

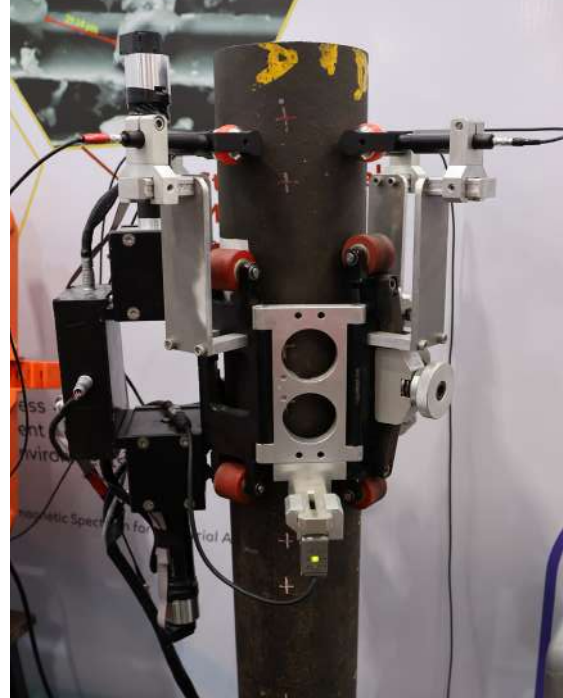
CENTRE FOR NON-DESTRUCTIVE EVALUATION

*A CENTER OF EMINENCE
Striving for Excellence*

25
Years
of Excellence

ABOUT CNDE

The Centre for Non-destructive Evaluation (CNDE) was established at the Indian Institute of Technology, Madras, in April 2001. It is Asia's leading academic center for research and technology translation in Non-destructive Evaluation (NDE).



VISION & MISSION

MISSION

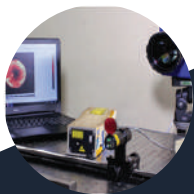
Deep-research based non-destructive technologies for improved performance, enhanced safety, and increased life for industrial applications and societal well-being.

VISION

To become the world's largest Deep-research and technology translational center in the field of NDE.

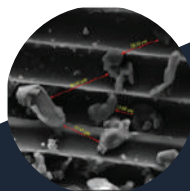
Focus Area

Applying the entire spectrum of Ultrasound and Electromagnetic for Industrial Inspection



Non-destructive Imaging & Evaluation

Faster, Economical, and Reliable inspection for improved performance and safety.



Structural Health Monitoring

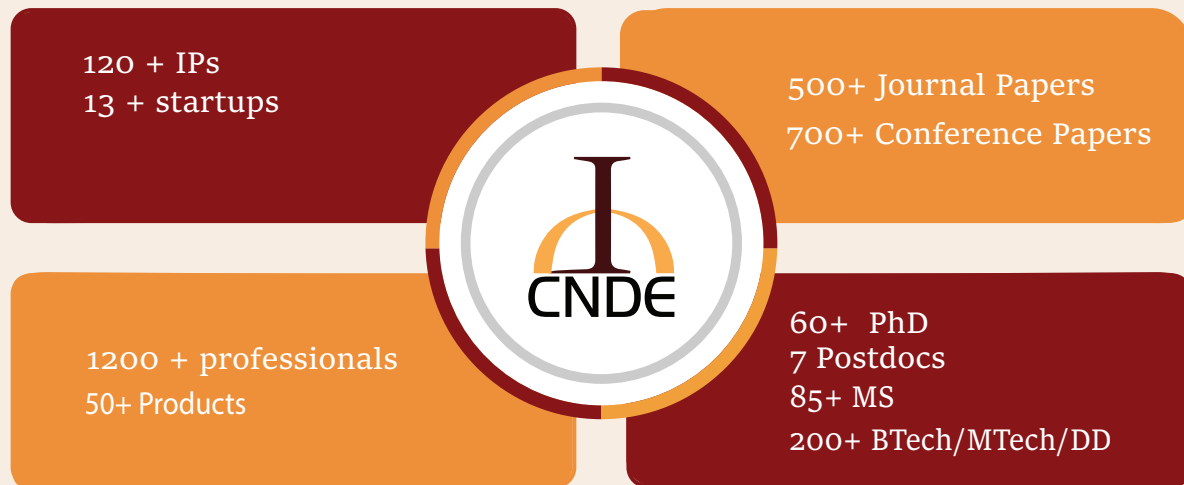
Continuous Monitoring for Life Extension and safety



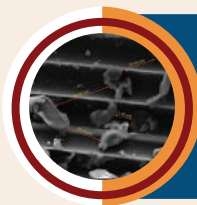
Measurements

Temperature and process parameter measurement at hostile & harsh environments

Impact of Last 10 Years



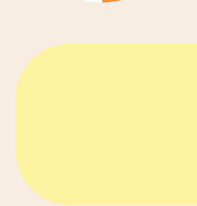
Research Themes



Ubiquitous Sensing

- Fiber Optic Sensing
- Ultrasonic Waveguide Sensing

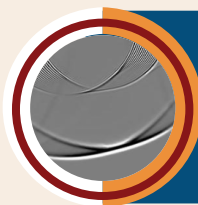
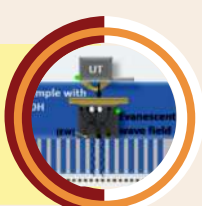
First High-Resolution FO-DAS
First 1400 C Ultrasonic Sensing



Structured Materials for Imaging

- Meta-materials based imaging & sensors

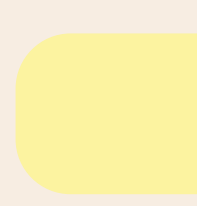
First Ultrasonic Super Resolution
Imaging at $\lambda/75$



Edge Intelligence & Soft-Sensing

- AI enabled edge computing
- Quantum Computing
- Simulated Assisted Decision Process

First Quantum Computing Result
First DPAI based Computing Result



Multi-Modal Inspection

- Data Fusion Algorithms

First Digital Xray + PAUT fused
Automated Data Analysis Result



Remote and Pervasive Inspection

- Autonomous Robots
- Bio-Inspired Robots

First Bio-Inspired Robot
First Autonomous Shop Robot

Our Partners



TATA STEEL

SAINT-GOBAIN



TIMKEN



AIRBUS



ALSTOM

TOSHIBA



Our Startups



Dhvani Research



Detect Technologies



Planys Technologies



Maximl



Solinas



**Dhvani Analytic
Intelligence**



**Dhvani Inspection
Technologies**



Xyma Analytics



Plenome



Rail Labs



Folium Sensing



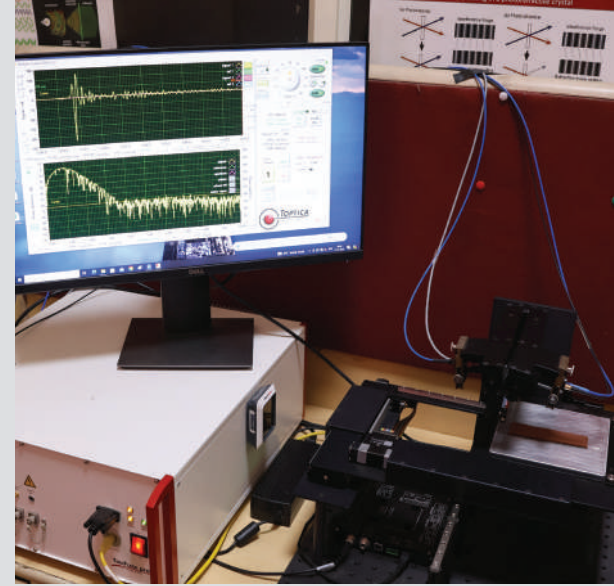
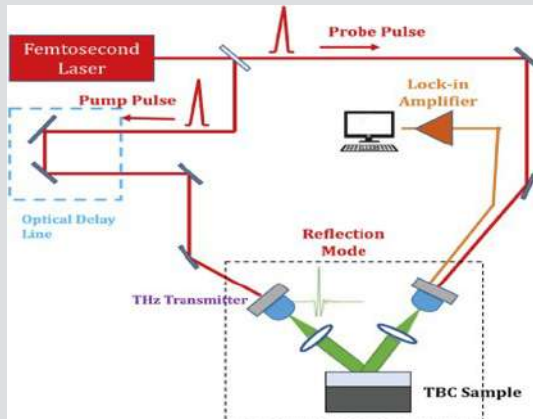
Azeriri



TIQWorld

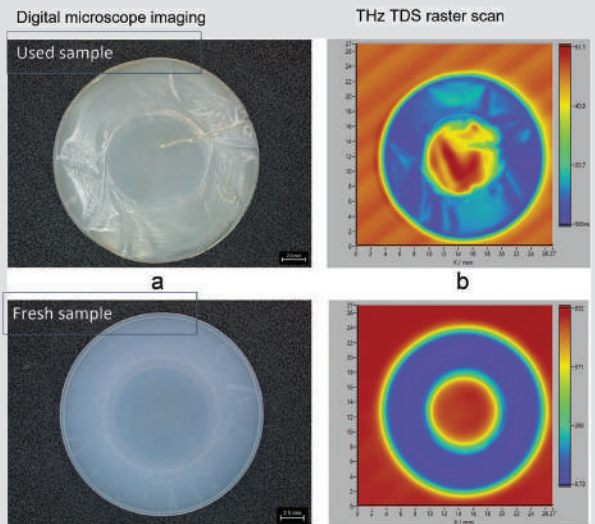
Terahertz (THz) -Time Domain Spectroscopy Imaging

Schematic of THz-TDS system



Mechanical heart valve disc

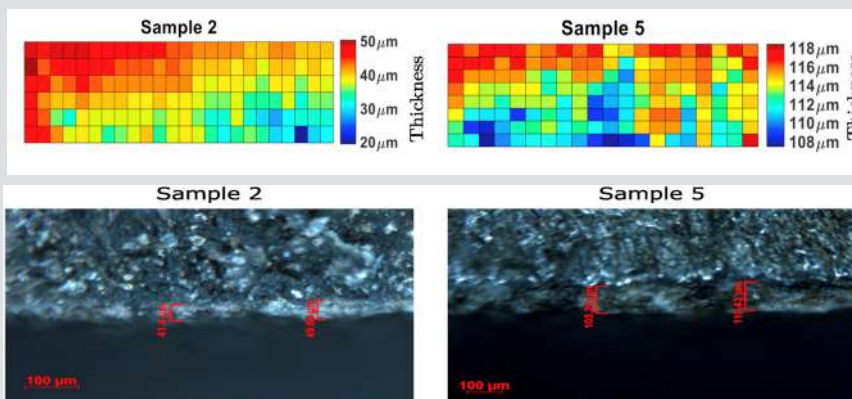
THz vs. DM: **Implant Disk Thickness Degradation**



Thermal Barrier Coating

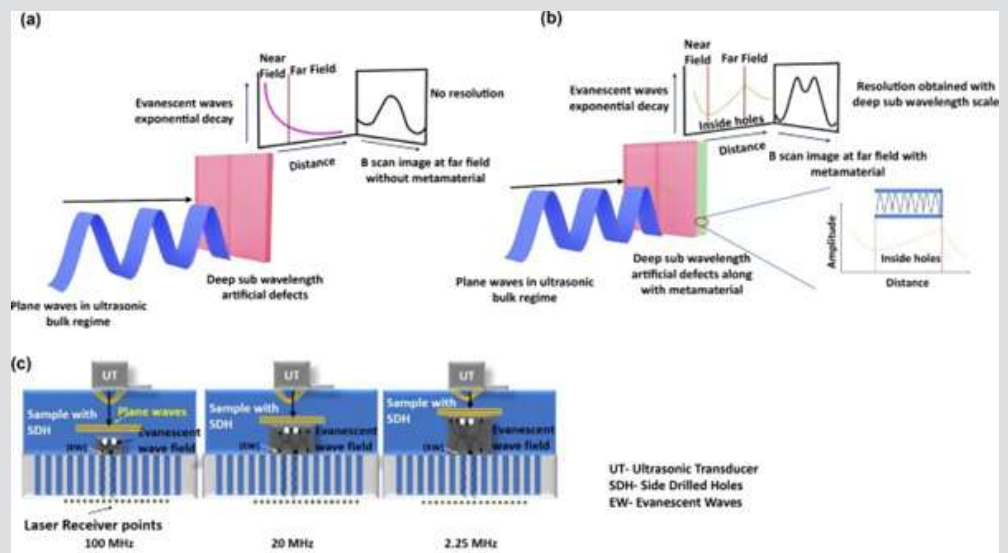
THz vs. OM: **Mean Coating Thickness Comparison**

Mean thickness = $40.38 \pm 4.06 \mu\text{m}$ Mean thickness = $113.17 \pm 2.13 \mu\text{m}$

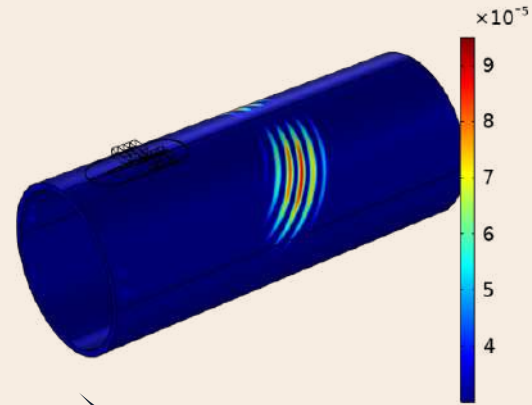
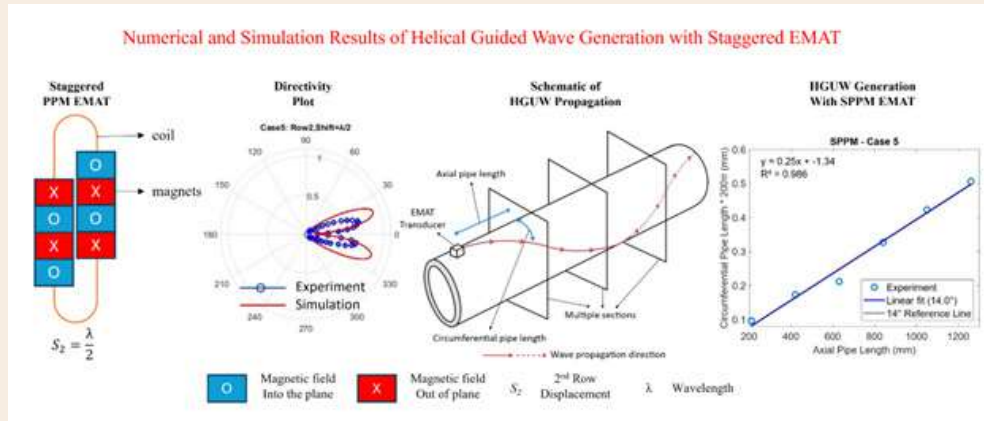


Super Resolution Ultrasonic Imaging

Achieving $\lambda/75$ ultra-sonic super-resolution using meta-materials, advancing towards compact and affordable high-precision imaging for industrial and bio-medical NDE.

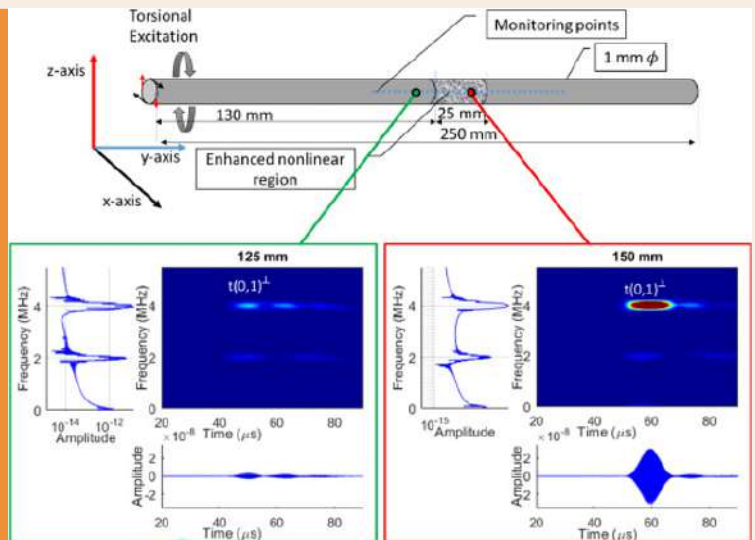


Staggered Electro Magnetic Acoustic Transducer (EMAT) Beam Steering in Pipes

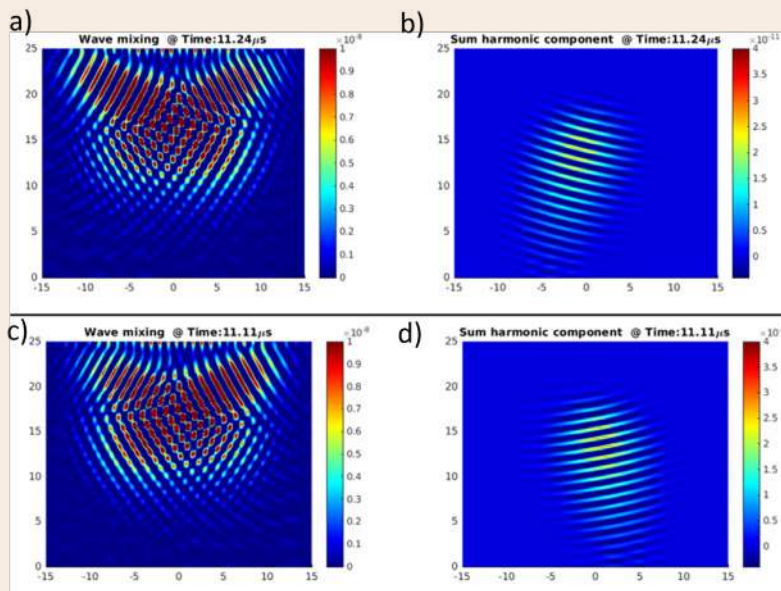


Non-Linear Ultrasonics (NLU)

A newly discovered second harmonic GW mode was found to be more sensitive to early damage characteristics

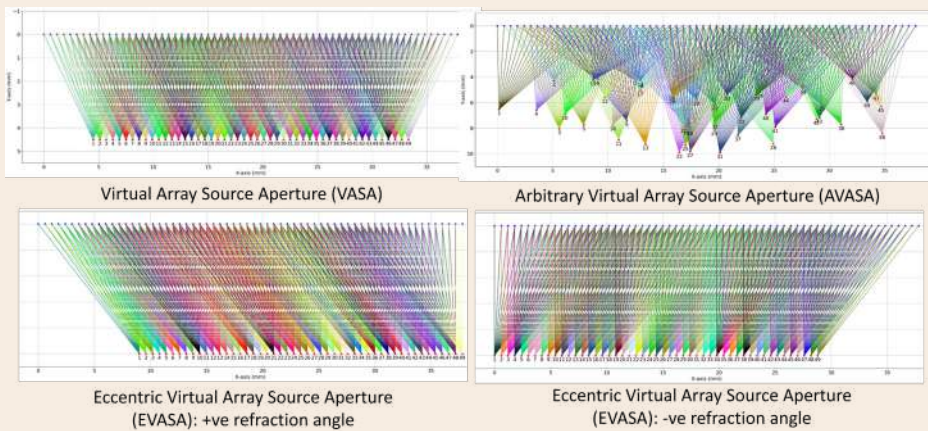


Non-Collinear Wave Mixing

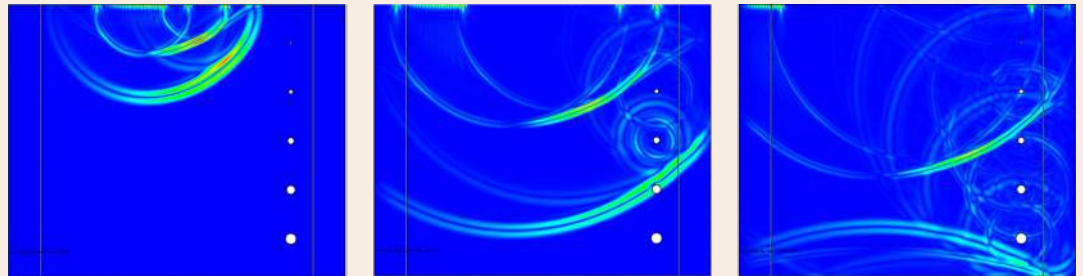


- A numerical model is developed in COMSOL Multiphysics package using Murnaghan's coefficients in the hyper-elastic material model
- A phased excitation approach is adopted in the model to steer the primary waves in the intended direction

Eccentric Virtual Array Source Aperture (EVASA) - Phased Array Ultrasonic Testing (PAUT) Imaging Technique



Wave propagation with EVASA method. Starting frame to ending frame of



Fiber-Optic Based Temperature, Strain and Acoustic Sensing for Infrastructure

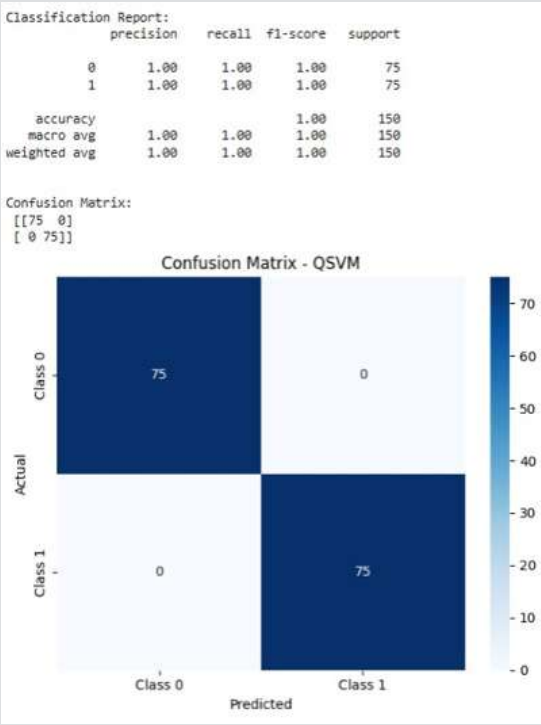
GAIL high pressure natural gas transport pipeline test facility in IIT Madras Discovery campus at Thaiyur uses Optical Fibre based Distributed Acoustic Sensing (DAS) and Distributed Temperature Sensing (DTS) technologies to capture any intrusion or events across pipe length.



Quantum Machine Learning techniques for image classification

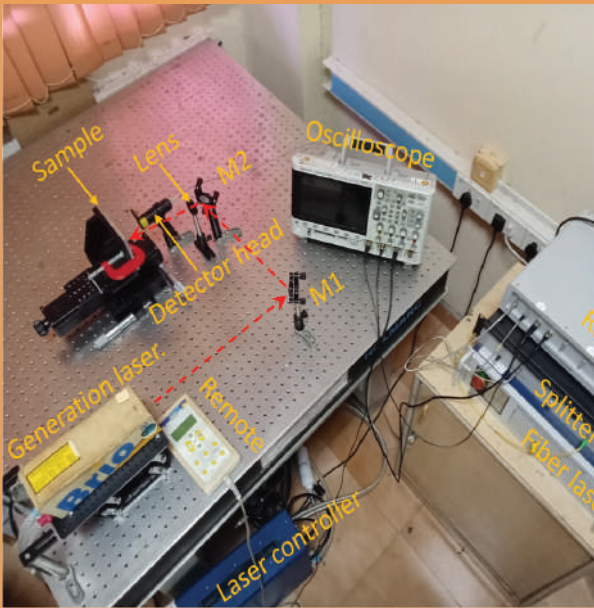
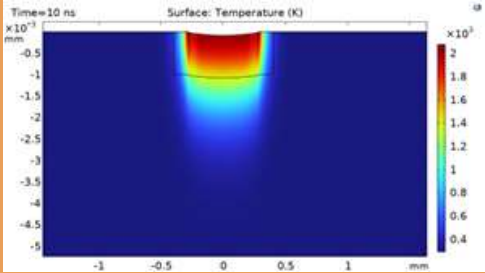
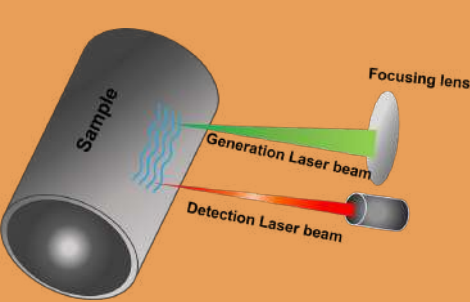


Model	Accuracy	Porosity Recall	Slag Recall	Notes
VQC	0.97–0.98	1.00	0.96–0.98	Best: ZZFeatureMap + TwoLocal + circular
QSVM	1.00	1.00	1.00	Quantum kernel with ZZFeatureMap
QCNN	0.61	1.00	0.22	3→2 qubit pooling; favors localized porosity

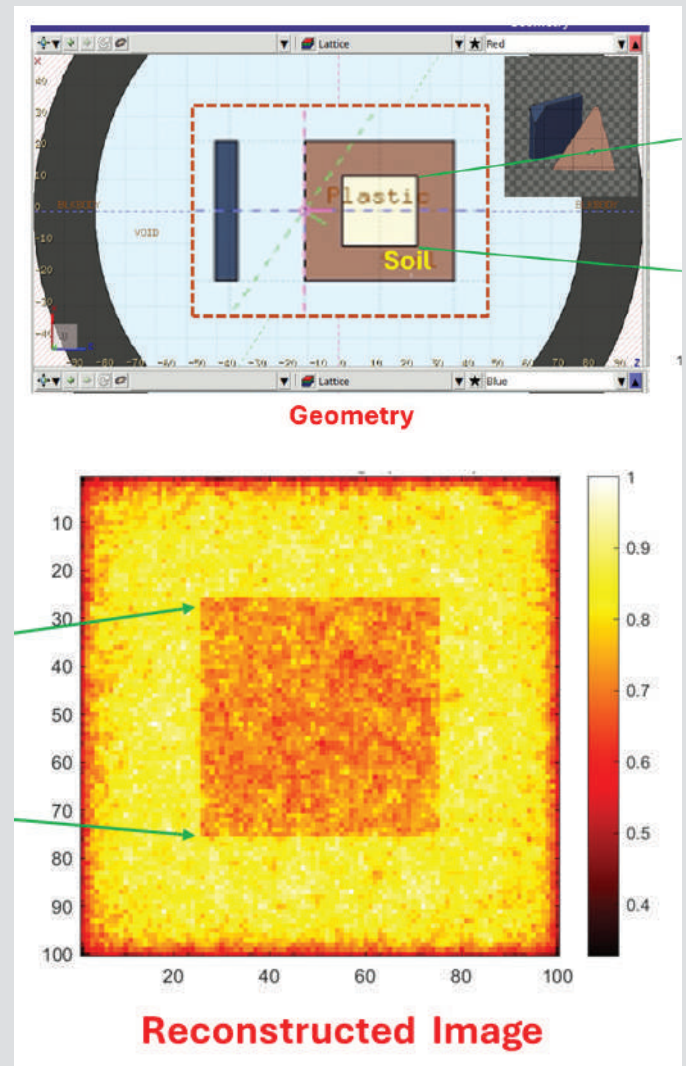
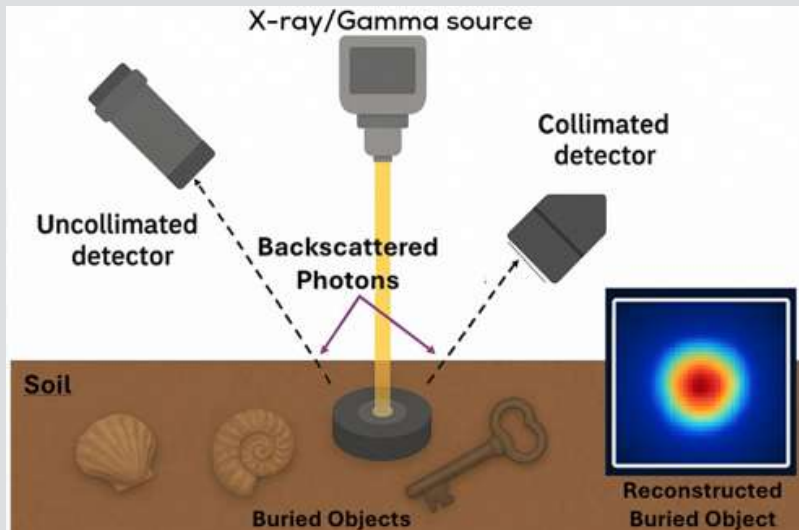


Industry-Accademic Collaborative Projects

Non-Contact Ultrasonic Evaluation of Structural Components Using Laser Excitation

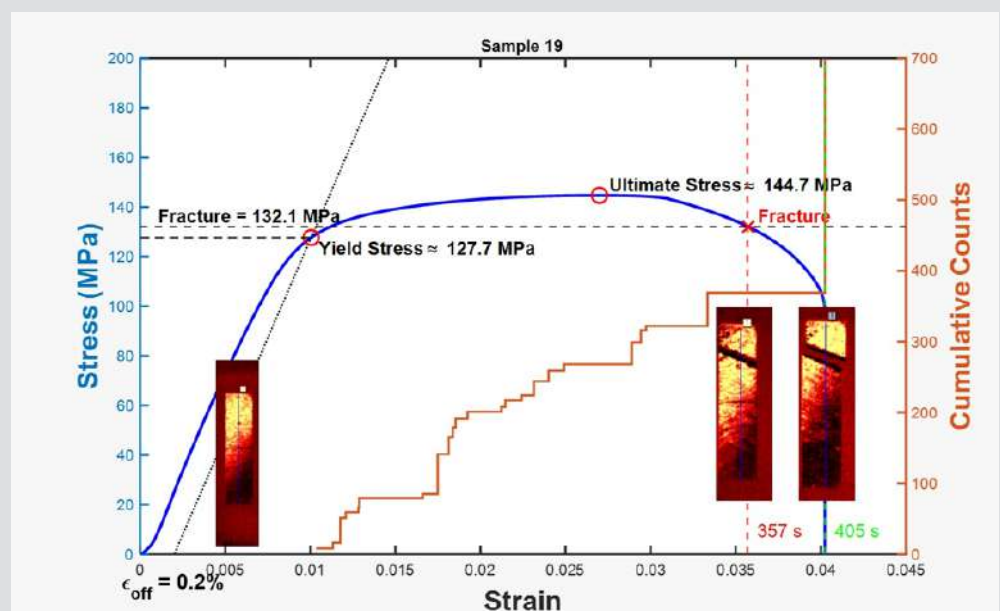


Compton Back-scattering Imaging (CBI) for detection of buried object as well as corrosion under insulation (CUI)



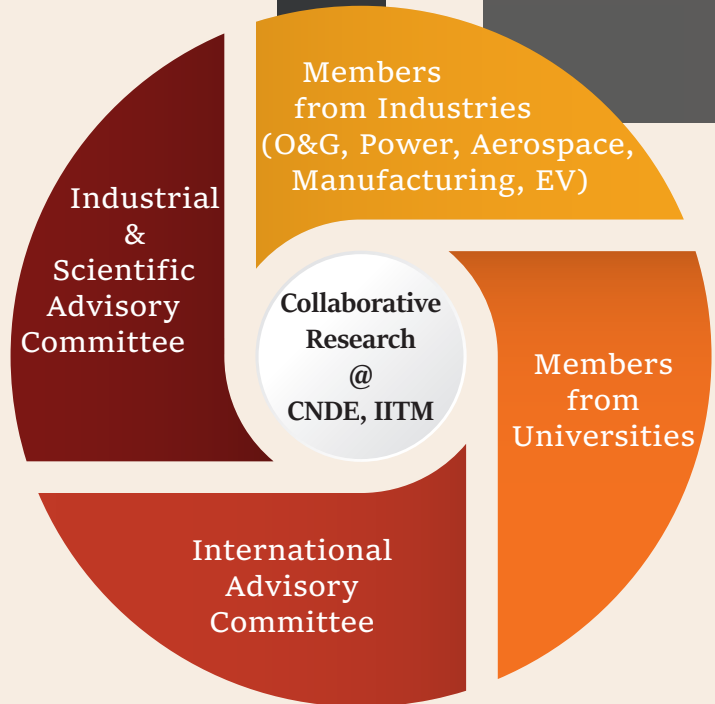
In-Situ NDE of Plate Samples under Static and Dynamic Loading

NDE (Acoustic emission and Infrared Thermography) of samples under static and dynamic loading



National Consortium for NDE (NCNDE)

The NCNDE aims to tackle the real-world challenges that stakeholders face in non-destructive evaluation (NDE) and structural health monitoring (SHM) through collaborative research and creating top-tier resources for NDE.



Celebrating 25 Years of CNDE – A Milestone in Non-Destructive Evaluation

The Centre for Non-Destructive Evaluation (CNDE) is proud to celebrate 25 years of excellence. Established in 2001 by Prof. Krishnan Balasubramanian at IIT Madras, and strengthened by the contributions of numerous collaborators, CNDE has grown into a global leader in NDE research and innovation.

To mark this milestone, CNDE will host a year-long series of workshops, seminars, webinars, and industry engagements, welcoming our partners, alumni, and the NDE community to join us in celebrating this significant achievement.





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