

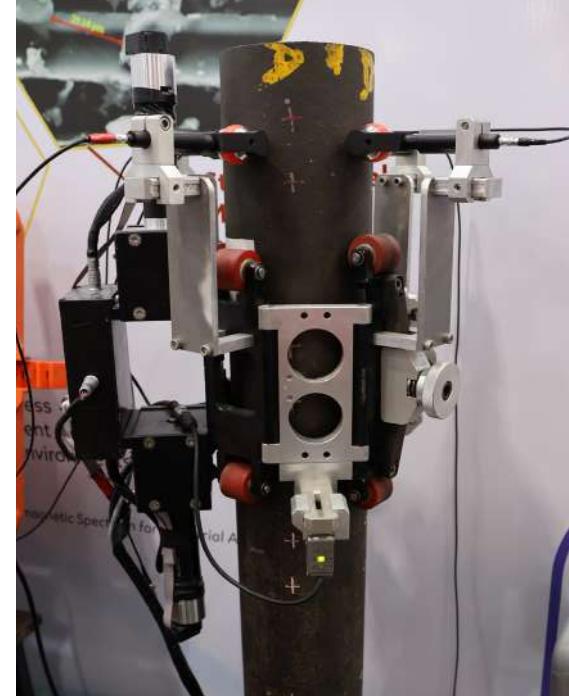
CENTRE FOR NON-DESTRUCTIVE EVALUATION

A CENTER OF EMINENCE
Striving for 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

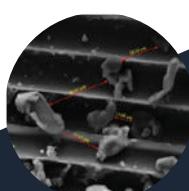
Deep-research based non-destructive technologies for improved performance, enhanced safety, and increased life for industrial applications and societal well-being.

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



Measurements

Temperature and process parameter measurement at hostile & harsh environments

Structural Health Monitoring

Continuous Monitoring for Life Extension and safety

Non-destructive Imaging & Evaluation

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

Impact of Last 10 Years

120 + IPs
13 + startups

500+ Journal Papers
700+ Conference Papers

1200 + professionals
50+ Products

60+ PhD
7 Postdocs
85+ MS
200+ BTech/MTech/DD



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



SIEGER
partner solutions



TIMKEN



AIRBUS



ALSTOM

TOSHIBA



Baker Hughes

EPRI
ELECTRIC POWER
RESEARCH INSTITUTE



ExxonMobil



Our Startups



Dhvani Research



Detect Technologies



Planys Technologies



Maximl



Solinas



Dhvani Analytic Intelligence



Dhvani Inspection Technologies



Xyma Analytics



Plenome



Rail Labs



Folium Sensing



Azeriri

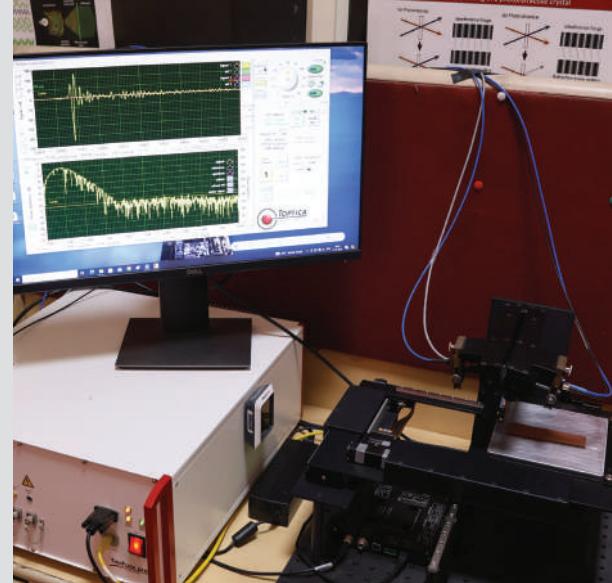
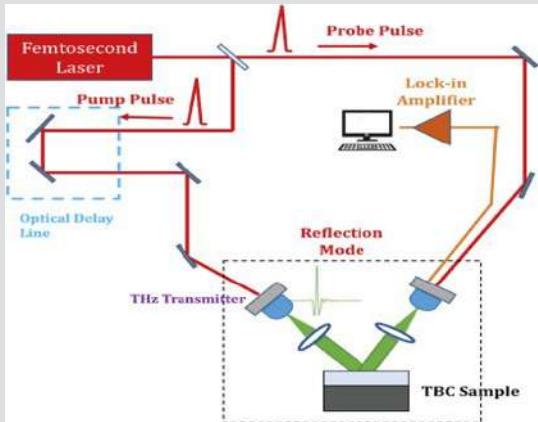


TIQWorld



Terahertz (THz) -Time Domain Spectroscopy Imaging

Schematic of THz-TDS system



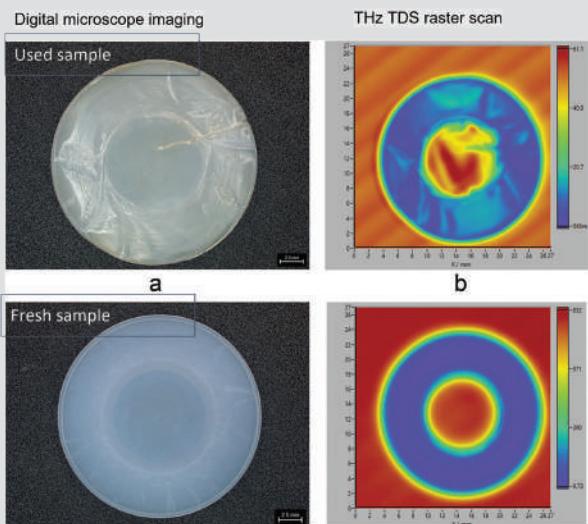
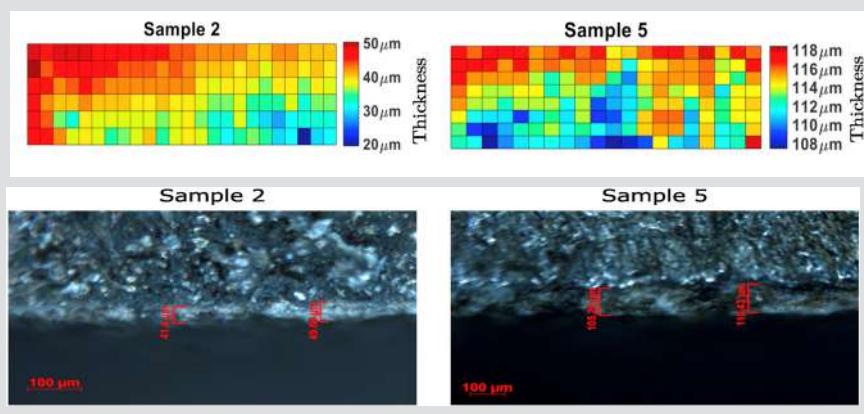
Mechanical heart valve disc

THz vs. DM: Implant Disk Thickness Degradation

Thermal Barrier Coating

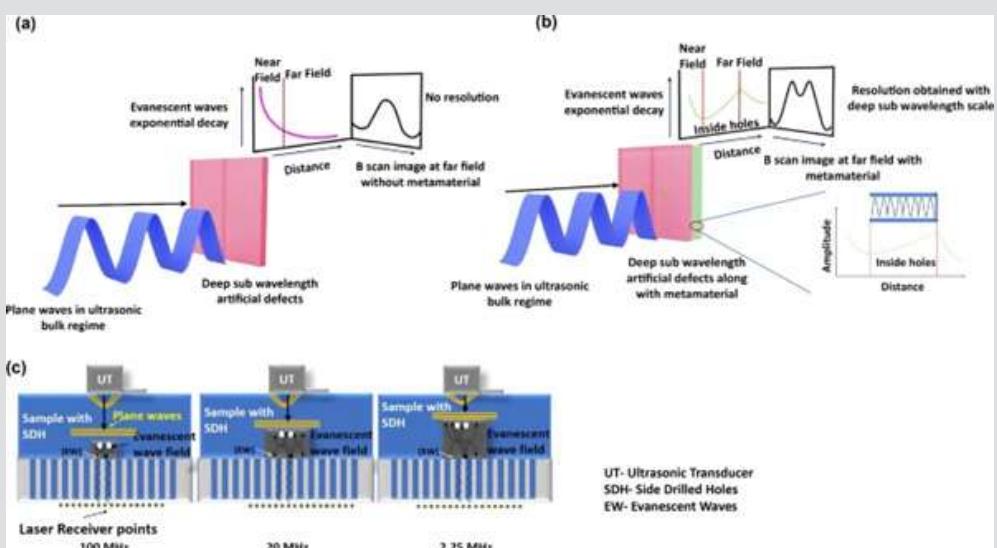
THz vs. OM: Mean Coating Thickness Comparison

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

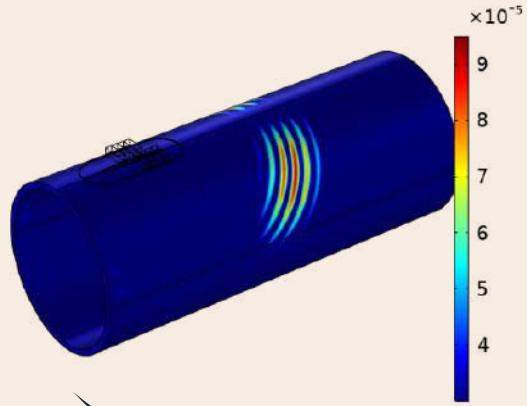
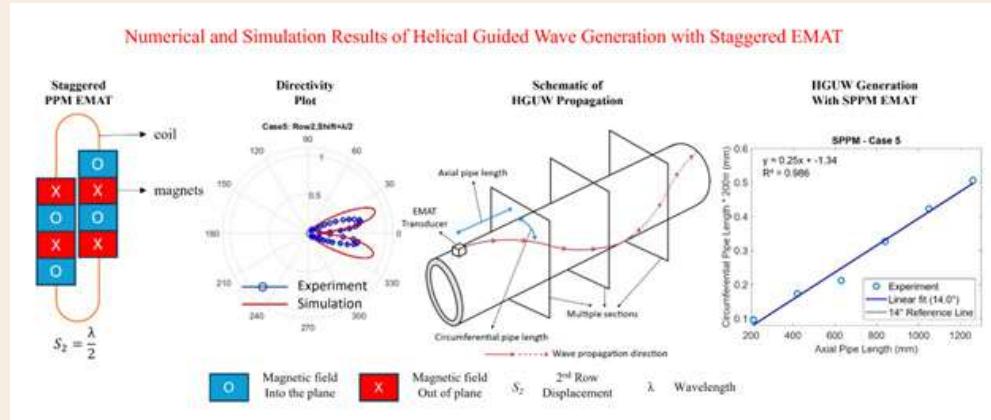


Super Resolution Ultrasonic Imaging

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

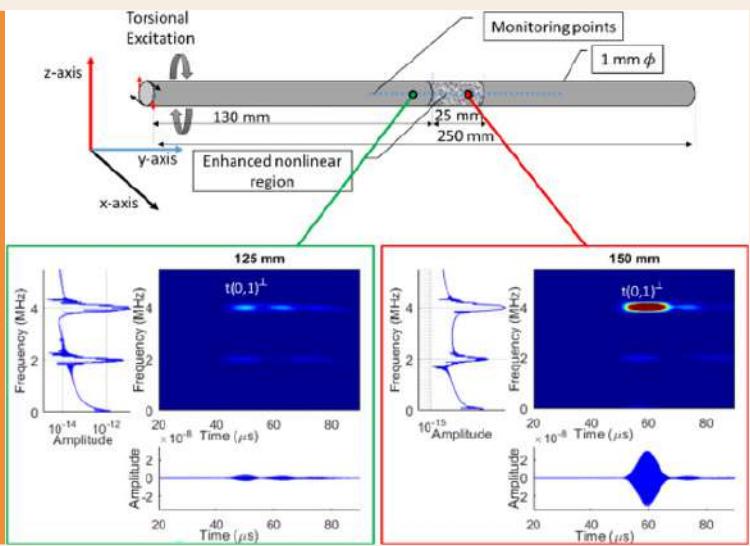


Staggered Electro Magnetic Acoustic Transducer (EMAT) Beam Steering in Pipes

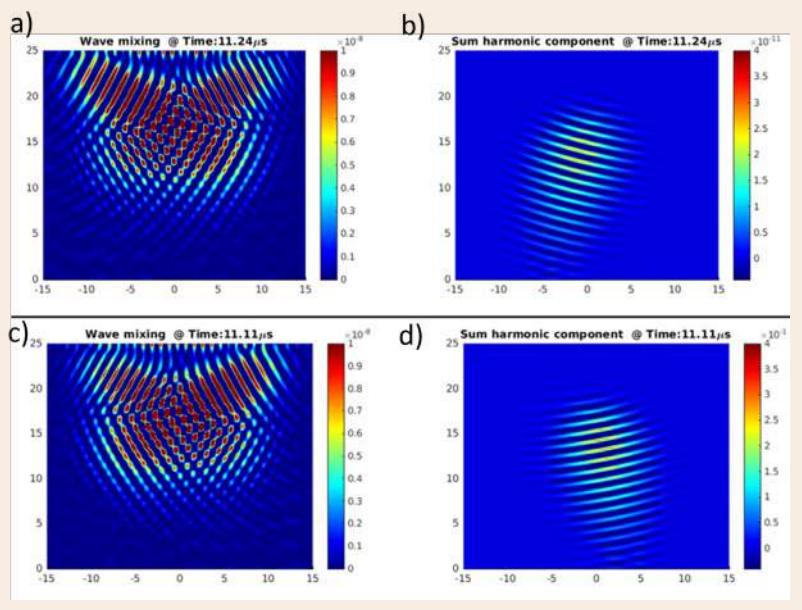


Non-Linear Ultrasonics (NLU)

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

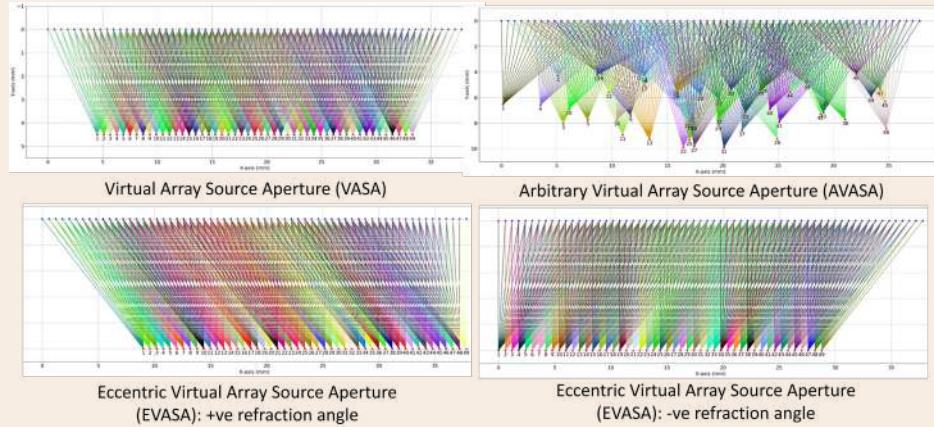


Non-Collinear Wave Mixing

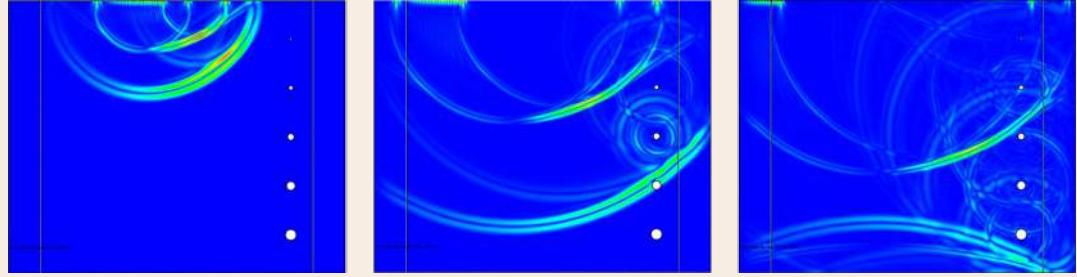


- A numerical model is developed in COMSOL Multiphysics package using Murnaghan's coefficients in the hyper-elastic material model
- A phased excitation approach is adopted in the model to steer the primary waves in the intended direction

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



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



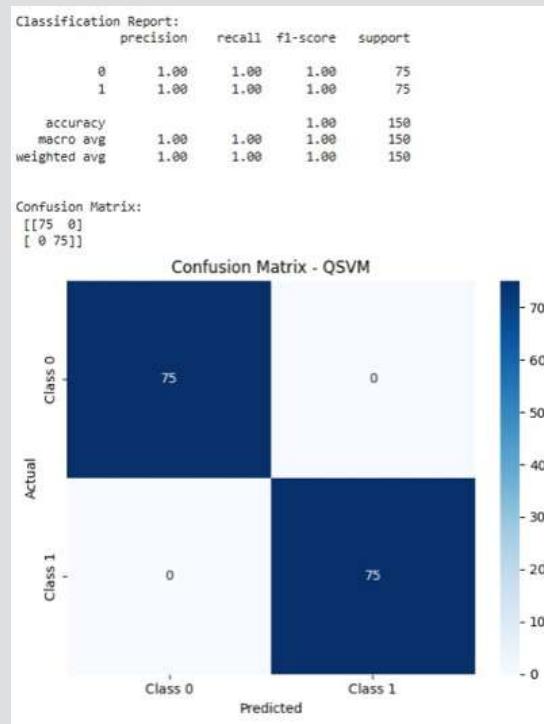
Fiber-Optic Based Temperature, Strain and Acoustic Sensing for Infrastructure

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



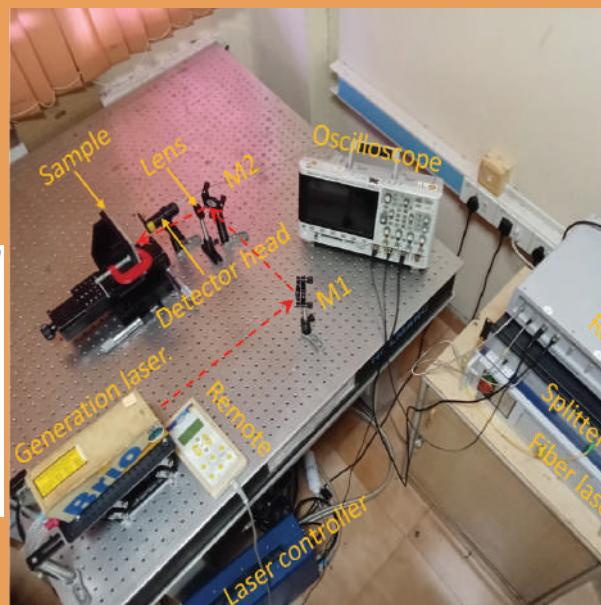
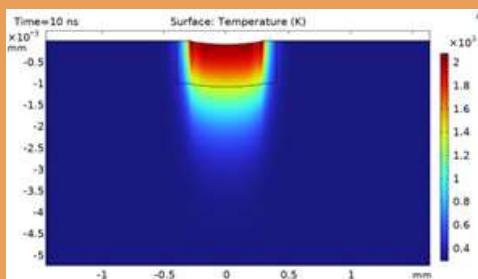
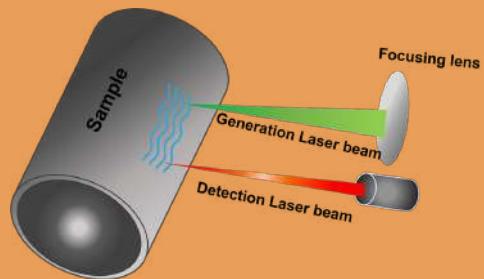
Quantum Machine Learning techniques for image classification

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

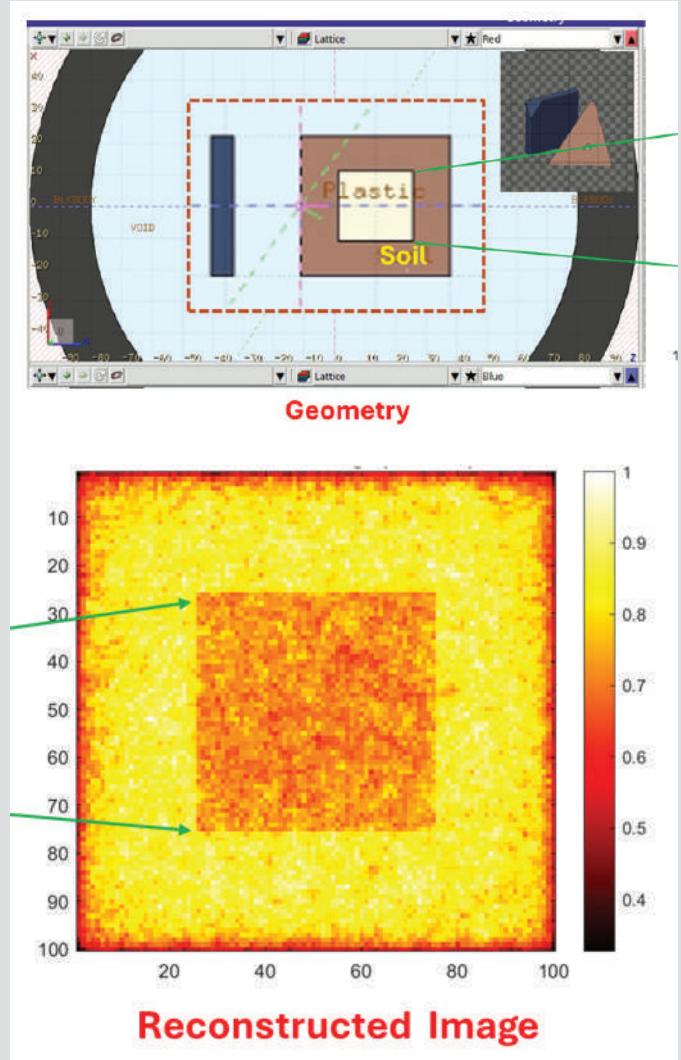
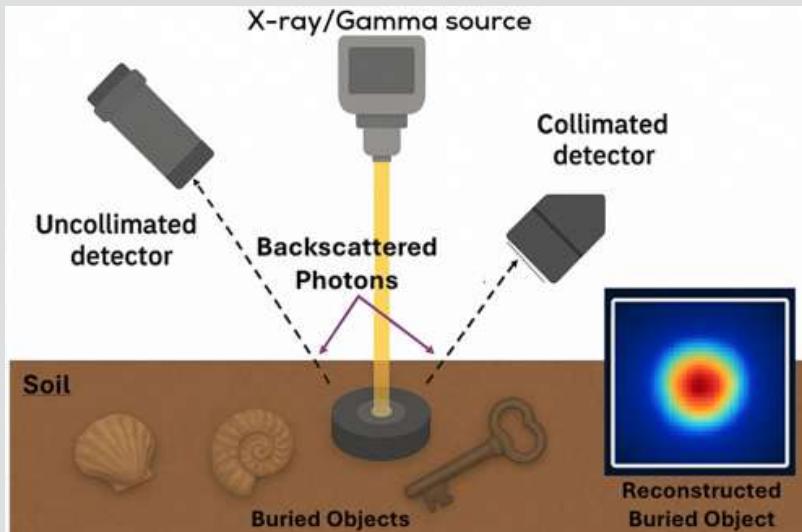


Industry-Accademic Collaborative Projects

Non-Contact Ultrasonic Evaluation of Structural Components Using Laser Excitation

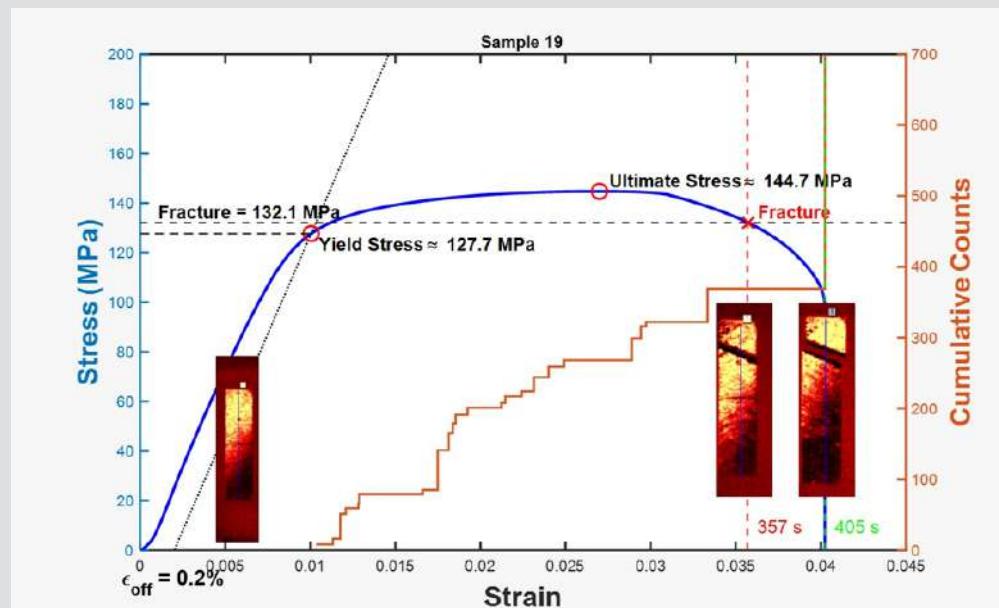


Compton Back-scattering Imaging (CBI) for detection of buried object as well as corrosion under insulation (CFI)



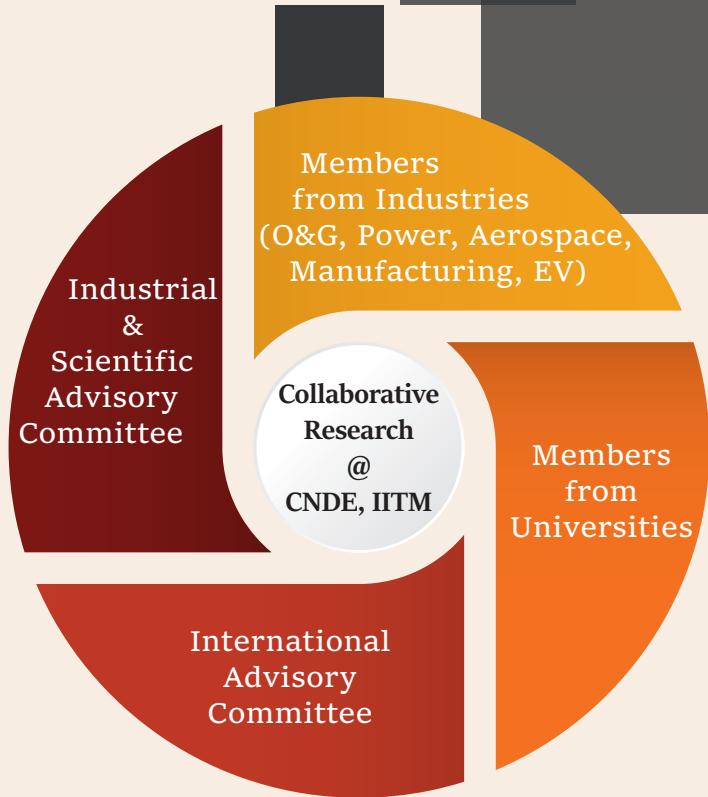
In-Situ NDE of Plate Samples under Static and Dynamic Loading

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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