The 28th International Workshop on Electromagnetic Nondestructive Evaluation (ENDE2025)

ENDE 2025

Knoxville, TN, U.S.A

CROWNE PLAZA, KNOXVILLE, TN, U.S.A.

JULY 6-9, 2025

Nondestructive Evaluation Laboratory

Founded 1855

JAPAN SOCIETY OF MAINTENOLOGY

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The 28th International Workshop on Electromagnetic Nondestructive Evaluation (ENDE2025) Program Summary

	Sunday	Monday	Tuesday	Wednesday
8:00 – 9:00		Keynote 1	Keynote 2	
9:00 – 9:20		Oral Session	Oral Session	Oral Session
9:20 – 9:40				
9:40 – 10:00				
10:00 – 10:20				
10:20 – 10:40		Break	Break	Break
10:40 – 11:00		Oral Session	Oral Session	Oral Session
11:00 – 11:20				
11:20 – 11:40				
11:40 – 12:00				
12:00 – 1:00		Lunch	Lunch	ORNL Tour (12:30-5:30) (Box lunch)
1:00 – 1:20		Oral Session	Oral Session	
1:20 – 1:40				
1:40 – 2:00				
2:00 – 2:20				
2:20 – 2:40				
2:40 – 3:00				
3:00 – 3:20		Break	Break	
3:20 – 3:40		Oral Session	Oral Session	
3:40 – 4:00				
4:00 – 4:20				
5:00 – 6:00	Registration			
6:00 – 8:00	Opening Reception		Banquet (6:00-9:00)	

Content

Welcome to the ENDE 2025 Workshop

Welcome to ENDE2025! This year's technical sessions, student posters competition, industry exhibition and tour, and other special events will be held in Knoxville, Tennessee - the Gateway to the Great Smoky Mountains. We hope to provide a comprehensive and well-balanced program in theoretical and applied research of electromagnetic NDE (ENDE) methods.

This workshop is intended to provide an international forum for the exchange of information on state-of-the-art technologies and development in NDE sensors, modeling, signal processing, inverse problems, materials state awareness and characterization, damage diagnosis and prognosis, biomedical applications, and innovative applications of ENDE. This workshop is intended to provide an international forum for the exchange of information on state-of-the-art technologies and development in but are not limited to：

- Advanced sensors and sensing systems
- Analytical and numerical modeling
- AI and Machine Learning Applications
- Automated Inspection Techniques Applicable
- Data fusion and big data applications
- Electromagnetic NDE in Digital Twins and NDE 4.0
- Materials state awareness and characterization
- Methodology in damage diagnosis and prognosis
- Inverse problems
- In-situ characterization, including in advanced manufacturing
- Structural Health Monitoring
- Applications including:
  - o Biomedical applications
  - o Aerospace
  - o Composites
  - o Nuclear Power
  - o Transportation
  - o Renewable energy
  - o Power systems

Through a range of technical and social activities, ENDE 2025 will provide a unique opportunity to interact with the world's leading experts in electromagnetic NDE from academia, industry and government.

The International Workshop on Electromagnetic Nondestructive Evaluation (ENDE) has been held every year since 1995. Its aim is to bring together engineers and scientists from universities, research institutions and industry who are active in research, development and industrial applications of Electromagnetic Nondestructive Evaluation. The program is detailed next, make it your own and welcome you to join us in Knoxville in 2025!

Committees

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Yiming Deng	*Michigan State University, USA,* ***co-Chair***

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Junliang Dong	*University of Arkansas, USA*
Matt Cherry	*Air Force Research Laboratory, USA*
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Pradeep Ramuhalli	*Oak Ridge National Laboratory, USA*
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Publications Chair:

Ian Gravagne	*Baylor University, USA*

Keynote Talks

1. Practical Use of Models for Quantitative Eddy Current Nondestructive Evaluation (NDE) of Aerospace Materials and Structures

John C. Aldrin,
Computational Tools, Gurnee, IL, U.S.A

Abstract:
The vision for quantitative nondestructive evaluation is to provide techniques to assess the state of a material, and to detect and characterize any discontinuities present. While eddy current nondestructive evaluation has been readily used for many decades to detect fatigue cracks in metallic aerospace structures and components, there is an outstanding need for innovative methods to reliably classify eddy current indications and provide accurate sizing of discontinuities, to improve maintenance decision making and provide critical data for digital twin models. While there is a growing desire to leverage emerging artificial intelligence and machine learning tools, successful applications in NDE have been limited to cases where the data interpretation task is relatively straightforward, or when large, high quality, and well-understood empirical NDE data sets have been acquired. As an alternative approach, considerable work on model-based inversion, incorporating a 'first-principles' physics model with an iterative solution scheme, has been performed to address certain eddy current NDE characterization problems. However, transition has been limited by three primary challenges: the inherent ill-posedness of certain inverse problems in NDE, long solution times for accurate NDE measurement models, and the lack of robustness of the inverse method schemes to the presence of noise and uncontrolled variation with in-field NDE measurements.

This talk present progress to overcome the challenges of implementing model-based inversion for practical use in eddy current NDE. A comprehensive approach has been developed for model-based inversion design to ensure reliability through (a) an initial key factor assessment on the eddy current response due to discontinuities dimensions, part material conditions and probe state, (b) model benchmarking and use of model approximations where feasible, (c) model parameterization and application of surrogate models to reduce solution time, (d) rigorous model calibration aligned with the inspection procedure, (e) signal processing and filtering, (f) robust indication registration, (g) feature extraction to reduce the size of inverse problem, (h) use of global optimization techniques, (i) strategies to manage sensitivity to probe liftoff, and (j) comprehensive testing and validation studies with specimens replicating the full variation of expected test conditions. Two applications are highlighted throughout the talk, the inspection of cracks in bolt-hole eddy current (BHEC) inspections of metallic structures, and the characterization of crack and other discontinuities present in nickel-based superalloy propulsion components. Recent comprehensive studies of BHEC inversion of crack size demonstrate clear advantages over a simple amplitude-based analysis over a wide range of test conditions. Validation studies are also presented for classifying and sizing both planar and volumetric discontinuities in propulsion components.

2. Manufacturing with Certainty: The Critical Role of Nondestructive Testing and Evaluation in Advancing Modern Manufacturing

Ahmed Arabi Hassen,
Composites Innovation Group, Manufacturing Science Division, Oak Ridge National Laboratory(ORNL), U.S.A

Abstract:
Advanced manufacturing is reshaping how we design, build, and maintain everything from infrastructure and vehicles to energy systems and next-generation materials. As manufacturing accelerates in speed, complexity, and customization, the role of nondestructive testing and evaluation (NDT/E) has become more critical than ever. This keynote will explore how NDT/E is evolving into a foundational enabler for digital manufacturing, additive processes, smart materials, and high-rate convergent production systems. We will highlight key applications of NDT/E in safeguarding product quality, ensuring structural integrity, and delivering critical process feedback to support adaptive control and continuous improvement. Emphasis will be placed on the future integration of NDT/E data into artificial intelligence and machine learning frameworks, unlocking predictive insights, automated decision-making, and smart process optimization. This vision positions NDT/E as a strategic data source in the digital transformation of key sectors such as aerospace, energy, defense, and infrastructure.

Sunday (July 6, 2025)

5:00 PM	Registration Open
6:00 PM - 8:00 PM	**Opening Reception**

Monday (July 7, 2025)

8:00 AM	Registration Open

Keynotes:

8:00 AM - 9:00 AM	**Practical Use of Models for Quantitative Eddy Current Nondestructive Evaluation (NDE) of Aerospace Materials and Structurers** **Dr. John C. Aldrin**, Computational Tools

Technical Sessions:

Oral Session: Terahertz and Eddy Current Applications

Session Chairs: Junliang Dong(University of Arkansas, USA)

9:00 AM-9:20 AM	(2058)**(Remote)** **INFLUENCE OF PLY ORIENTATION ON EDDY CURRENT BEHAVIOUR IN CFRPs USING INDUCTIVE COUPLING** **Atul Sharma**, Robert Hughes
9:20 AM-9:40 AM	(1991) **AN ANALYTICAL SOLUTION FOR A COIL OUTSIDE A MULTIPLAYER PIPE IN EDDY CURRENT TESTING PROBLEM USING CHENG MATRIX METHOD** **Jiuhao Ge**, Fei Xu
9:40 AM-10:00 AM	(2094) **TERAHERTZ IMAGING FOR NONDESTRUCTIVE EVALUATION** **Junliang Dong**
10:00 AM-10:20 AM	
10:20 AM-10:40 PM	Break

Oral Session: AI and Machine Learning

Session Chairs: Matt Cherry(Air Force Research Laboratory, USA)

10:40 AM-11:00 AM (2061)
Overcoming Data Challenges in Heat Exchanger Tube Inspection with AI-Driven Tools
Etienne Drouin-Provencal

11:00 AM-11:20 AM (2081)
Using 2.5D Super-Resolution to Improve Defect Detection in Steel Additively Manufactured Parts
Haley Duba-Sullivan, Obaidullah Rahman, Singanallur Venkatakrishnan, Amirkoushyar Ziabari

11:20 AM-11:40 AM (2099)
A DATA EFFICIENT SPARSE MODELING FRAMEWORK FOR POWER ESTIMATION IN WATER TREATMENT SENSING OPERATIONS
Subrata Mukherjee, Kris Villez, Alexander Melin

11:40 AM-12:00 PM

12:00 PM-1:00 PM Lunch

Oral Session: Material State Awareness

Session Chairs: Anant Raj(Oak Ridge National Laboratory)

1:00 PM - 1:20 PM (2037)
Magneto-elastic interactions in iron-silicon single crystals: influence of tensile stress on magnetization, magnetostriction, and Barkhausen noise
Benjamin Ducharne

1:20 PM - 1:40 PM (2059)
DETECTION OF WELD LINE IN STEEL TUBES BASED ON EDDY CURRENT TESTING
Dario J. Pasaddas, Prashanth Baskaran, Lian Xie, Mohsen Barzegar, Helena Ramos, Artur Ribeiro

1:40 PM - 2:00 PM (2077)
Nondestructive Residual Stress Measurement of Deep Rolled Nickel Superalloys
Jakob Lotfering, Martin Schulze, Till Schulze, Markus Meurer, Henning

Heuer,Thomas Bergs

2:00 PM - 2:20 PM (2079)
Rapid Time-Resolved 3D Characterization of Printing Flaws in LPBF Ni-282 During Creep
Rahul Franklin, Obaidullah Rahman, Holden Hyer, Sebastien Dryepondt, Amirkoushyar Ziabari

2:20 PM - 2:40 PM (2089)
PREDICTING COMPRESSIVE STRENGTH OF CONCRETE WITH SYNTHETIC APERTURE RADAR IMAGES
Tzuyang Yu

2:40 PM - 3:00 PM (2095)
Eddy Current Characterization of Microtexture Region Orientation in Titanium Alloys
Matt Cherry, Laura Homa, John Wertz, Michael Rogers

3:00 PM - 3:20 PM Break

Oral Session: ECT and Magnetometry I

Session Chairs: Subrata Mukherjee(Oak Ridge National Laboratory)

3:20 PM - 3:40 PM (2039)
RESIDUAL STRESS DISTRIBUTION ANALYSIS WITH A NEW NEEDLE PROBE SETUP
Patrick Fagan, Abdellahi Abderahmane, Mathieu Domenjoud, Laurent Daniel

3:40 PM - 4:00 PM (2098)
Omnidirectional Eddy Current Imaging Technique With Phase-Amplitude Controlled Array
Lei Peng, Na Zhang, Yiming Deng

4:00 PM - 4:20 PM (2022)
A Pot-Cored Sensor for Advanced Corrosion Detection and Characterization
Antonello Tamburrino, Alessandro Sardellitti, Marco Laracca, Filippo Milano, Luigi Ferrigno, Gui Yun Tian

4:20 PM - 4:40 PM (2028)
AN ECT PROBE COMPRISING TWO CIRCULAR ARRAYS OF TMR SENSORS FOR THE INSPECTION OF DEFECTS BENEATH RIVETS
Chaofeng Ye, Chenzhi Zhang, Yu Tao, Yang Wang

Tuesday (July 8, 2025)

8:00 AM	Registration Open

Keynotes:

8:00 AM - 9:00 AM	**Manufacturing with Certainty: The Critical Role of Nondestructive Testing and Evaluation in Advancing Modern Manufacturing** **Dr. Ahmed Arabi Hassen**, Composites Innovation Group, Manufacturing Science Division, Oak Ridge National Laboratory (ORNL)

Technical Sessions:

Oral Session: Modeling and Characterization I

Session Chairs: Matthew Newton (Baylor University, USA)

9:00 AM-9:20 AM	(2104) **Statistical Assesment of Inversion Robustness for Hysteresis Characterisation Using Harmonic Distortion Measurements** **Anastassios Skarlatos**
9:20 AM-9:40 AM	(2054) **Modeling of the inter-layer resistance in carbon fiber reinforced plastic laminates to calculate eddy-current probe signal** **Sandor Bilicz**, Arnold Bingler, Tetsuya Uchimoto, Jozsef Pavo
9:40 AM-10:00 AM	(2087) **Robust eddy-current transient calculations using a z-transfrom approach** **Anastassios Skarlatos**
10:00 AM-10:20 AM	
10:20 AM-10:40 PM	Break

Oral Session: Modeling and Characterization II

Session Chairs: Helena Ramos(Instituto Superior Técnico, Portugal)

10:40 AM-11:00 AM (2049)
Interpolation-Based Analytical inversion for Stress Characterization in Ferromagnetic Materials
Abdellahi Abderahmane, Laurent Daniel

11:00 AM-11:20 AM (2033)
A NUMERICAL MODELLING APPROACH FOR OPTIMAL EDDY CURRENT SENSOR LOCATION IN AEROSPACE WING-SKIN BOLTHOLE INSPECTION
Will Punter, Rob Hughes

11:20 AM-11:40 AM (2085)
REFORMULATION OF THE DODD & DEEDS MODELS BY USING EIGENFUNCTION EXPANSIONS
Theodoros Theodoulidis, Athanasios Kyrgiazoglou

11:40 AM-12:00 PM (2084)
THEORETICAL PREDICTIONS OF MAGNETIC FIELD SIGNALS DUE TO A RECTANGULAR COIL IN A TUBE
Artur Ribeiro, Prashanth Baskaran, Dario Pasadas, Helena Ramos

12:00 PM-1:00 PM Lunch

Oral Session: Digital Twins, Data Fusion and Inverse Problems

Session Chairs: Ian Gravagne (Baylor University, USA)

1:00 PM - 1:20 PM (2075)
Metal artifact reduction in X-ray computed tomography of TRISO fuel compacts
Obaidullah Rahman, William Chuirazzi, Ryan Dehoff, Amir Ziabari

1:20 PM - 1:40 PM (2088)
DATA FUSION APPROACH TO LAYUP CHARACTERIZATION OF CFRP LAMINATES USING ECT, UT, AND CT
Matthew Newton, Rachel Van Lear, Pruthul Ravindranath Kokkada, David Jack, Ian Gravagne

1:40 PM - 2:00 PM (2070)
An Approximation Model for a Yoke Ferrite Core ECT Probe Simulation Using a Hybrid Approach

Athanasios Kyrgiazoglou, Anastassios Skarlatos, Theodoros Theodoulidis

2:00 PM - 2:20 PM (2090)
SIMULTANEOUS ESTIMATION OF ELECTRICAL CONDUCTIVITY, THICKNESS, AND LIFT-OFF OF LAMINATES VIA EDDY CURRENT TESTING
Vincenzo Mottola, Luigi Ferrigno, Marco Laracca, Filippo Milano, Alessandro Sardellitti, Antonello Tamburrino

2:20 PM - 2:40 PM

2:40 PM - 3:00 PM

3:00 PM - 3:20 PM Break

Oral Session: ECT and Magnetometry II

Session Chairs: Will Punter(University of Bristol, UK)

3:20 PM - 3:40 PM (2082)**(Remote)**
PULSED MULTIFREQUENCY EXCITATION AND SPECTROGRAM EDDY CURRENT TESTING (PMFES-ECT) METHOD
Tomasz Chady

3:40 PM - 4:00 PM (2071)
DETECTION OF SUBSURFACE DEFECTS IN STEEL TUBES WITH AN EXTERNAL SURFACE FERROMAGNETIC LAYER
Helena Ramos, Prashanth Baskaran, Artur Ribeiro

4:00 PM - 4:20 PM (2035)
Advanced nondestructive detection of grinding burns via NV-center based magnetometry
Benjamin Ducharne

4:20 PM - 4:40 PM (2047)**(Remote)**
NOVEL TRANSMISSION UNIFORM EDDY CURRENT TESTING TECHNIQUE FOR INSPECTION OF STAINLESS STEEL CRACKS
Xiangyang Wang, Wei Li, Xin'an Yuan, Xiaokang Yin, Xiao Li, Guoming Chen, Jianchao Zhao, Jianxi Ding, Qinyu Chen

6:00 PM - 9:00 PM **Conference Banquet**

Wednesday (July 9, 2025)

Technical Sessions:

Oral Session: Structural Health Monitoring and Damage Diagnosis

Session Chairs: Benjamin Ducharne (ELyTMaX, Tohoku University, Japan)

9:00 AM-9:20 AM (2109)
Eddy current experiments for monitoring sub-surface temperature dynamics: towards an in-situ metal additive manufacturing diagnostic
Saptarshi Mukherjee, Ethan Rosenberg Edward Benavidez, Peng Lei, Yiming Deng, David Stobbe, Joseph W. Tringe

9:20 AM-9:40 AM (2092)
Feasibility of electrical impedance tomography for defect monitoring in graphite for microreactors
Anant Raj, Brandon Schreiber, Pradeep Ramuhalli, Christian Petrie

9:40 AM-10:00 AM (2078)
Advanced Surface Fitting Model of Monocular Underwater Laser Scanning
Jicen Hu, Yiming Deng

10:00 AM-10:20 AM

10:20 AM-10:40 PM Break

Oral Session: Advanced Sensors and Sensing Systems

Session Chairs: Saptarshi Mukherjee (Lawrence Livermore National Laboratory, USA)

10:40 AM-11:00 AM (2086)
Deep Learning Based Sparse X-ray CT Image Reconstruction of Thick and Complex AM Parts Made of High-Density Nickle Super-Alloys
Amirkoushyar Ziabari, Zackary Snow, Julio Ortega, Vincent Paquit

11:00 AM-11:20 AM (2076)
Domain wall activity and magnetic losses under rotational magnetization: classical and Barkhausen noise hysteresis cycles
Benjamin Ducharne, Floran Martin, Anouar Belahcen

11:20 AM-11:40 AM (2100)**(Remote)**
Double Modes of Torsional Guided Waves for Locating and Quantifying Cracks in Riser Using Electromagnetic Acoustic Transducer

Jianlei Liu, Yanting Zhang, Wei Li, Xiao Li, Xiaokang Yin, Xin’an Yuan

11:40 AM-12:00 PM (2103)**(Remote)**
Spatial Light Path Analysis and Calibration Method for Underwater Structured Light Vision System
Xingpei Chen, Wei Li, Xiao Li, Xin'an Yuan, Xiaokang Yin

12:00 PM-5:30 PM ORNL Tour Departs at 12:30 PM, box lunch provided.