenarios even under abnormal grid voltages. In contrast to the state-of-art system, the proposed system can easily synchronize with the grid without any additional semiconductor switches, diodes, etc. The second aspect of the project deals with leakage current suppression in a solar PV system. The harmonic controller is proposed herein to deal with harmonics for power quality improvement of the grid enabling reactive power compensation capability. The proposed controller follows IEEE-519/IEC-62109/VDE-00126 standards by suppressing the leakage current even under the presence of reactive/nonlinear load, unlike the conventional system. The third and fourth aspects of the project deal with resilient operation and ride-through operation of renewable energy sources. The sole resilient controller is proposed to identify any kind of attack signal. The sole controller is designed in such a way that it can cope up with the distinct attack signals. In the fourth aspect, the harmonic compensator is modified in such a way that it locally compensates the harmonics and facilitates the power quality improvement features even under ride-through operation, unlike traditional algorithms.

Dr Sayan Dey

Engineering College/Institution: Indian Institute of Technology Kharagpur

Title of Thesis: NiO Based Sensors for VOC and Heavy Metal ion detection

Summary of Thesis: With growing industrialization, the environment is degrading exponentially. Hence, air and water quality monitoring are quintessential. This work establishes NiO based (i) gas and (ii) Heavy metal ion sensors for environmental monitoring. The improvement of sensing parameters were performed by (i) tuning nanostructure morphologies (ii) doping NiO and (iii) fabricating junction devices. Two different morphologies of NiO were proposed: (i) novel coral-like optically active nanostructures, which sensed formaldehyde at 300^{o}C under light and (ii) liquid exfoliated NiO nanosheets sensed acetone selectively at 200^{o}C. Secondly, the nanostructures were doped by (i) Cu and (ii) Fe. $Cu_{0.1}Ni_{0.9}O$ showed sensitivity towards humidity (at 25^{o}C) and multiple VOCs at 300^{o}C which were segregated using PCA. It also showed excellent re-usable sensing towards Cr (VI) ions. $Fe_{0.1}Ni_{0.9}O$ showed excellent humidity resistant toluene vapours and bio-compatible in-vivo mapping of As (V) ions. A novel heterojunction device technology was proposed to replace commercial sensors. The devices (i) $Fe_{0.1}Ni_{0.9}O$/NiO (p^{+}/p) and (ii) ZnO/NiO (n/p) heterojunctions, when operated under forward bias showed tunable selectivity among 2-propanol, toluene and formaldehyde vapours respectively with changing (i) operating temperature and (ii) forward bias voltage respectively. A microcontroller-based sensor interfacing circuit was designed to support multiple sensors for real-time sensing as a hand-held device.

Dr Chandan Bose

Engineering College/Institution: Indian Institute of Technology Madras

Title of Thesis: Dynamical Analysis of unsteady flow phenomena around Flapping wings

Summary of Thesis: The present thesis is the first study to systematically investigate the aperiodic regime of the unsteady flow-field behind rigid and flexible flapping wings. The dynamical manifestation of chaos in the flow-field (both 2D and 3D) behind periodically flapping rigid and flexible foils and the revelation of chaotic force generation mechanisms are the novel contribution of this thesis. A phenomenological bifurcation scenario, involving quasi-periodic and intermittent transition routes to chaos and the underlying vortex interactions in the unsteady wake have been reported in this thesis. The leading-edge vortex shedding is found to be the primary trigger behind the transition from order to chaos in the flow topology. The findings of this thesis established that dynamical chaos can be physically observed behind periodically flapping wings at high Strouhal numbers in both 2D and 3D flow-field and it is not a two-dimensional artifact as conjectured in the previous literature. The effect of stochastic flow-fluctuations on the flexible flapping response has also been studied and the presence of two qualitatively different ‘on-off’ and ‘burst-type’ intermittency behaviour is established. The findings of this thesis can directly benefit in finding a stable operating regime for the efficient design of futuristic nature-inspired Micro-Aerial-Vehicles (MAVs).

Dr Jhansi Jadav

Engineering College/Institution: University of Hyderabad, School of Engineering Sciences & Technology, Hyderabad

Title of Thesis: Assessment of Precipitation, deformation and fracture behaviour of Superni 263 Ni base Superalloy under Tensile and Low cycle fatigue conditions.

Summary of Thesis: The current research work, aimed at establishing appropriate heat treatments of Alloy Superni-263(1373K/1.5h/WQ and 1023K/8h), for AUSC plants. The Effect of strain rate and temperature on tensile flow properties of Superni-263 superalloy have revealed that the alloy was sensitive to strain rate and peak value in yield strength was obtained at intermediate strain rate 1.3×10^{-3} s^{-1} and 673K is due to dynamic strain aging (DSA). The guidelines for fatigue design of Alloy 263 for its usage in A-USC power plants have not yet been established. Hence further investigation has been carried out from 298K to 1023K at ±0.6%strain amplitude, to understand the cyclic deformation and micro-mechanisms and fracture behaviour of Superni-263 alloy. The Effects of DSA and temperature on strain controlled low cycle fatigue behaviour of Superni-263, have shown a marked variation in its temperature dependence. Further, the combined effects of strain amplitude and temperature on low cycle fatigue properties of superni-263 superalloy are investigated at 298 K, 673 K, and 923 K employing the strain amplitudes from ± 0.25% to ± 0.80%. The fatigue life observed was decreased drastically with increasing temperature, particularly at low strain amplitudes.

Dr. Debanjan Das

Engineering College/Institution: Indian Institute of Science Bangalore

Title of Thesis: New avenues to transition metal-based water splitting electrocatalysts.

Summary of Thesis: This thesis focuses on new synthesis methodologies for various earth-abundant electrocatalysts supported heteroatom-doped carbon nanostructures and exploited for water splitting. An in-situ solid state route was developed to integrate ruthenium nanoparticles with N-doped graphene sheets which exhibited an HER activity rivalling state-of-art Pt/C over a wide pH range. Thereafter, a new, phosphine-free, solid state method to hybridize Co2P with N, P co-doped CNTs was developed as an efficient bifunctional electrocatalyst for both HER as well as OER, thereby effecting total water splitting. Next, to maximize the exposed edge sites in MoS2 (which are considered to be active for HER), the awardee synthesized vertically aligned MoS2 nanosheets directly on a Mo foil. The foil not only acted as a conducting support but also as a source of Mo during the reaction resulting in excellent HER activity. Finally, an in-situ strategy was developed to hybridize N-doped graphitic carbon sheets with Ni and MoxC nanoparticles exhibiting total water splitting. Although, further improvement is needed in terms of mass activity and long-term stability in order to be competitive with the commercially available systems, development of these low-cost electrocatalysts as attempted in this project is fundamental towards the realization of the “hydrogen economy”

Dr Souvik Ghosh

Engineering College/Institution: Indian Institute of Science, Bangalore

Title of Thesis: Optical and opto-thermal route towards dynamic nanomanipulation in fluids

Summary of Thesis: The thesis proposes and demonstrates a new paradigm in the field of colloidal nanomanipulation. The aim was to build a new generation of realistic nanomachinery capable of selective action and locomotion, which has so far held back development of anything that can move on both surfaces and solutions at ambient conditions. Previous techniques for optical nano-manipulation were either slow (based on plasmonic tweezers) or could not be applicable for small particles (based on micromachines) or required high laser intensity (based on optical tweezers). By combining these independent research fields, for the first time they have demonstrated a dynamic nanomanipulation platform that surpasses their individual limitations. Their innovation establishes a new research direction towards dynamic optical nanomanipulation in three-dimension. This enables fresh opportunities in soft-matter research, which may lead to interesting applications in nanobiotechnology and colloidal-atom paradigm. From being able to carry live bacteria to placing very small objects such as nanoparticles, fluorescent nanodiamonds and quantum dots at specific positions on a lab-on-chip device, their applications could range from biotechnology to quantum technologies, sensor devices and many more.

INNOVATIVE STUDENT PROJECTS AWARD 2020

MASTER'S LEVEL

JOINT AWARDEES

I. Mr Sarosh Alam Ghausi

Engineering College/Institution: Indian Institute of Technology Bombay

Title of Thesis: Sensitivity of Precipitation and Streamflow Extremes to Temperature over Central and South Asia.

Summary of Thesis: Clausius Clapeyron (CC) equation suggests a 6-7% increase in extreme precipitation per degree rise in temperature. This relationship is often referred as extreme precipitation scaling. Scaling rates of extreme precipitation with temperature at different regions significantly deviate from the CC rate. We find that the daily extreme precipitation scaling is negative over sites in the warmer tropical region of South Asia, as opposed to positive scaling over the cooler sub-tropics. Daily precipitation scaling tends to break down and becomes negative above a temperature of 23°-24°C in all the regions. However, such breakdown disappears for sub-daily precipitation extremes and they continue to increase at high temperatures over both tropics and sub-tropics. This leads to high positive streamflow-temperature scaling over small catchments, in contrast to extreme precipitation scaling at a daily scale which is partly negative. The study modified the applicability of CC theory for precipitation extremes at a sub-daily scale and provides an explanation for negative scaling at a daily scale. The analysis also highlights an increased threat due to flash flood in a warmer climate, which cannot be fully estimated with the analysis of daily precipitation extremes.

JOINT AWARDEES

II. Mr. Suman Banerjee

Engineering College/Institution: Indian Institute of Technology Madras

Title of Thesis: Incorporating Domain Knowledge in Multilingual, Goal-Oriented Neural Dialog Models

Summary of Thesis: Goal-oriented conversation systems can assist users in various day-to-day activities. These systems should harness domain specific information, typically stored in a knowledge base(KB). The awardee proposed a Sequential Attention Network (SeAN) which computes attention scores over different segments of a conversation and combines them to feed a better context representation to the decoder. Current state-of-the-art models ignore the rich structure inherent in knowledge graphs and dependency parse trees. The awardee proposed a memory augmented Graph Convolutional Network(GCN) with sequential attention which exploits the knowledge graph and dependency graphs of utterances. Most of the existing datasets for conversation systems focus on monolingual conversations, which do not cater to the multilingual regions of the world, such as India, where it is common for people to speak and switch between multiple languages. To facilitate the development of code-mixed conversation models, they build a goal-oriented dialogue dataset containing code-mixed conversations in Hindi-English, Bengali-English, Gujarati-English and Tamil-English. In the case of code-mixed conversations, dependency parsers may not be available and therefore they used the global word co-occurrence graph to enrich the representations of utterances. Their experiments on the DSTC2 dataset and its code-mixed versions show that our method outperforms existing state-of-the-art methods.

JOINT AWARDEES

I. Mr. Adarsh Somayaji

Engineering College/Institution: Indian Institute of Technology Madras

Title of Thesis: Design & Analysis of a Variable Stiffness Adaptive Jaw for Robust Grasping

Summary of Thesis: Robots utilize graspers to physically interact with an environment. Traditional industrial robotic graspers require precise positioning for grasping objects and are not suited for modern robotic applications. The advent of soft robotics has led to the development of novel materials and technologies aimed at building robots with a higher degree of compliance. Varying stiffness of soft robotic graspers can lead to new modes of grasping that are robust and allow the user to control the force exerted on objects. Soft robotic graspers provide these features through different modalities such as granular jamming, and usage of fluids or shape-memory materials. However, these modalities face issues such as slow response time, requirement of external power packs for operation and low range of stiffness. This work presents a novel method of achieving variable stiffness by utilizing the principle of stability of truss structures. The grasper design is the first of its kind to have the following characteristics:

- Compact design with fine, rapid, and continuous control of stiffness variation by a mechanical input
- Capability of switching between form/force closure grasps
- Low actuation power with no continuous power requirement for maintaining stiffness

Potential applications include end effectors for assistive robots, material handling, fruit picking, and grasping of objects in unstructured environments.

JOINT AWARDEES

II. Ms. Krishna Manoj

Engineering College/Institution: Indian Institute of Technology Madras

Title of Thesis: Emergence of Rich Dynamical Behaviour in Networks of Coupled Candle-Flame Oscillators: Synchronization, Amplitude Death, and Chimeras

Summary of Thesis: Experimental research on studying interactions between flames in combustors is costly, laborious and dangerous. The awardee proposes the novel candle-flame oscillators, an elegant handy system, which can be used to understand the interaction between oscillatory flames. Towards this, the interaction between two candle-flame oscillators is examined from a nonlinear dynamics perspective. Increasing the separation between them, the system transitions from in-phase to anti-phase oscillations via an amplitude death state, where the oscillations are completely suppressed. These results can potentially be extended to quench the oscillations in a combustor by optimally selecting the injector or stabilizer location. The investigation is extended to determine ideal placing and topology for the injectors to reduce flame oscillations. Moreover, Ms Manoj presents the experimental evidence of several theoretically described phenomena, including chimera, clustering, and partial amplitude death, and the existence of several routes to transition from undesirable oscillations to a desired oscillation quenching state. Insights from this investigation can be applied while designing the arrangement of injectors in rocket chambers, annular and gas turbine combustors. Comparison of the experimental results with a generic mathematical model of time-delay coupled Stuart-Landau oscillators showed high similarity between them and can be extended to hazardous interaction of oscillating flames in combustors

JOINT AWARDEES

I. Ms. Smruti Thakur

Engineering College/Institution: Institute of Chemical Technology Mumbai

Title of Thesis: Ultrasound assisted catalytic transfer hydrogenation of corn oil using Pd/C catalyst by formaldehyde reduction method

Summary of Thesis: The work focuses on synthesis of Pd/C catalyst initially based on formaldehyde reduction approach followed by detailed investigation into intensification of CTH using ultrasound. The obtained catalyst was characterized by X-ray diffraction (XRD), BET surface analysis and FT-IR. The subsequent part of the work focused on understanding the effect of different operating parameters in CTH of corn oil to maximize the progress of reaction. Comparison of the obtained results for ultrasound assisted approach with conventional approach also allowed demonstrating the process intensification aspects of applying ultrasound for catalytic transfer hydrogenation of corn oil. The work presented in the thesis conclusively established that drawbacks of conventional hydrogenation process such as longer reaction time, poor conversion and yield of desired products, higher requirement of energy as well as use of higher temperature were eliminated by using ultrasound. The work has demonstrated beneficial results for corn oil as the model vegetable oil and the results can be applied to other vegetable oils and can possibly translated into a technology based on more work in terms of scale up.

JOINT AWARDEES

II. Mr. Pravin Kumar

Engineering College/Institution: Indian Institute of Space Science and Technology Thiruvananthapuram.

Title of Thesis: Effect of Process Parameters on the Microstructures, Defects, and Mechanical properties in 3D-Printed (SLM/PBF) Inconel 718 alloy.

Summary of Thesis: This research work was carried out to understand the effect of two process parameter : scan speed and laser power on microstructure, defects and microhardness of 3D printed IN 718 alloy components of size (30 X 10 X 10) mm: Melt pool analysis predicted that only cellular columnar grains and dendritic columnar grains growth can occur with slight CET. Grain size measurement according to ASTM E 112-12, predicted that columnar grains become thicker and longer with the increase in volume energy density (VED).Qualitative and quantitative (porosity % and pore density) defect analysis was carried out. This has helped in optimizing the range of process parameters for obtaining defect-free components. The oxides of Cr, Nb, Ti, Al, and Fe were observed near interlayer cracks, large open pores and cluster of pores. These oxides serve as precipitation sites for intermetallics and carbides. Anisotropy in microhardness was observed in the samples even after double ageing heat treatment: variation of MEAN$\pm$40 HV in the XZ-plane and MEAN$\pm$30 HV in XY-plane. Average microhardness on the XZ-plane was 15% to 20% more than that on the XY-plane in each sample. Conclusively, VED in the range of 65 J/mm^3 to 70 J/mm^3 with scan speed and laser power between 860 mm/s to 900 mm/s and 250 W to 300 W respectively, could produce tolerable microscopic defects and least anisotropy in printed components.

JOINT AWARDEES

I. Mr. Malepati Venkata Sai Krishna

Engineering College/Institution: National Institute of Technology Calicut

Title of Thesis: Development of Active Switched Impedance Network Based NON- Isolated DC-DC Converters.

Summary of Thesis: Energy sources such as solar PV, fuel-cell, battery, etc., are promoted throughout the world to reduce environmental impact due to fossil fuel. The DC-DC converter plays a significant role in integrating the aforementioned energy sources. An active switched 2L-C-2D network-based symmetric and asymmetric converter is proposed. The converter utilizes minimum components with two MOSFET switches and has a feature of fault ride through capability when any one switch fails. The structure of an active LC2D network-based multi-stage high gain DC-DC converter is proposed. The performance of the cubic gain converter is verified experimentally using a hardware prototype of 250 W, 50 kHz, 650 V. With the help of the SiC devices, the cubic gain converter achieves the efficiency of 92.5 at 250 W output power. The cubic gain converter has the potential applications in solar photovoltaic, UPS, high-density discharge lamps, X-ray machines, etc. A dual input DC-DC converter with high DC-voltage gain is also proposed in this work. The proposed converter produces the output voltage of 336 V for the input sources of 48 V and 24 V and also achieves 92.2% efficiency at 200 W. To improve the converter performance SiC devices are used in the proposed DC-DC converters.

JOINT AWARDEES

II. Mr. Vinay Chandrasekhar K

Engineering College/Institution: International Institute of Information Technology Bangalore

Title of Thesis: Design, fabrication, and analysis of a portable anthropomimetic upperlimb rehabilitation and exoskeleton system.

Summary of Thesis: The device proposed can be used as a low-cost low-profile solution for a range of applications from rehabilitation to exoskeletal devices. An upper limb anthropomimetic rehabilitation system has been designed where the actuators and the electronics are sited in strategic positions such as the forearm to efficiently utilize the available space with a minimal profile. The developed device has been designed as a portable device and attempts to supplement all known functions of the human arm and hand. A novel 8 channel surface EMG (sEMG) acquisition system is designed and developed to acquire signals for various upper limb movements. sEMG signals characterize different actions performed by the upper limb, which is considered apt for assessing the improvement for post-stroke patients undergoing routine physical therapy activities. The developed sEMG signal acquisition circuit could automatically collect signals over time from an individual that will provide insight into the rehabilitation progress of the individual. Thus, avoiding tedious manual evaluation of the individual and provide personalized exercise and physiotherapy plans. Two sensor and actuator strategies were described: Mirroring and Exoskeletal system. Both have a large spectrum of use cases from rehabilitation exercises to remote surgical assistance.

Ms. Anukiruthika T

Engineering College/Institution: Indian Institute of Food Processing Technology (IIFPT), Thanjavur

Title of Thesis: Design and Fabrication of Customized Foods Using 3D Printing

Summary of Thesis: With immense potential 3D printing is all set to revolutionize food manufacturing processes, and this is the first full-fledged research work of food 3D printing in the country. As a part of this work, a 3D extrusion-based food printer CARK (controlled additive-manufacturing robotic kit) was designed and developed. Egg was 3D printed using the CARK and the findings of this study have been reported as India's first scientific publication on 3D food printing (in the Journal of Food Engineering), emphasizing the delivery of customized and personalized foods through 3D printing. For this purpose, both egg yolk and egg white fractions were separated and made printable using appropriate pre-processing of their conductive-hydro dried powders. The task was to evaluate the rheological characteristics and link them with the printability of these intricate food matrices. The post-printing characteristics and process conditions were also optimized, considering consumer preferences. Following this, several other food matrices were printed; these include 3D printed snacks from fiber-rich indigenous composite flour, 3D printed mushroom-based snack and 3D printed food packaging casings from agro-processing wastes. On the overall, the technology offers scope for mass customization of foods, allowing enhanced nutrient customization as well as improved consumer acceptability. This research work was funded by the Ministry of Food Processing Industries, Government of India.

INNOVATIVE STUDENT PROJECTS AWARD 2020

BACHELOR'S LEVEL

Mr Rishav Dutta

Engineering College/Institution: Indian Institute of Engineering Science and Technology (IIEST), Shibpur.

Title of the Project: Prediction of Stochastic Non-Stationary Downbursts and Hurricane Wind Field

Summary of project: This project work involves developing of a computationally efficient wind field model for effective use by Indian Civil Engineering industry to check safety of structure under frequently occurring storms like Am-Phan, Fani, etc. Since, such storms are associated with extreme randomness and nonstationarity, present IS code or conventional frequency domain analysis cannot be applied. Most available wind generation models are semi-empirical in nature, and depends on the statistical parameters of the particular wind climate under which it has been developed. Hence, to build 'Atmanirvar Bharat', it is essential to develop such an indigenous model, which was the prime goal of this study. The developed model is applicable to any structure, any wind climate, and any wind direction with least possible input parameters. The results are in excellent agreement with observed data during actual storms, like RFD, Derecho, Fani, Amphan, Bulbul, etc. In this way, the developed model surpasses the existing numerical experimental wind generation models. In this work, with the help of various existing models, a stochastic nonstationary wind field model has been proposed. The proposed model does not require empirical data, and applicable for both foreign and Indian wind climates. The model prediction agreements well with Indian and foreign storms, like Derecho, Amphan

Ms Gayathri Girish

Engineering College/Institution: Indian Institute of Space Science and Technology, Thiruvananthapuram

Title of the Project: Utilizing Energy Function and Variational Inference Training for Designing a Novel Graph Neural Network Architecture.

Summary of project: In this work, the awardee has proposed an innovative inference algorithm to approximate the posterior of unknown variables in relational data. Conventional methods use iterative algorithms for approximating this posterior density. However, as iterative methods have many disadvantages like overfitting and instability, the goal is to propose a variational method that can be optimized with minimum hassle. By integrating probability theorems with established machine learning models, an algorithm is proposed which is simple and flexible enough to be optimized without any iterative convergence. In the project, the distribution is used for semi-supervised node classification in graphical data. The model comprises of 3 novel building blocks, which represent the node features, its neighbourhood information and the energy of each node. As the model is very representative of all information present in the dataset, fast and efficient convergence is achieved. To optimize the performance, energy-based inference is conducted by integrating a graph convolutional network (GCN) aided with novel energy functions. With intuitive reasoning, the awardee was able to incorporate the Coulomb's energy and Pott's energy functions inspired from theoretical physics to successfully capture the dependency relations. The algorithm could classify all nodes with 90% accuracy in 0.1 seconds. The model exhibits far superior results than other baseline models and can be set as a benchmark for further innovative research.

JOINT AWARDEES

I. Mr Rayudu Rahul

Engineering College/Institution: National Institute of Technology Raipur

Title of the Project: Internal Linear Mechanism Device for Vertical Transport Distraction Osteogenesis of Maxillo Mandibular Reconstruction

Summary of project: Mechanism and device developed for the procedure of internal linear distraction osteogenesis mainly consists of converting rotary motion into linear motion. The device is for internal linear distraction of maxillo mandible. The entire device is embedded into the mandible except the upper rotary part which is operated manually for the distraction procedure. Anti-clockwise rotation of rotary part provides the linear transition. The basic procedure of distraction osteogenesis is to distract the movable mandible in respective direction as 1mm/day. The device also supports other dental operations required after the distraction osteogenesis procedure like dental implantation for teeth rehabilitation. The device is combination of both procedures i.e., distraction osteogenesis and dental implantation. The device provides the required distraction i.e., bone tissue formation of about 3-4mm. The material for the device is stainless steel or titanium which are bio-compatible material and can be bound into the body tissues. The device eliminates surgery required for the removal of device after distraction osteogenesis. Simple design and working mechanism achieve the required height of mandible i.e., jaw. The device reduces the cost by around 75%.

JOINT AWARDEES

II. Mr. Aakash

Engineering College/Institution: Indian Institute of Technology Tirupati

Title of the Project: An Analytic study of the Wiedemann-Franz Law and the thermoelectric figure of merit.

Summary of project: The project deals with the optimization of thermoelectric material efficiency. The work provides corrections to the Wiedemann–Franz (WF) law based on the widely-used Fermi–Dirac integrals describing the thermoelectric properties of semiconducting materials and demonstrate how the corrections vary with the scattering parameter r and the reduced chemical potential μ*. The calculation of Fermi–Dirac integrals has enabled Wiedemann–Franz law (WF) generalization to augment the thermoelectric figure of merit. This project involved the development and use of innovative mathematical applications for the analysis of thermoelectric materials. Generalized Lambert W functions (offset log) have been used for optimizing the thermal and electric conductivity for thermoelectric materials. The solutions obtained by extremizing the thermal and electronic conductivity will aid experimental research and thus enable the search for new and efficient thermoelectric materials. Furthermore, conditions for minimum lattice thermal conductivity were also developed.

Mr Alok Kumar Pandey

Engineering College/Institution: Indian Institute of Technology Hyderabad

Title of the Project: Pencil Lead based Graphite-Silica Composite Anodes for Practical Lithium-ion Batteries

Summary of project: The researchers introduce two novel and facile anode fabrication methods using pencil lead for high-performance Li-ion batteries. Pencil lead as a composite of graphite-silica combines the advantages of graphite (better capacity retention) and silica (high specific capacity). In addition to the intercalation/de-intercalation mechanism for Li storage, these anodes utilize alloying/de-alloying mechanism as well. This mechanism dramatically increases the Li storage capacity of the electrode. In the graphite-silica composite anodes, graphite not only buffers the large volume changes of the Si during alloying/de-alloying but also provides efficient pathways for the electron migration. This improves the structural stability and electronic conductivity of the electrode. To check the practical applicability of the inexpensive electrode, coin cell batteries are developed based on the pencil lead (graphite- silica composites) as anode with three different commercial cathodes. These full cells electrochemically perform better than commercial anodes and certainly have the potential for their commercialization when scaled up.




Mr A Sai Darahas Mr R Raghavendra Ms K. Vineetha Mr Y. Nanda Kishore

Engineering College/Institution: National Institute of Technology (NIT) Andhra Pradesh

Title of the Project: 3D Multispectral Brain Tumor Segmentation Using Deep Neural Networks

Summary of project: The project presents a framework combining image analysis, deep learning, and statistics for segmenting the 3D-MRI images with low compute complexity in comparison to contemporary deep learning-based algorithms. Initially, a domain-specific pre-processing was employed to separate input volumes into small blocks so the trained deep learning model is translationally independent with reduced compute complexity. The model is a variant of encode-decoder architecture that emulates compact knowledge representation. The features constructed at each layer were standardized through batch normalization that ensured consistent dynamic ranges across layers and features scales. Consequently, the model was made robust to class imbalance using the training dataset by employing a hybrid loss function. The resultant model was trained patch-wise and evaluated against various state-of-the algorithms like SegNet, on benchmark dataset, BraTS-2018, that demonstrated improved performance. In addition, the compute complexity of the proposed framework was reduced in multiple folds using separable convolutions to facilitate the model deployment on edge devices instead of a cloud. The proposed model can support the experts by prioritizing the subjects to be screened. Additionally, the model can be deployed in remote areas where the computational resources and connectivity are limited.

Mr British Sontakke

Engineering College/Institution: Indian Institute of Space Science and Technology, Thiruvananthapuram

Title of the Project: Magnetic Transduction Schemes and Electronics for Angular Position Sensing of Through-Shafts over Full Circle Range

Summary of project: The project focused on the design and realization of a novel, digital, linear electronic system for measurement of through-shaft angle over full-circle range. The proposed system consists of two broad parts: a magnetic sensor module (SM) and an electronic processor. The magnetic-reluctance concept is intelligently exploited in the SM to obtain a unique magnetic-field distribution with-respect-to through-shaft angle. Magnetic sensors, placed quadrature angular spacing apart, in the SM provide easy-to-process electronic signals for further processing. The design also provides adequate magnetic shielding and minimal mechanical/frictional loading. An electronics-design, implementing new linearization functions, is proposed to process the SM outputs, through a combination of filter, digitizer and a linearizer stage to achieve full-circle operating range. This electronic processor selects and works on the optimal sensitivity regions of sensor outputs, avoids error-prone regimes, and thereby ensures good accuracy. Other salient features of the system are: Compact, simple and easy to assemble mechanical structure; Non-contact Sensing strategy with low number of magnetic sensors and thus, reduced electrical connections at congested locations; Capability to eliminate the effect of magnet's strength; Simple, but efficient, electronics which can be easily miniaturized and Reliable in harsh conditions like dust, dirt, vibration, etc.

Mr. Allam Varshith Reddy

Engineering College/Institution: Indian Institute of Space Science and Technology, Thiruvananthapuram

Title of the Project: Iterative Patched Conic Technique for Lunar Transfer Trajectories.

Summary of project: An iterative patched conic technique has been developed for lunar transfer trajectories. In the design process, apart from Earth and Moon, the perturbation due to second zonal harmonic term of oblateness of Earth is also accounted for. The patch point at the sphere of influence of the Moon is iterated upon and the improved solution is obtained. An analytical tuning strategy is used to achieve the selenocentric velocity at the patch point on the sphere of influence of Moon. Numerical propagation results show that the analytical design thus generated is a good substitute for the numerical strategy of obtaining the transfer trajectory results. The proposed technique, unlike the conventional patched conic technique, captures all the four design options for a given departure epoch and flight duration and ensures arrival orbit inclination. These four design options are crucial in the planning stage to choose an appropriate launch mission. Two sets of solutions were observed with minor differences in the right ascension of ascending node and argument of perigee of departure transfer orbit characteristics. Even though these differences are small, they result in completely different arrival scenarios. The Iterative Patched Conic Method is suitable for design analysis since it gives quick and accurate solutions for all possible design options. The proposed method provides additional information on arrival angles such as RAAN and AoP, in addition to providing a good initial guess, which are required to generate distinct numerical designs. The approach suggested conserves the simplicity of the patched conic approach involving only two-body models, recognizing the four distinct design options available for a fixed opportunity.

Mr Arvind Pujari

Engineering College/Institution: Indian Institute of Technology Madras

Title of the Project: Al-based Plasmonic Nanoparticles as an Alternative to Noble Metal Plasmonics

Summary of project: Plasmonic nanoparticles (especially Au, Ag and Al) are used for many applications, including light-trapping in thin-film solar cells. However, Au and Ag are expensive, while Al corrodes easily. The project offers two alternatives. The first, is alloying Al with other metals: especially other earth-abundant plasmonic metals. Using a combination of Transfer Matrix Modelling and Effective Medium Theory, they developed a simple numerical solution to this problem, side-stepping the need for computationally intensive software such as COMSOL. Al-In and Al-Mg alloy nanoparticles can increase the absorption of light by silicon by up to 18%. “Maps” are provided to predict the plasmonic behaviour for Al alloys as a function of their composition and radius, which will be useful for industrial design.The second is coating Al with a thin shell of another metal. New reports on the stabilization of Al(0) by coating it with a Cu shell have created an opportunity for corrosion-resistant aluminum plasmonics, and we study this system for the first time. “Design Equations” are obtained for the peak scattering and absorption wavelength of Al-Cu core-shell nanoparticles. These can be used to position the peak at a desired wavelength to capture the desired part of the solar spectrum, enabling materials design.

Ms Siri Gadipudi

Engineering College/Institution: Indian Institute of Space Science and Technology Thiruvananthapuram

Title of the Project: Grid Connected Open-end Winding Induction Generator System with Series Reactive Power Compensation for Wind Energy Systems

Summary of project: A new series reactive power compensated induction generator system with open-end stator windings for wind energy system that can deliver active power to the grid without drawing reactive power from the grid is proposed in this project. Unlike the existing shunt compensated schemes for grid connected induction generator systems, this scheme does not require an interfacing inductor for connecting to the grid thereby reducing the hardware footprint and cost of the system. A current oriented rotating reference frame based control scheme is developed to control the operation of the induction generator and the series reactive power compensator. Such wind energy systems will not draw reactive power from the grid thereby facilitating improvement of the utilization of the energy input from mechanical prime mover in the generating stations. The proposed scheme was first validated through simulation using PLECS software. A hardware prototype comprising of an induction machine with open-end stator winding and IGBT based inverter was then built in the laboratory for experimental verification. TMS320F28335 digital signal processor was used for implementation of the control algorithm. The experimental results demonstrated that the proposed wind power generating system is capable of supplying active power to the grid without drawing reactive power from it. The prototype of the system can be developed further as a commercial product for wind energy system, especially for using in rural areas.

JOINT AWARDEES

I. Mr Amogh B S

Engineering College/Institution: Birla Institute of Technology and Science, Pilani

Title of the Project: Black Phosphorous based sensors for healthcare applications

Summary of project: This project demonstrates the fabrication and performance of novel biosensors. One is a transient, stable breath sensor based on Black Phosphorus Quantum Dots (BPQDs) and Polyvinyl Alcohol (PVA) composite while other was the growth of Black Phosphorus (BP) on paper and its subsequent passivation using Polydimethylsiloxane (PDMS) for its use as a strain sensor**.** The novel fabrication processes overcome the oxidation of Black phosphorous upon exposure to ambient conditions. Simple sonochemistry was utilized to obtain BP from Red Phosphorus, which was then grown on cellulose paper using solvothermal method. The BP-on-paper substrate displayed piezoresistivity and finds applications in human motion monitoring. Encapsulation of the substrate in PDMS plays a dual role of preventing oxidation of BP as well as aiding to the flexibility of the device in strain sensing. The breath sensor displays high sensitivity to human breaths and can discern our breathing patterns based on the intensity and water content in our breath. The placement of contacts within the sensor plays a crucial role in measuring device performance and eliminating the noise component of degradation effects. The successful fabrication of BP nanostructures and their demonstration as flexible and biodegradable sensors opens up new avenues of research in optoelectronics, healthcare, security etc.

JOINT AWARDEES

II. Mr. Khushank Singhal

Mr. Sumakesh Mishra

Engineering College/Institution: Indian Institute of Technology Delhi

Title of the Project: Development of Fast and Efficient Air Purification System

Summary of project: This project explores factors for making air purifiers efficient and introduces novel methods to achieve the same. Specifically, this invention introduces novel filter media, air controller circuitry, and efficient housing. The filter media is optimized structurally to impart high CADR using inexpensive needle-bonding technology. The controller circuitry utilizes an air-velocity sensor, microcontroller, and power regulator module to make the purifier intelligent. This controller maintains a constant CADR by changing the fan RPM, preventing the cleaning rate from declining over time. The housing was designed using fluid-flow simulations to impart 1.4 times more pressure across the filter with the same fan and power supply. The system was five times more efficient in converting electricity to airpower (all comparisons were made with commercially available reference air purifier). The product is minimalistic, which has been achieved using scientific theories of air filtration and fluid dynamics. It is also incorporated with Bluetooth enabled communication via a mobile application, which allows for control of the purifier remotely. The system successfully achieved filtration performance concerning PM2.5 to levels equivalent to HEPA by utilizing a seemingly inferior filter media. Furthermore, the novel purifier's capital expenditure and operational cost are lower by 70% compared to commercial substitutes.

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