NEWSLETTER

NDE VARTIKA

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APRIL - JUNE

CELEBRATING 25 YEARS OF EXCELLENCE AT CNDE

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Celebrating 25 Years of Excellence: Reflections and Vision for CNDE's Future

The Centre of Non-Destructive Evaluation (CNDE), Indian Institute of Technology Madras, proudly celebrated its Silver Jubilee, commemorating 25 years of excellence, innovation, and transformative contributions to the field of Non-Destructive Evaluation (NDE). This remarkable milestone reflects CNDE's journey of advancing cutting-edge research, enabling impactful industrial solutions, and building a strong ecosystem that connects academia, industry, and society.

As part of the Silver Jubilee celebrations, CNDE released its Annual Report, highlighting the Centre's achievements, research advancements, technology developments, industry collaborations, and contributions to the global NDE community over the past year. The report showcases CNDE's multidisciplinary research initiatives, innovation-driven solutions, technology transfer activities, and continued efforts toward addressing critical challenges in infrastructure safety, reliability, and sustainability.

The Silver Jubilee celebration also featured inspiring messages from distinguished leaders who recognized CNDE's significant contributions to research excellence, technology development, and the global advancement of the NDE community. Dr. Shivkumar Kalyanaraman, CEO of the Anusandhan National Research Foundation, highlighted CNDE's exceptional ability to translate cutting-edge research into meaningful real-world impact. He acknowledged CNDE's contributions through technology transfer, startup -

creation, industry collaborations, and solutions for strategic sectors, emphasizing the importance of achieving “impact beyond publications.” He recognized CNDE as a benchmark for innovation-driven research in India, demonstrating how academic excellence can be transformed into technologies that address critical national and industrial challenges.

Dr. Sajeesh Kumar Babu, Chairman of the International Committee for Non-Destructive Testing, conveyed his appreciation and best wishes on this significant occasion, recognizing CNDE’s role as a global contributor to the advancement of Non-Destructive Testing and Evaluation. He highlighted CNDE’s pioneering research contributions in emerging areas, including AI-driven NDT, advanced sensing technologies, robotics, and intelligent inspection systems, which are shaping the future of inspection and monitoring technologies. He also acknowledged CNDE’s commitment to nurturing the next generation of researchers, engineers, and innovators while strengthening international collaborations and knowledge exchange across the global NDE community.

The messages from these eminent leaders, along with the release of the Annual Report, reaffirm CNDE’s continued impact in advancing smart infrastructure solutions, emerging inspection technologies, and innovation-led research. Over the past 25 years, CNDE has established itself as a leading hub for interdisciplinary research, industry engagement, and technology innovation, contributing to enhanced safety, reliability, and sustainability across critical sectors.

As CNDE enters the next phase of its journey, it remains committed to pursuing excellence in research, fostering collaborative partnerships, developing future-ready technologies, and creating lasting societal impact through science, innovation, and knowledge sharing. Celebrating 25 years of achievements, CNDE looks forward to continuing its mission of shaping the future of Non-Destructive Evaluation in India and across the world.

Strengthening CNDE

CNDE Welcomes Govind Walavalkar to Strengthen Industry Engagement and Outreach Initiatives

The Centre for Non-Destructive Evaluation (CNDE), India, is pleased to welcome Govind Walavalkar to its team as part of its continued efforts to strengthen industry engagement, outreach activities, and ecosystem development. Govind will play a key role in enhancing CNDE's visibility and expanding its connections with industry partners, technology stakeholders, and the growing startup ecosystem. His responsibilities will include driving business development initiatives, strengthening digital communication strategies, promoting CNDE's research activities, and supporting the organization of events and platforms that encourage collaboration, knowledge exchange, and industry participation. With a strong professional background at OnestopNDT, Govind has made valuable contributions to the Non-Destructive Testing (NDT) community through his involvement in industry outreach, technology promotion, and ecosystem building. His experience, extensive professional network, and understanding of the NDT landscape will further support CNDE's mission of advancing inspection technologies and creating stronger connections between research, industry, and innovation. This new association marks an important step in CNDE's journey toward expanding its engagement with stakeholders and creating new opportunities for collaboration. Govind's expertise will contribute to strengthening partnerships, increasing awareness of CNDE initiatives, and accelerating the adoption of advanced NDT solutions across industries.

CNDE warmly welcomes Govind Walavalkar to the CNDE family and looks forward to his valuable contributions in supporting organizational growth, fostering meaningful collaborations, and advancing the future of Non-Destructive Evaluation.

HMEL Joins NCNDE as Platinum Member, Strengthening the NDE Industry Ecosystem

The National Consortium for Non-Destructive Evaluation (NCNDE) is delighted to welcome HPCL Mittal Energy Limited (HMEL) into the NCNDE family as a Platinum Member. HMEL's commitment to operational excellence, technological advancement, and innovation aligns strongly with NCNDE's vision of building a robust and collaborative Non-Destructive Evaluation(NDE). ecosystem in India. This association represents an important milestone in strengthening the partnership between leading industries and the NDE community, fostering opportunities for knowledge sharing, research Collaboration, and technology-driven solutions. As a leading organization in the energy sector, HMEL's focus on reliability, safety, and advanced operational practices complements NCNDE's mission of promoting the adoption of innovative inspection methodologies and enhancing asset integrity management across critical industries. Beyond a membership association, this partnership reflects a shared commitment toward advancing inspection technologies, encouraging industry - academia collaboration, and addressing complex engineering challenges through innovative NDE solutions. The collaboration will provide opportunities to exchange expertise, explore emerging technologies, and contribute to the development of safer, more reliable, and sustainable industrial infrastructure.

NCNDE warmly welcomes HMEL and looks forward to a long and impactful association. Together, we aim to strengthen the NDE ecosystem, accelerate technological advancements, and create meaningful contributions toward the future of industrial inspection and asset reliability.

CNDE Contributes to Indo-German Innovation Dialogue on Future Industrial Technologies

The Centre of Non-destructive Evaluation (CNDE), Indian Institute of Technology Madras, continues to expand its engagement with the global innovation ecosystem by actively connecting research, industry, and academia to address emerging technological challenges. On June 5–6, Prof. Krishnan Balasubramanian, Head of CNDE, participated in the inauguration of the Indo-German Innovation Studio in Coimbatore, a landmark initiative designed to foster collaboration between Indian and German industrial and academic communities. The platform aims to strengthen regional innovation capabilities by enabling knowledge exchange, technology partnerships, and collaborative problem-solving across critical sectors. As part of the event, Prof. Balasubramanian participated in roundtable discussions focused on building innovation ecosystems for the Automotive and Defence sectors. These industries rely heavily on advanced inspection, monitoring, and reliability assessment technologies, where Non-Destructive Evaluation (NDE) plays a vital role in ensuring structural integrity, operational safety, and long-term performance. The discussions emphasized the increasing importance of advanced NDE solutions in supporting India's growing manufacturing and defence capabilities. With the rapid evolution of smart manufacturing, advanced materials, and complex engineering systems, reliable inspection and health monitoring technologies are becoming essential for improving safety, efficiency, and sustainability.

The Indo-German Innovation Studio provided an important forum for experts from academia and industry to exchange perspectives on future challenges, emerging technologies, and collaborative approaches. Discussions highlighted the need for integrated innovation frameworks that combine research expertise, industrial experience, and advanced digital technologies to develop solutions for real-world applications. CNDE's participation in this initiative reflects its continued commitment to advancing research-driven innovation, industry collaboration, and technology translation in the field of Non-Destructive Evaluation.

Unveiling Hidden Corrosion: Advanced NDE Approaches for Process Industries

The Centre of Non-destructive Evaluation (CNDE), Indian Institute of Technology Madras, is pleased to share the successful delivery of an insightful technical webinar by Prof. Krishnan Balasubramanian, Institute Chair Professor, Department of Mechanical Engineering, IIT Madras, organized by the AMPP Chennai Chapter. The webinar, titled "In Search of the Invisible Corrosion: Our Approach for Process Industries," focused on the challenges associated with detecting hidden corrosion and the role of advanced Non-Destructive Evaluation (NDE) and Structural Health Monitoring (SHM) techniques in ensuring the safety, reliability, and longevity of critical industrial assets. During the session, Prof. Balasubramanian highlighted the importance of adopting advanced inspection methodologies for proactive asset integrity management. He discussed emerging technologies such as guided-wave ultrasonics, drone-assisted inspection systems, and in-service structural monitoring solutions that enable effective evaluation of complex industrial components, including pipelines, storage tanks, pressure vessels, and high-temperature systems.

With over four decades of experience in the field of non-destructive evaluation, Prof. Balasubramanian shared valuable insights into the evolution of inspection technologies and their increasing role in preventing unexpected failures, improving operational safety, and enhancing reliability across process industries. The webinar provided an engaging platform for professionals, researchers, and students from the NDT, corrosion, and process industries to understand the latest advancements in corrosion detection, monitoring strategies, and future directions in asset health management.

Industrial Collaboration

CNDE Hosts Epiroc and CAAR Team to Explore Future Technologies in Intelligent Industrial Systems

The Centre of Non-destructive Evaluation (CNDE), Indian Institute of Technology Madras, had the pleasure of welcoming the leadership team from Epiroc along with the team from the Centre of Excellence in Advanced Automotive Research (CAAR), IIT Madras, at the IIT Madras Research Park. The visit provided an opportunity for meaningful technical discussions and knowledge exchange on emerging technologies that are shaping the future of industrial automation, mobility, and intelligent systems. The visiting delegation included Anand Lakshmanan, Venkatraj, and Abhimanyu, along with leadership representatives from Epiroc. The interaction brought together expertise from advanced research, industrial automation, and engineering applications, creating a platform to explore opportunities for future collaboration. The discussions focused on the transformative potential of Software-Defined Vehicles (SDVs), autonomous off-road mobility, artificial intelligence-driven industrial systems, and advanced sensing technologies for mining and remote industrial environments.

The teams explored how the shift from conventional hardware-centric approaches toward software-defined architectures can enable enhanced adaptability, scalability, predictive capabilities, and operational intelligence in complex industrial settings. A key area of discussion was the deployment of intelligent systems in challenging environments where reliable communication, autonomous decision-making, and continuous monitoring are critical. The

teams exchanged insights on overcoming these challenges through the integration of edge intelligence, resilient communication frameworks, advanced sensing technologies, and intelligent inspection solutions. The interaction also highlighted the growing importance of advanced Non-Destructive Evaluation (NDE) technologies in supporting autonomous and smart industrial ecosystems. By combining AI-driven analytics, sensing capabilities, and condition monitoring approaches, next-generation inspection systems can play a crucial role in improving safety, reliability, and efficiency across industrial operations. CNDE sincerely appreciates the visit and the valuable discussions with the Epiroc and CAAR teams. This engagement marks an important step toward exploring collaborative opportunities in autonomous systems, industrial artificial intelligence, advanced NDE technologies, and next-generation intelligent mobility solutions. Through such partnerships, CNDE continues to strengthen its commitment to bridging research and industry, enabling innovation that addresses real-world engineering challenges.

AMRC Research Engineer Visits CNDE, IIT Madras to Explore Collaborative Opportunities in NDE and Advanced Manufacturing

As part of his India visit, a Research Engineer from the University of Sheffield Advanced Manufacturing Research Centre (AMRC) visited the Centre for Non-Destructive Evaluation (CNDE), Indian Institute of Technology Madras, to explore research activities, advanced facilities, and potential opportunities for collaboration in Non-Destructive Evaluation (NDE) and manufacturing technologies. The visit provided an opportunity to interact with faculty members, researchers, and students working in diverse areas of NDE, manufacturing engineering, robotics, and industrial inspection. The guest was introduced to CNDE's wide-ranging research initiatives, including ultrasonic inspection, acoustic metamaterials, robotic inspection systems, large-scale pipeline inspection facilities, railway inspection technologies, and advanced structural health monitoring solutions. The visit highlighted CNDE's strong focus on developing innovative inspection and monitoring technologies to address real-world industrial challenges across critical sectors. The discussions emphasized the importance of collaborative research, knowledge exchange, and technology development in advancing reliable and sustainable engineering solutions. The delegation also visited the Manufacturing Engineering Section at IIT Madras, where ongoing research activities in robotic manufacturing, process improvement, and simulation-driven engineering were showcased. The interactions provided valuable insights into emerging manufacturing technologies and their potential applications in future industrial systems. The visit also included discussions with researchers and students working in related domains, fostering opportunities for future collaboration between IIT Madras and the University of Sheffield AMRC in areas including advanced manufacturing, robotics, inspection technologies, and Non-Destructive Evaluation.

The visit concluded with an appreciation of the vibrant IIT Madras campus and its unique environment, where research excellence, innovation, and nature coexist harmoniously. The interaction marked a meaningful step toward strengthening international collaboration and advancing shared goals in engineering research and industrial innovation.

Visit of Testia Representative to CNDE, IIT Madras

CNDE, IIT Madras, had the privilege of hosting Mr. Nicolas Fournier from Testia, an Airbus Company, during his visit to the Centre. The interaction provided an opportunity to showcase CNDE's advanced research and technological capabilities in the field of Non-Destructive Evaluation (NDE). Discussions focused on emerging trends in NDE, aerospace inspection technologies, potential areas of collaboration, and ongoing initiatives under the National Consortium for Non-Destructive Evaluation (NCNDE). The visit also provided an opportunity to highlight NCNDE's role in fostering industry academia partnerships and advancing innovative NDE solutions for critical industrial applications. The engagement facilitated valuable knowledge exchange between CNDE researchers and a leading global aerospace NDT organization, strengthening connections that may lead to future collaborative opportunities in research, technology development, and skill advancement within the NDE community.

ISNT Industrial Forum - O&G & Chemical Conducts Technical Webinar on NDT-Based Remaining Life Assessment

The ISNT Industrial Forum - Oil & Gas and Chemical successfully organized an online technical webinar on 26 June 2026, featuring an insightful lecture by Dr. Kannan Chandrasekaran on the topic "NDT-based Material Property Evaluation for Remaining Life Assessment." The webinar focused on the application of advanced Non-Destructive Testing (NDT) techniques for evaluating material properties and estimating the remaining service life of critical engineering components. Dr. Chandrasekaran discussed the role of NDT in assessing material degradation, monitoring in-service structural integrity, and supporting predictive maintenance strategies for industrial assets operating under demanding conditions. The session highlighted the integration of material characterization with asset integrity management, emphasizing how reliable NDT measurements contribute to informed maintenance decisions, enhanced operational safety, and optimized lifecycle management. Real-world industrial perspectives and emerging developments in remaining life assessment were also presented, providing participants with valuable technical insights.

The webinar witnessed enthusiastic participation from industry professionals, researchers, academicians, and students, fostering engaging discussions on current challenges and future opportunities in NDT for the oil & gas and chemical sectors. The event served as an excellent platform for knowledge sharing and strengthening collaboration between academia and industry in advancing modern NDT applications.

Showcasing Next-Generation NDE Innovation: CNDE Presents Meta Material-Based Imaging Technology

The Centre of Non-destructive Evaluation (CNDE), Indian Institute of Technology Madras, had the privilege of showcasing its advanced research and technological innovations at a prestigious national platform, highlighting the future potential of Non-Destructive Evaluation (NDE) and electromagnetic imaging technologies. During the event, Hon. Minister of Education Shri Dharmendra Pradhan witnessed CNDE's cutting-edge Meta Material-Based Imaging Technology, an emerging deep-tech innovation that demonstrates the potential of advanced electromagnetic sensing and imaging solutions for industrial and strategic applications. The showcased technology represents CNDE's continued efforts toward developing next-generation inspection methodologies that can address complex engineering challenges. By leveraging the unique capabilities of metamaterials and electromagnetic imaging, such advanced approaches have the potential to enhance detection, characterization, and monitoring of critical components and structures across diverse sectors. The interaction highlighted the growing impact of deep-tech research emerging from CNDE and its commitment to translating scientific discoveries into practical solutions with societal and industrial relevance. The demonstration provided an opportunity to showcase how fundamental research, advanced materials, and innovative engineering approaches can contribute to the development of future-ready technologies.

This milestone marks a proud moment for the entire CNDE team, reflecting its dedication to advancing research excellence, fostering innovation, and strengthening the connection between academia, industry, and national technology missions.

Training Programme

NCNDE Digital Radiography Training Program 2026

The National Consortium for Non-Destructive Evaluation (NCNDE), Centre for Nondestructive Evaluation (CNDE), IIT Madras, successfully conducted a five-day Digital Radiography Training Program from 15-19 June 2026. The program brought together participants from academia, research organizations, and industry to gain practical exposure to advanced digital radiographic inspection technologies. The training combined comprehensive theoretical sessions with extensive hands-on experience on state-of-the-art Digital Radiography (DR) systems. Participants were introduced to the principles of digital imaging, detector technologies, image acquisition, image quality assessment, defect characterization, and industrial applications of digital radiography in non-destructive testing. Expert faculty members and industry professionals delivered technical lectures covering current developments, best practices, standards, and emerging trends in digital radiographic inspection. The practical sessions enabled participants to acquire, process, and interpret digital radiographic images under real-world inspection scenarios. The program also provided a valuable platform for interaction and knowledge exchange among researchers, engineers, NDT practitioners, and industry experts. Through technical discussions and networking opportunities, participants gained insights into contemporary challenges and advancements in digital radiography and its growing role in ensuring structural integrity and quality assurance across industrial sectors.

The successful completion of the training program further strengthened NCNDE's commitment to capacity building and skill development in advanced non-destructive evaluation technologies.

Glimpses of the NCNDE Digital Radiography Training Program (15-19 June 2026)

Awards & Achievements

Prof. Prabhu Rajagopal Elected Fellow of the Indian National Academy of Engineering

A proud moment for the CNDE family — Prof. Prabhu Rajagopal has been inducted as a Fellow of the Indian National Academy of Engineering (INAE), one of the highest honours conferred on engineers in the country, recognising sustained and outstanding contributions to engineering research, practice, and innovation.

He was formally inducted at the INAE Annual Convention 2025, held at the HAL Management Academy (HMA), Bengaluru, on December 20, 2025.

We extend our warm congratulations to Prof. Rajagopal on this well-deserved recognition and wish him continued success in advancing research, innovation, and entrepreneurship.

CNDE Scholar Akhil Balachandran Honored with Ms. Bala Rao Award for Excellence in NDT

The Centre of Non-destructive Evaluation (CNDE), Indian Institute of Technology Madras, is delighted to announce the outstanding achievement of its scholar Akhil Balachandran, who has been awarded the prestigious Ms. Bala Rao Award for Best Academic Student in Postgraduate Studies with an NDT Project. The award, instituted by Late Mr. I. M. Rao, recognizes exceptional academic performance, innovation, and meaningful contributions in the field of Non-Destructive Testing (NDT). This recognition celebrates students who demonstrate excellence in research and showcase the potential to advance the applications of NDT technologies. Akhil's achievement reflects his dedication, research capabilities, and commitment to developing innovative solutions in the field of non-destructive evaluation. His work represents the continuous efforts of young researchers in addressing critical challenges through advanced inspection methodologies and technology-driven approaches. This prestigious recognition also highlights the strong research environment and academic excellence fostered at CNDE, where scholars are encouraged to pursue impactful research, explore emerging technologies, and contribute to the advancement of NDE practices.

The award stands as a testament to Akhil's perseverance and passion for research, inspiring fellow scholars and strengthening CNDE's commitment to nurturing the next generation of NDT professionals and innovators. CNDE congratulates Akhil Balachandran on this well-deserved honor and wishes him continued success in his research journey and future contributions to the field of Non-Destructive Evaluation.

Kaushik V N Selected for Boeing BUILD 5.0

250+	20	3
Applications Received	Teams Selected	Day Intensive Bootcamp

We are proud to share that Kaushik V N, MS Entrepreneurship scholar at CNDE, IIT Madras, was selected and participated in the Boeing BUILD 5.0 Bootcamp, Boeing's prestigious University Innovation Leadership Development Program, hosted at the IITM Incubation Cell. Starting from over 250+ applications nationwide, a rigorous selection process narrowed the field to just 20 promising startups, and Kaushik was among those chosen to take part in the intensive three-day bootcamp. The program will culminate in the Regional Pitch Day on 12 June 2026, where participants will present to Boeing India leadership and industry experts. This is a proud moment for CNDE and a testament to the entrepreneurial spirit that our research community fosters.

About Boeing BUILD 5.0

- Boeing's flagship India startup accelerator program
- Partners with IITM Incubation Cell & 6 other IIT incubators
- Open to early-stage founders across Tier 1, 2 & 3 cities
- Sectors: Aerospace, Deep Tech, Sustainability, Social Impact

Startup Corner

CNDE-Associated Deep-Tech Startups Selected for Bharat Innovates 2026, France

A remarkable achievement for the Centre for Nondestructive Evaluation (CNDE), IIT Madras, as several deep-tech startups closely associated with the laboratory and nurtured through the research ecosystem established by Prof. Krishnan Balasubramanian and Prof. Prabhu Rajagopal have been selected to represent India at Bharat Innovates 2026, held in Nice, France. The event brings together leading innovators, investors, technology partners, and industry leaders from across the world, providing a global platform for showcasing cutting-edge Indian technologies. Among the selected startups are XYMA Analytics, Planys Technologies, Detect Technologies, and Solinas Integrity, each addressing critical industrial and infrastructure challenges through advanced sensing, robotics, artificial intelligence, and digital technologies. These companies exemplify the successful translation of research and innovation emerging from the IIT Madras ecosystem into globally relevant technological solutions.

XYMA Analytics, co-founded by IIT Madras alumni and faculty members including Prof. Krishnan Balasubramanian and Prof. Prabhu Rajagopal, has developed patented ultrasonic sensing technologies for real-time monitoring of corrosion, erosion, scaling, and process parameters in harsh industrial environments. Its solutions are deployed across multiple industries worldwide, improving asset reliability and operational efficiency.

Planys Technologies, founded by IIT Madras alumni with guidance from Prof. Prabhu Rajagopal and Prof. Krishnan Balasubramanian, has pioneered robotic and AI-enabled underwater inspection systems for critical infrastructure. Its remotely operated vehicles and inspection platforms serve ports, bridges, power plants, offshore energy facilities, and defence applications across several countries.

Detect Technologies, an IIT Madras-incubated startup founded by IIT alumni, has emerged as a global leader in industrial AI and IoT solutions. Its technologies for workplace safety, asset monitoring, and operational intelligence are deployed across asset-intensive industries worldwide, delivering significant improvements in safety and productivity.

Solinas Integrity, founded by IIT Madras alumni, has developed robotic inspection systems and AI-powered analytics platforms for underground water and sewer infrastructure. Through innovative solutions such as Endobot and Swasth AI, the company assists utilities in defect detection, asset digitisation, water-loss reduction, and infrastructure management, positively impacting communities across the country.

The selection of these startups for Bharat Innovates 2026 highlights the strength of the innovation and entrepreneurship ecosystem fostered at CNDE, IIT Madras. It reflects the laboratory's long-standing commitment to advancing non-destructive evaluation, sensing technologies, robotics, artificial intelligence, and infrastructure monitoring while translating research outcomes into globally competitive technologies. Their participation on the international stage serves as a testament to the impact of CNDE-led research and the vision of Prof. Krishnan Balasubramanian and Prof. Prabhu Rajagopal in nurturing leading deep-tech ventures. addressing critical societal and industrial challenges.

Shaping the Future of NDE: Connecting Skills, Trust, and Technology

The future of Non-Destructive Evaluation (NDE) will be driven by the successful integration of skills, trust, and technology, creating a more connected, collaborative, and innovation-focused ecosystem. As the industry continues to evolve with rapid advancements in digital technologies, the need to bridge the gap between people, processes, and emerging solutions has become increasingly important. We are pleased to share that an insightful article exploring this vision has been featured in the ASNT (The American Society for Nondestructive Testing) Materials Evaluation (ME) edition. The article highlights the changing landscape of NDE and discusses the importance of developing a connected ecosystem where expertise, technology, and industry requirements converge to enable sustainable growth and transformation. The article emphasizes that technological advancement alone cannot drive meaningful change; successful digital transformation in NDE requires skilled professionals, effective collaboration, and trust among stakeholders. By integrating human expertise with advanced digital solutions, the industry can overcome fragmentation and create more efficient, reliable, and intelligent inspection frameworks. This initiative was inspired by Ripi Singh, Digital Adoption Coach, and smoothly facilitated by Jill Ross, CAE, AAiP, whose valuable perspectives contributed to shaping discussions around digital adoption and the future direction of NDE. Through TIQWorld Pvt. Ltd., this vision continues to evolve by placing people at the center of innovation. The objective is to connect different layers of the NDE ecosystem professionals, organizations, technologies, and knowledge platforms to create a unified and future-ready environment. By promoting collaboration, enabling digital transformation, and encouraging the adoption of emerging technologies, this contribution represents another step toward strengthening the global NDE community and accelerating the transition toward smarter, more connected inspection solutions. The journey ahead will depend on collective efforts to build an ecosystem where technology empowers people, expertise drives innovation, and collaboration creates lasting impact in the field of Non-Destructive Evaluation.

XYMA Analytics Celebrates 7 Years of Innovation and Technology Impact

XYMA Analytics, a startup emerging from the Centre for Non-Destructive Evaluation (CNDE), Indian Institute of Technology Madras, celebrates seven years of innovation, growth, and impactful contributions in the field of advanced sensing and analytics technologies. What began as a vision to transform research-driven solutions into real-world industrial applications has evolved into a successful journey of technology development, collaboration, and value creation. Over the past seven years, XYMA Analytics has worked towards enabling industries through innovative solutions, combining advanced sensing technologies, data-driven insights, and engineering expertise to address critical challenges. This milestone reflects the collective efforts of the dedicated team, research collaborators, industry partners, and customers who have contributed to the company's growth and success. Each challenge encountered and every achievement gained has strengthened XYMA Analytics' commitment to developing reliable, impactful, and industry-relevant technologies. The journey of XYMA Analytics represents CNDE's continued commitment to fostering innovation, entrepreneurship, and industry engagement by translating advanced research outcomes into practical solutions. The startup's progress demonstrates the potential of academia–industry collaboration in creating technologies that contribute to safer, smarter, and more sustainable engineering systems. As XYMA Analytics enters its next phase of growth, it remains committed to advancing technology development, nurturing talent, strengthening partnerships, and creating lasting impact through innovation.

CNDE congratulates XYMA Analytics on this remarkable seven-year milestone and wishes it continued success in its journey towards technological excellence and global impact.

Invited Talk

From Data to Decisions: Enabling AI-Driven Predictive Maintenance in Oil & Gas

Dr. Gopichand Katragadda

Founder & CEO of Myelin Foundry

The ISNT Industrial Forum - Oil & Gas and Chemical successfully organized an online invited talk on “From Quantitative to Agentic: Predictive Maintenance Using AI on Operational Data in Oil and Gas” on 24th April 2026. The session featured Dr. Gopichand Katragadda, Founder & CEO of Myelin Foundry and former Group Chief Technology Officer of Tata Sons, who shared valuable insights into the evolving role of Artificial Intelligence (AI), multimodal operational data, and edge analytics in transforming asset maintenance strategies for the oil and gas sector. The talk highlighted the transition from traditional reactive maintenance approaches toward advanced predictive and prescriptive maintenance frameworks powered by AI. Dr. Katragadda discussed how intelligent systems can utilize diverse operational data sources to enable early detection of equipment degradation, failure prediction, remaining useful life (RUL) estimation, and enhanced asset health intelligence. The session also explored the emerging concept of agentic AI, where autonomous AI-driven systems can support decision-making, optimize maintenance workflows, and provide actionable insights for complex industrial operations. The integration of AI with real-time monitoring and edge-based analytics was emphasized as a key enabler for improving reliability, safety, and operational efficiency across critical oil and gas assets.

The discussions further focused on the importance of collaborative AI ecosystems that bring together industry expertise, operational knowledge, and advanced digital technologies to address challenges in asset integrity management. The insightful session provided valuable perspectives on the future of AI-driven industrial transformation and reinforced the importance of data-driven approaches in building safer, smarter, and more resilient oil and gas operations.

Expert Talk on Physics-Informed Digital Twins for Clean Energy Infrastructure

CNDE, IIT Madras, hosted an expert talk by Dr. Jai Krishna Sahith Sayani, Senior Researcher at the Energy, Water & Sustainable Environment Research Center (EWSERC), American University of Sharjah, UAE, on 26 May 2026 at the NAC-2 Conference Hall. The talk, titled "Physics-Informed Digital Twins for Clean Energy Infrastructure: From Electrolyzers to Pipelines," highlighted the growing role of digital twin technologies in enhancing the reliability, safety, and long-term performance of clean-energy infrastructure. Dr. Sayani discussed how physics-informed models integrated with real-time sensing and state-estimation techniques can support predictive maintenance, fault detection, integrity monitoring, and lifecycle management of critical energy systems. Key highlights included a digital twin framework for Solid Oxide Electrolyzer Cells (SOECs), incorporating physics-based degradation models and Extended Kalman Filter techniques for fault detection and diagnostics. Applications in hydrogen and CO_2 pipeline infrastructure were also presented, including hydrate risk prediction and thermodynamic assessment of hydrogen–methane blends in repurposed natural gas networks.

The talk concluded with a discussion on emerging research opportunities at the intersection of digital twins, non-destructive evaluation (NDE), structural health monitoring, and clean-energy technologies. The session provided valuable insights into the development of intelligent monitoring solutions for next-generation sustainable energy systems and fostered discussions on potential interdisciplinary collaborations.

Research Seminar Spotlight

CNDE RESEARCH GROUP MEETING

“How to Build a Storyline as an Entrepreneur”

Presenter: Mr. Kaushik V N

KEY TAKEWAYS

- **Startups disrupt**
  They don’t just build business - they change industries
- **Lab to Market is a journey**
  validate early, fail fast, iterate relentlessly
- **Know your customer deeply**
  The Royal Enfield way: confidence from understanding
- **Don’t follow the herd**
  Strategic thinking beats reactive discounting
- **Your Story is your weapon**
  Craft it, refine it, live it - stories build empires

The talk concluded with a discussion on emerging research opportunities at the intersection of digital twins, non-destructive evaluation (NDE), structural health monitoring, and clean-energy technologies. The session provided valuable insights into the development of intelligent monitoring solutions for next-generation sustainable energy systems and fostered discussions on potential interdisciplinary collaborations.

Session Highlights

- **Understanding Startups**

  Startups disrupt, not just build. Key traits: scalability, innovation, high-risk, high-reward. Startup vs traditional business: exponential vs linear growth.

- **Lab to Market**

  Validate before you build: TAM→SAM→SOM framework, MVP testing (Dropbox, Airbnb, Zappos models), and navigating the Valley of Death.

- **Customer Understanding**

  42% of startups fail for lack of market need. Deep customer discovery 50+ interviews, behavior mapping, pain-point scoring, and LTV/CAC metrics.

- **Case Study: Royal Enfield**

  BS4→BS6 transition masterclass held brand premium, no discounts, exported to Bangladesh. Lesson: confidence comes from deep customer DNA knowledge.

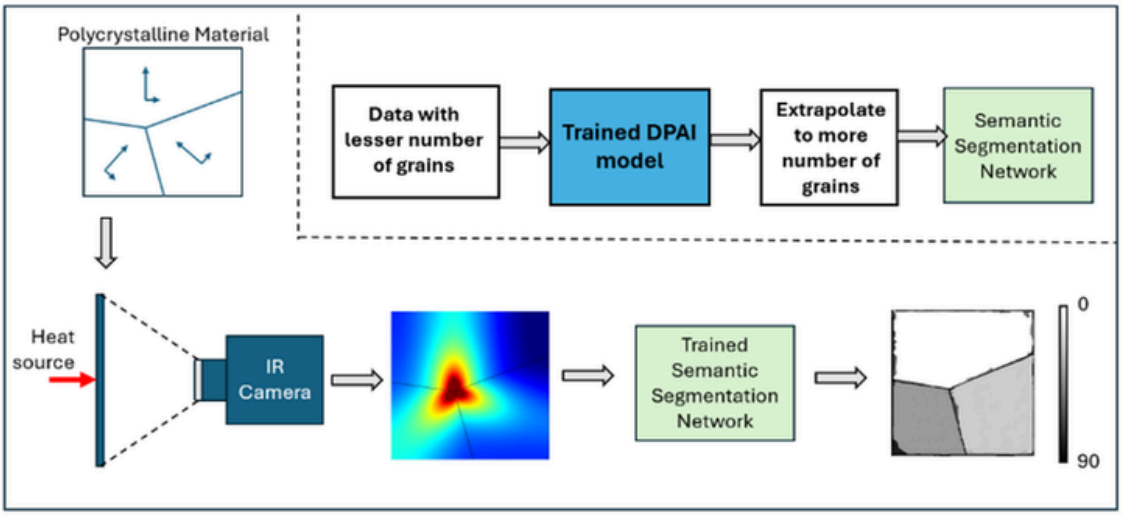
- **Building Your Story**

  Problem → Insight → Solution → Proof → Vision. The 10-slide pitch deck framework and storytelling tools to move investors and customers to action.

Key Takeaways

- Startups change industries not just build businesses
- Validate early, fail fast, iterate relentlessly
- Know your customer deeply the Royal Enfield way
- Your story is your weapon craft it, live it

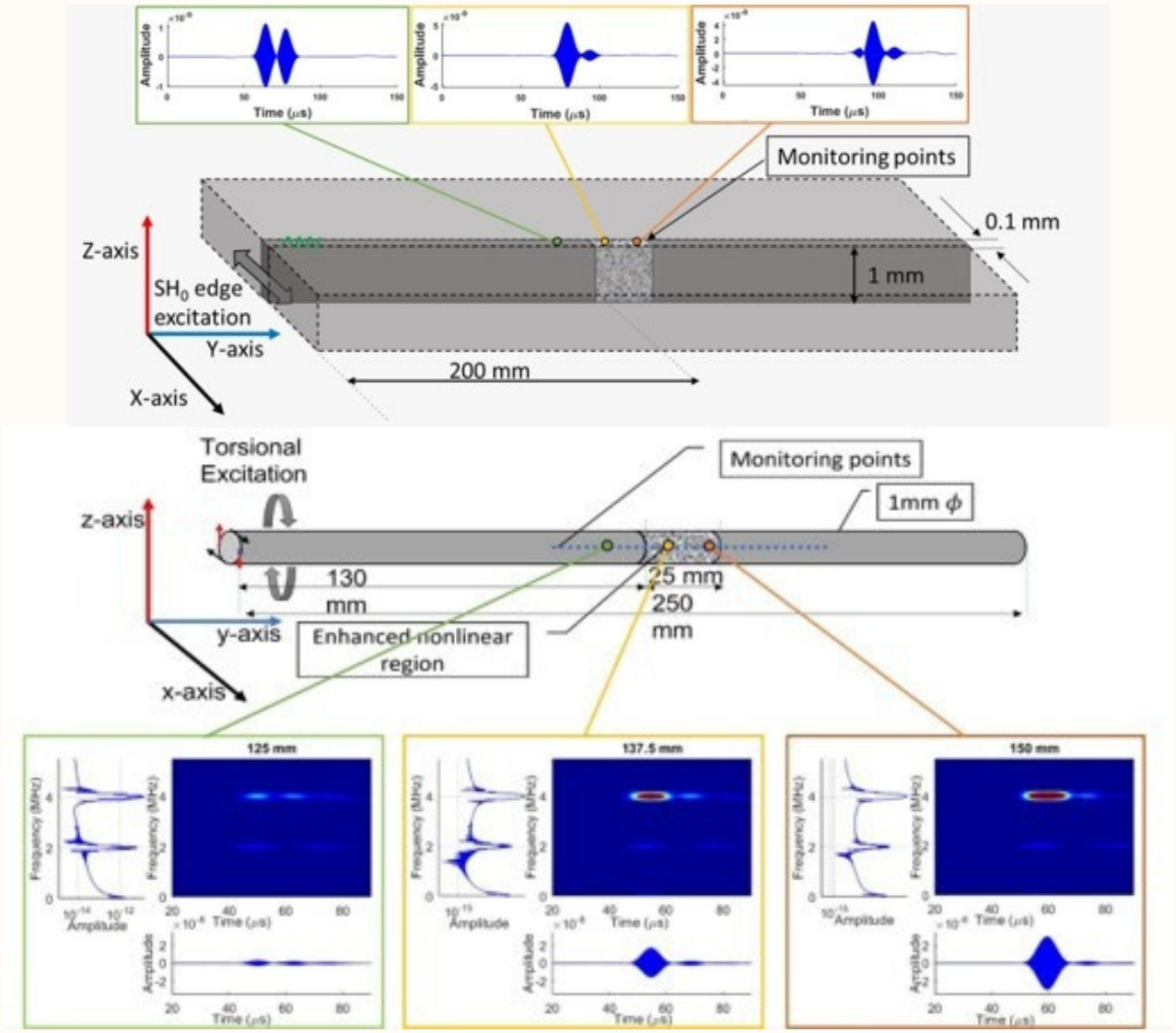
Prediction of Grain Orientation from Thermal Maps Using a Data-Driven and AI Approach



Nishi Bhemani Researcher at CNDE recently delivered a technical seminar titled "Prediction of Grain Orientation from Thermal Maps Using a Data-Driven and AI Approach". Understanding microstructure is essential for predicting the mechanical and thermal properties of materials. This study presents a thermal imaging based approach for microstructure characterization by integrating computational modelling and data-driven learning. Synthetic polycrystalline microstructures containing 10-15 orthotropic grains with varying crystallographic orientations are generated using Voronoi tessellation. Due to the anisotropic nature of the grains, conventional finite element (FE) simulations of heat diffusion are computationally expensive. To overcome this limitation, a Data-driven Physics-Informed Artificial Intelligence (DPAI) framework is developed. The DPAI model employs a four-level encoder-decoder architecture with 256 ConvLSTM cells to learn heat diffusion behaviour from FE-generated thermal data and subsequently generate thermal maps for larger microstructures containing up to 100 grains. Using this approach, a dataset of 1000 thermal images is created. Each grain is assigned an orientation angle between 0° and 90°, and the resulting thermal images are labelled accordingly, leading to segmentation into 90 discrete orientation classes. A segmentation network is trained to predict grain orientations directly from thermal maps. To validate the model experimentally, simplified three-grain anisotropic samples are fabricated using carbon-fibre composite laminates with tailored stacking sequences. The trained model is applied to experimental thermal images and demonstrates reliable grain-orientation prediction.

The results highlight the potential of combining thermal imaging, physics-informed AI, and semantic segmentation for rapid and non-destructive microstructure characterization, significantly reducing computational cost while maintaining predictive accuracy.

When Sound Goes Nonlinear: Detecting the Invisible



The schematics demonstrate the sensitivity of the newly discovered NLU GW mode to localised material degradation on a plate and a cylindrical structure.

Dr Krishnadas V. K, Post-Doctoral Researcher at the Centre for Non-Destructive Evaluation (CNDE), recently delivered a technical seminar titled "When Sound Goes Nonlinear: Detecting the Invisible." The talk explored how Nonlinear Ultrasonics (NLU) can reveal early-stage material degradation that often remains undetected using conventional ultrasonic inspection techniques.

The seminar began with an overview of traditional NDE methods and highlighted the limitations of linear ultrasonic testing in detecting microstructural damage such as incipient cracks, fatigue accumulation, and localised material degradation. Dr Krishnadas demonstrated how nonlinear acoustic phenomena generate higher harmonics and wave-mixing products that act as highly sensitive indicators of early damage.

A significant portion of the presentation focused on the author's research on guided-wave nonlinear ultrasonics, covering both numerical and experimental investigations. Through finite-element simulations incorporating hyperelastic material models, the study demonstrated the generation of higher harmonics, wave-mixing frequencies, and novel guided-wave modes in plates and cylindrical structures. Experimental measurements further validated these nonlinear signatures and their sensitivity to localised material nonlinearity.

Particular emphasis was placed on:

- Higher harmonic generation in guided-wave propagation.
- Nonlinear wave-mixing between Lamb wave modes.
- Discovery of new mode-conversion phenomena in plates and pipes.
- Sensitivity of nonlinear guided waves to localised material degradation.

The seminar concluded by discussing current challenges in nonlinear ultrasonic measurements, including signal-to-noise ratio, repeatability, and calibration requirements, while emphasising the significant potential of NLU for structural health monitoring and early damage detection.

Key Message: "Nonlinearity is not noise-it is information." The work demonstrates how nonlinear guided waves can provide complementary information to conventional ultrasonic testing, enabling earlier and more reliable assessment of structural integrity.

Research Presentation: Linear and Nonlinear Ultrasonic Approaches for Debond Characterisation in FRP-Strengthened Concrete Beams

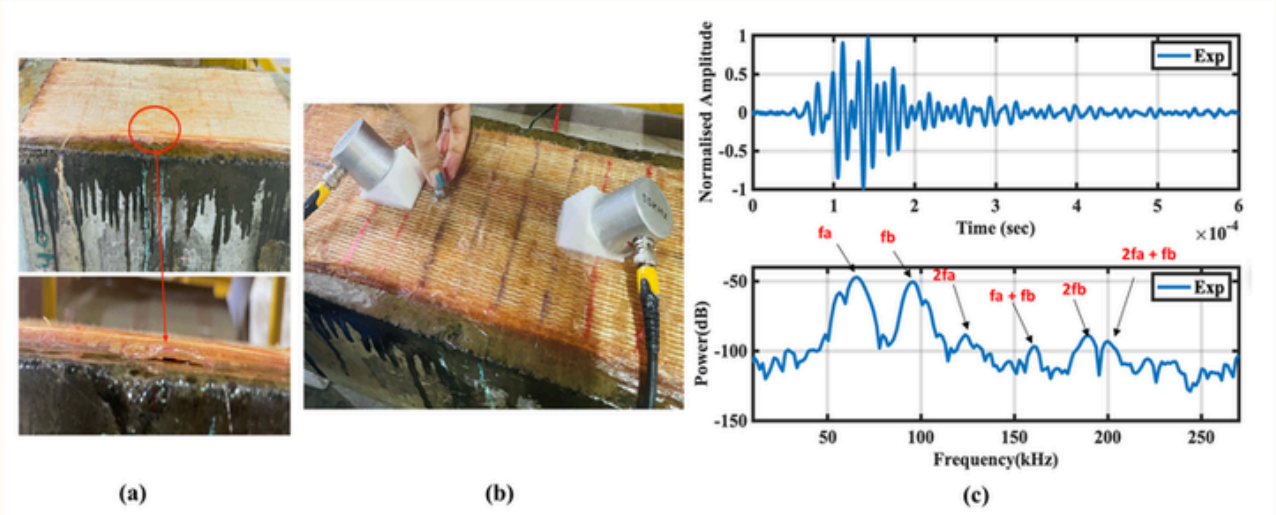


Fig. 2. (a) Debond created due to the removal of mylar sheet immediately after final layer application, (b) Collinear wave mixing setup, (c) Captured signal in time and frequency domain

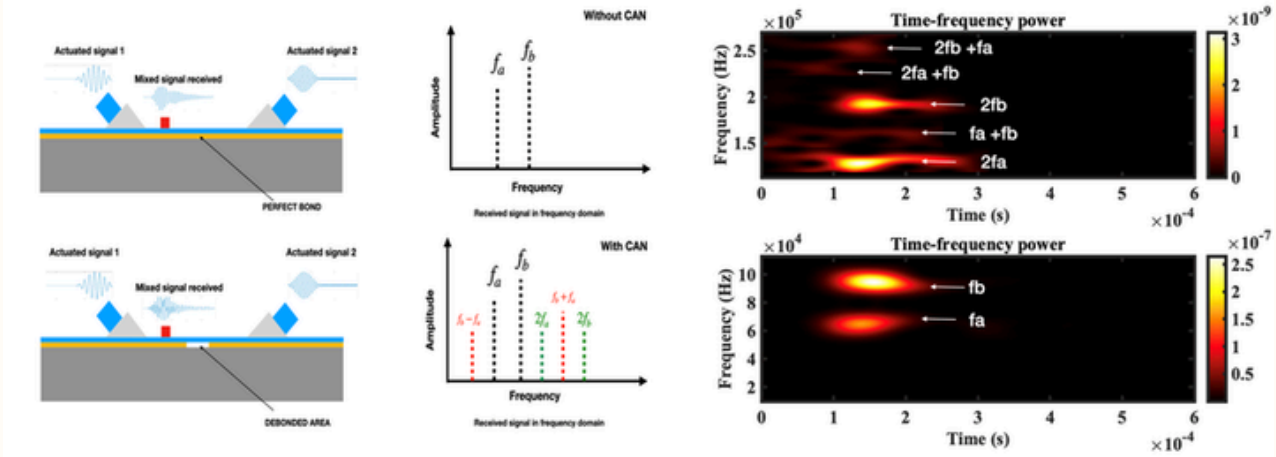


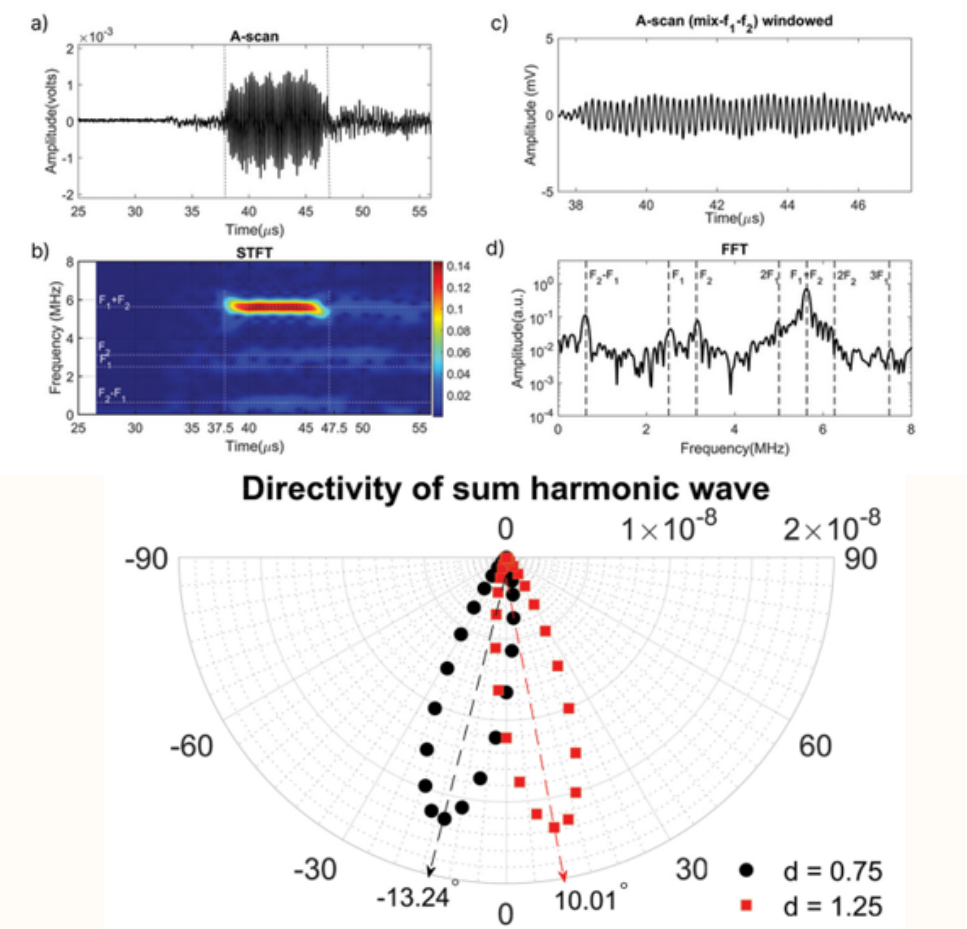
Fig. 1 Schematic diagram showing mixed harmonic generation phenomenon, (b) Experimental data in in time-frequency domain

As part of a recent research group meeting at CNDE, IIT Madras, Dr. Udita Pant presented a segment of her PhD research focused on the use of nonlinear ultrasonic techniques for the assessment of FRP-strengthened concrete structures. The presentation began with an overview of the growing need for strengthening and rehabilitation of aging concrete infrastructure using Fiber Reinforced Polymer (FRP) composites. While FRP strengthening significantly improves structural performance, debonding at the FRP–concrete interface remains one of the most critical failure mechanisms, often initiating internally before visible signs of damage appear. The study explored the use of surface-guided ultrasonic waves generated in FRP-strengthened concrete beams through a Teflon wedge transducer. Unlike conventional linear ultrasonic methods that primarily rely on changes in wave amplitude or velocity, the proposed approach utilizes nonlinear wave interactions that occur in the presence of interfacial defects. Through collinear wave mixing experiments, two

ultrasonic frequencies were simultaneously introduced into the structure, resulting in the generation of higher-order harmonics and mixed-frequency components. Experimental investigations demonstrated that these nonlinear features are highly sensitive to the presence of debonding and can reveal damage at a much earlier stage than traditional linear ultrasonic indicators. The work highlights the potential of nonlinear ultrasonics as an advanced non-destructive evaluation and structural health monitoring tool for strengthened concrete infrastructure. The presentation concluded with discussions on the underlying wave interaction mechanisms, experimental observations, and future opportunities for translating the technique to field-scale inspection of civil engineering structures.

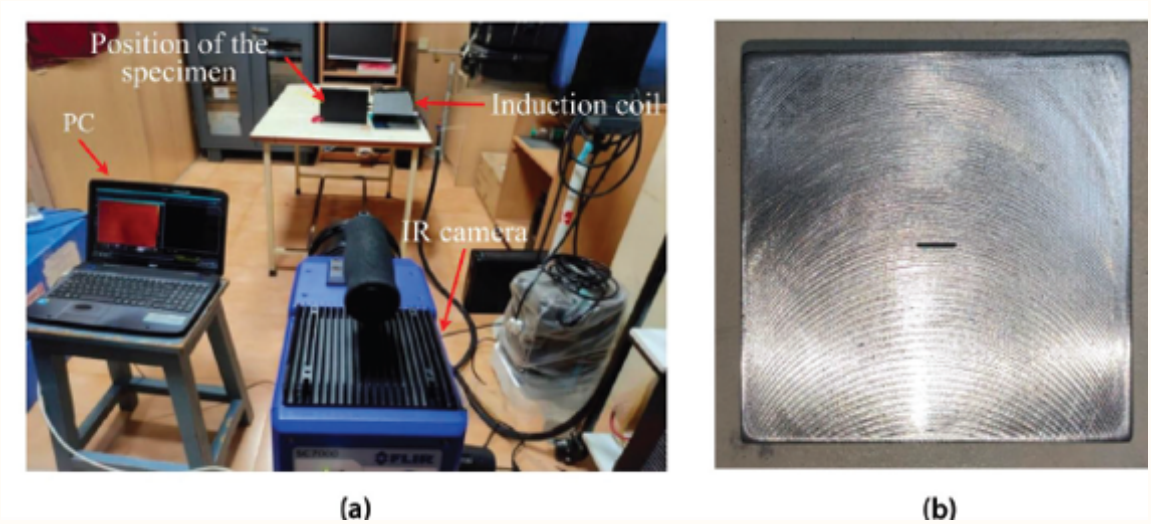
Recent Publications from CNDE

Akhil Balachandran & Krishnan Balasubramanian Published “Immersion-based non-collinear shear wave mixing: effects of experimental assembly on scattering directivity and nonlinear characterisation”

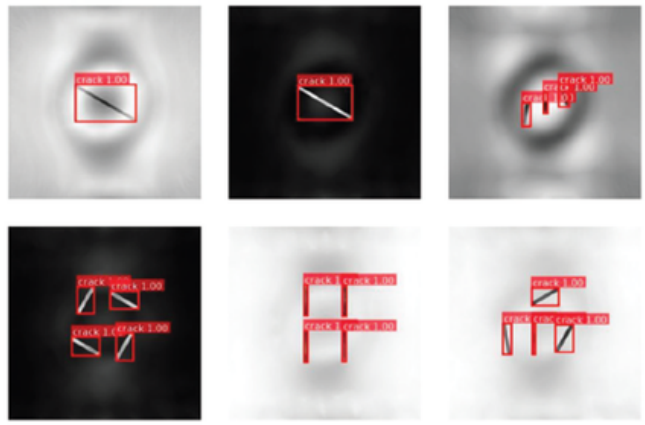


Non-collinear wave mixing has emerged as a powerful technique for characterising material nonlinearity, offering enhanced sensitivity to localised microstructural damage by effectively isolating the mix frequency harmonics. This study develops a numerical model to investigate non-collinear shear wave mixing in near-isotropic materials and validates it through immersion ultrasonic experiments on aluminium and mild steel samples. The primary objective is to quantify the sensitivity of the sum-harmonic wave’s scattering directivity to experimental uncertainties. A systematic sensitivity analysis quantifies the effects of variations in material velocity, transmitter positioning, and transmission angles. Results show that a 1.0% perturbation in the transmission angle induces an 11.7% deviation in the scattering directivity, identifying it as the most influential parameter. This analysis provides a quantitative foundation for designing robust, high-repeatability immersion-based scanning setups.

Krithik Krishna K & Krishnan Balasubramanian published “Automated defect detection by deep learning algorithm from tone burst eddy current thermography data”



(a) experimental set-up for validation of the numerical model; and (b) stainless steel plate with a slot crack



Detection results with the Faster R-CNN network

Quality control is of paramount importance in the modern industrial landscape. Infrared thermography (IRT) is a non-destructive testing (NDT) technique that in recent years has experienced notable advancements and found widespread applications in the domains of defect detection and material characterisation. Tone burst eddy current thermography (TBET) is an active IRT testing procedure that is based on the principle of electromagnetic induction. The method has already proven to be valuable due to its cost-effectiveness, fast inspection rates and non-invasive nature. These features make TBET an ideal tool for in-process evaluation of conductive materials and composites. With the emergence of object detection and segmentation algorithms, deep learning (DL) has been widely applied in the field of IRT. DL-empowered thermography can achieve automated real-time inspection of materials. Such systems align perfectly with the objective of zero-defect manufacturing by enabling active inspection and detection of defects.

However, the lack of sufficient training data is one of the major hurdles to realising an intelligent quality control system. This work presents a methodology for bridging the data gap using synthetic TBET measurements generated from finite element method (FEM)- based simulations. The proposed approach utilises two object localisation deep neural networks: the faster region-based convolutional neural network (Faster R-CNN) with an Inception-v4 backbone and the You Only Look Once version 8 (YOLOv8) network, to enable interpretations from the synthetic thermal data for automated quality management. The results reveal the potential of adopting synthetically generated datasets for pre-training the DL algorithms and, henceforth, the effective deployment of an automated defect detection and quality monitoring system based on TBET.

Krithik Krishna K & Krishnan Balasubramanian Published “Simultaneous estimation of electrical and thermal properties of aluminum alloys from tone-burst eddy current thermography time-temperature data using machine learning”

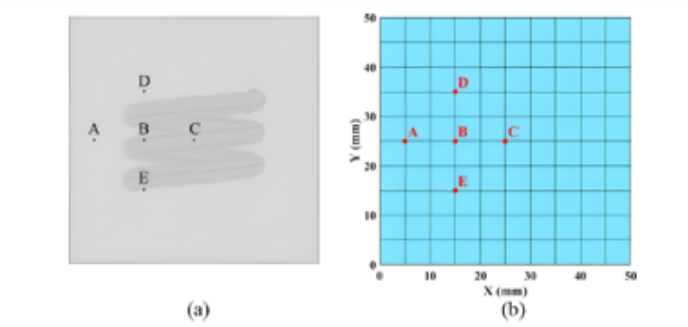


Figure 3. (a) The numerical model of the test specimen indicating the observation points on the surface and the position of the coil behind it. (b) the location of the observation points on the surface of specimen.

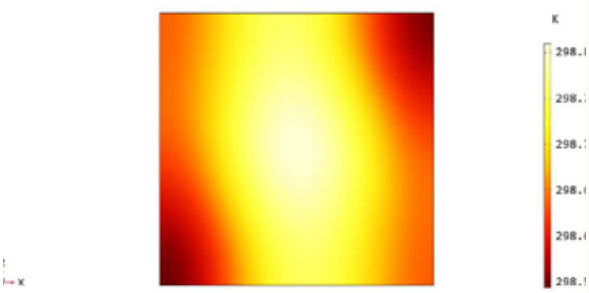


Figure 4. Simulated thermogram for aluminum sample at $t = 5$ s.

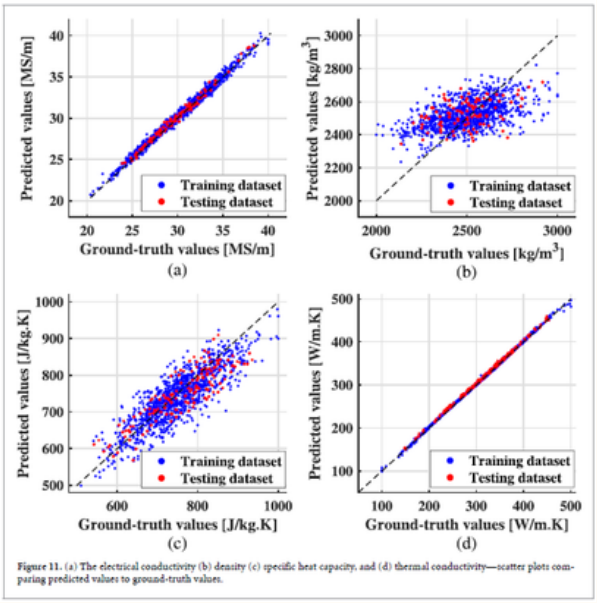
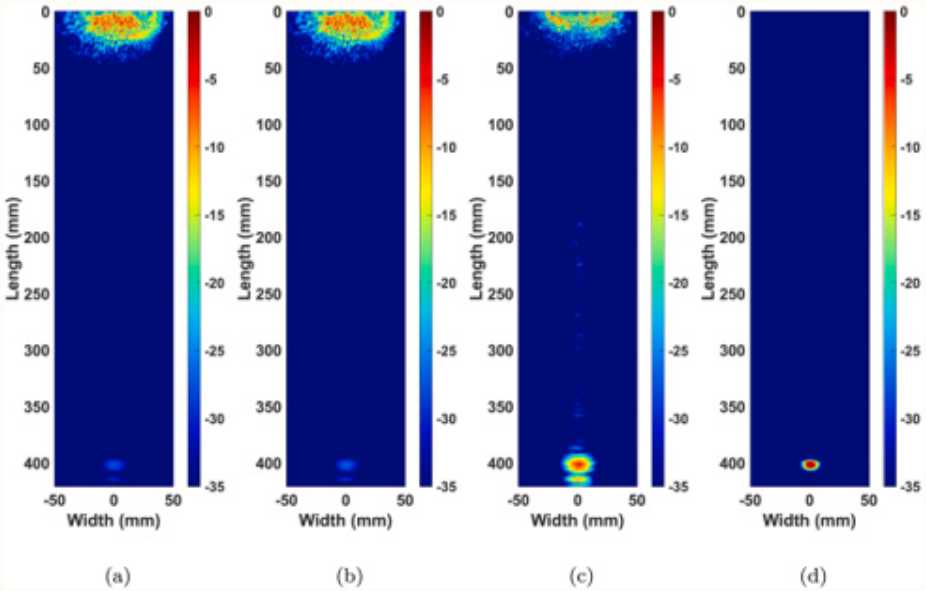


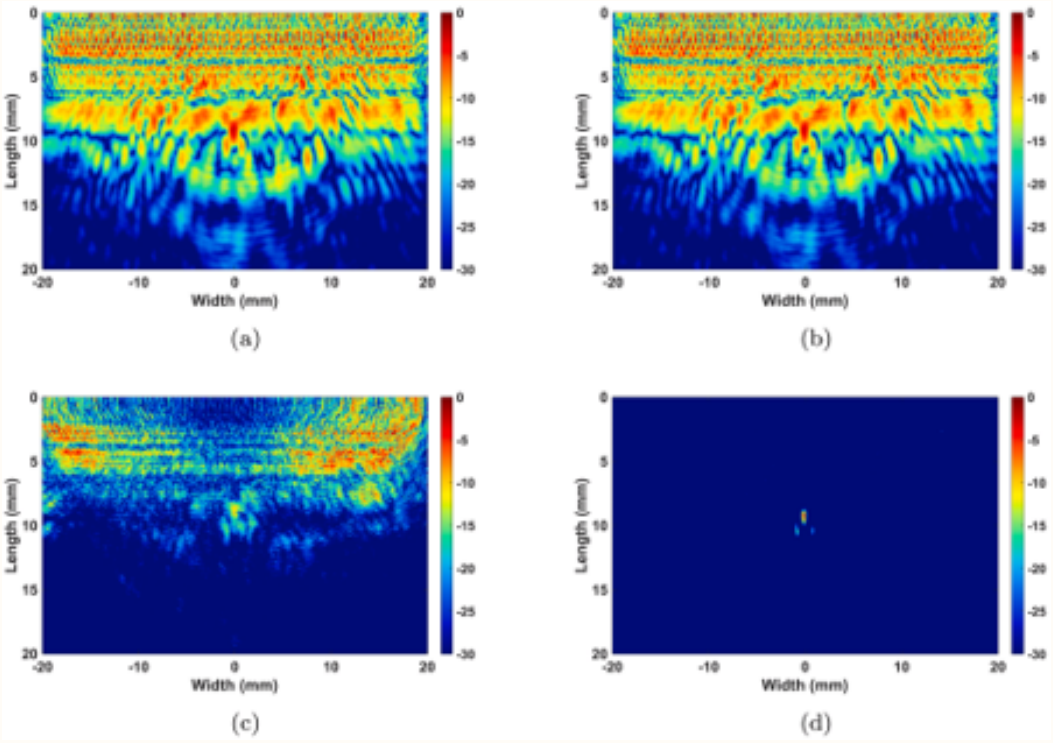
Figure 11. (a) The electrical conductivity (b) density (c) specific heat capacity, and (d) thermal conductivity—scatter plots comparing predicted values to ground-truth values.

In this study, a machine learning (ML)-based inversion technique is presented to estimate the electrical and thermal properties of aluminum alloys using tone burst eddy current thermography (TBET). To obtain the necessary training data for the ML algorithm, a three-dimensional finite element method-based model of the TBET inspection process was developed. The correctness of the numerical model was established by comparing the computational results against experimental data. The simulated thermal response serves as the input feature set for the ML model. The outputs estimated were electrical conductivity, density, specific heat capacity, and thermal conductivity. The performance of the developed inversion technique is first assessed using noise-free synthetic data. The average relative error in the predictions using the noise-free data was less than 5%. Furthermore, to evaluate the effect of noise on the estimation results, the model is tested using data with artificially induced noise. The proposed method demonstrated promising capabilities in predicting the properties under investigation.

Kaushal Bachhav, Thulsiram Gantala, Krishnan Balasubramanian “Phased array guided wave imaging with Vector Coherence Factor for thin-walled structures”

In this paper, we propose an advanced guided wave phased array (PA) ultrasonic imaging technique for improved defect detection in thin plate-like structures, leveraging Vector Coherence Factor (VCF)-weighted Total Focusing Method (TFM). In this approach, the guided wave is transmitted and received, particularly lamb waves, using the full matrix capture (FMC) scanning strategy for long-range inspection. A high-resolution image is obtained by virtually focusing on every point in the region of interest through TFM beamforming, which is weighted with VCF to improve the detectability of the defects in near-field, dead-zone, and far fields. However, in long-range inspections using Lamb waves, employing the FMC-TFM technique reduces the signal-to-noise ratio (SNR) in the received signals and lowers image resolution due to beam spreading and their inherent dispersive nature. Therefore, we implemented the VCF to weight the TFM beamforming process. VCF-TFM utilizes both amplitude and instantaneous phase information by analyzing received signals as complex vectors. Specifically, VCF evaluates coherence by analyzing the received signals as vectors in the complex domain, effectively enhancing phase-consistent defect reflections while suppressing incoherent background noise. The effectiveness of the proposed technique is experimentally validated on long stainless steel plate specimens containing multiple defects located in the near-field, far-field, and dead-zone regions. The results demonstrate that the proposed VCF-TFM approach significantly improves SNR and image resolution compared to conventional amplitude-based TFM techniques, enabling more accurate and reliable defect characterization in thin plate-like structures.

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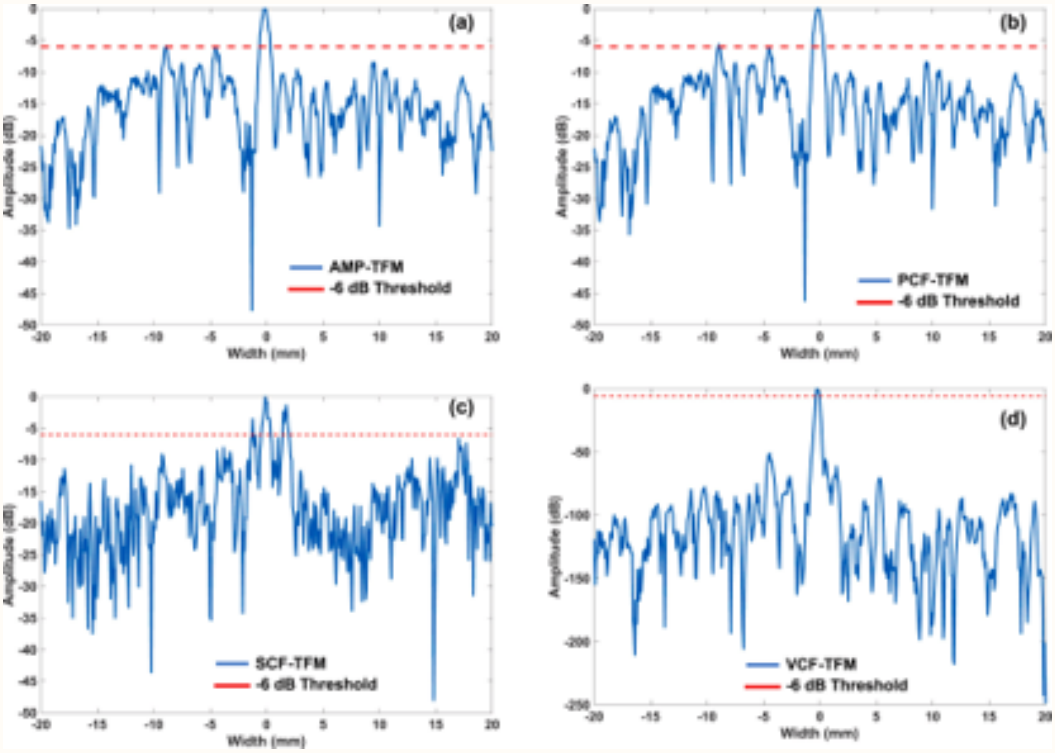
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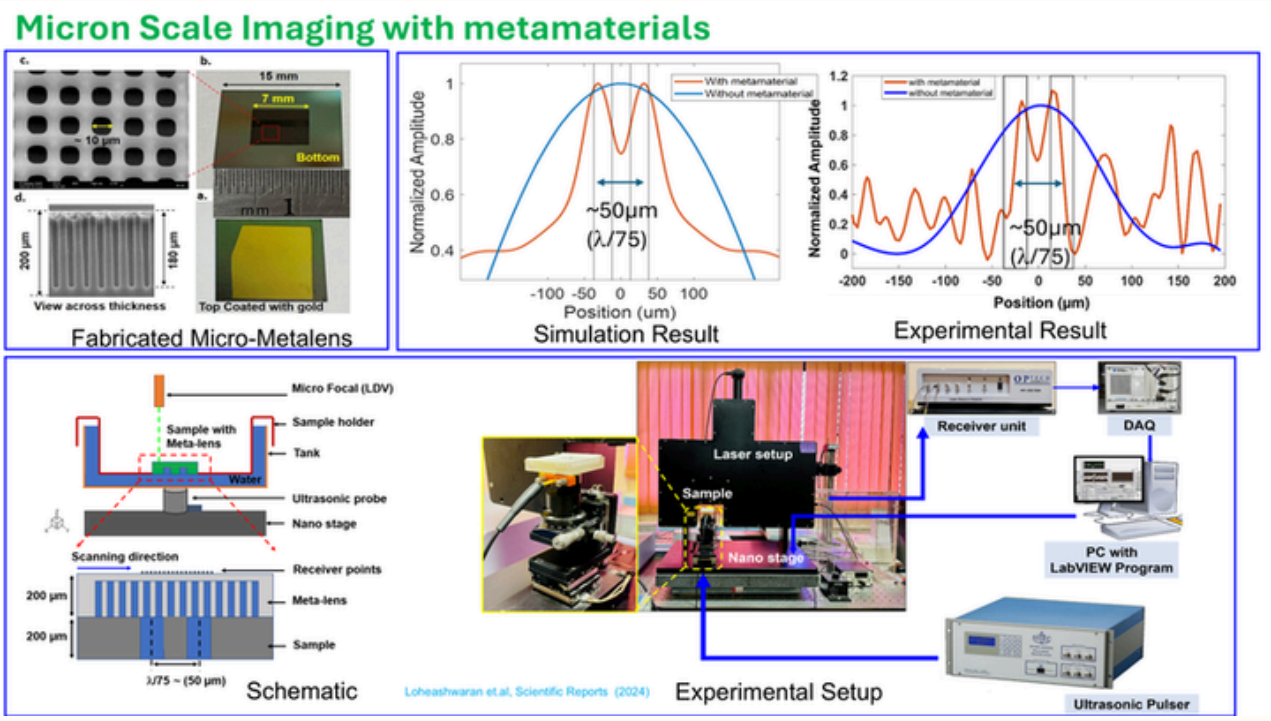
Patent Granted for Advanced Ultrasonic Super-Resolution Imaging Technology

Congratulations to Prof. Prabhu Rajagopal, Loheshwaran Chandran, and Dr. Mohamed Subair on being granted a patent for their innovative invention, “A System and Method for Micro Metalens-Based Super-Resolution Imaging Using Bulk Ultrasonics.” The patented technology represents a significant advancement in ultrasonic imaging and has the potential to enhance resolution capabilities in non-destructive evaluation applications.

This work builds on our earlier research in micron-scale imaging using bulk ultrasonics. At the heart of the invention is a specially designed microfabricated metalens that can control acoustic waves at extremely small scales. What makes this approach unique is its ability to capture and enhance evanescent waves signals that usually fade away before they can be detected allowing us to see details beyond the usual limits of ultrasonic imaging. In simple terms, this means we can now achieve much higher resolution imaging while still using low-frequency ultrasonic waves that can travel deeper into materials. Traditionally, there’s been a trade-off between how deep you can see and how clearly you can see but this technology helps overcome that challenge. The potential applications are wide-ranging. It could significantly improve non-destructive testing by helping detect tiny defects or early signs of material damage. It also has exciting possibilities in areas like biomedical imaging, microelectronics inspection, and materials science, where seeing fine internal details is essential. Overall, this patent represents an important step forward in turning our research into practical technology with real-world impact.



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