(DEEMED TO BE UNIVERSITY)

CATEGORY 1 UNIVERSITY
BY MHRD, Govt. of India

KL ACCREDITED BY NAAC WITH A++
GRADE

nirf 2024 NATIONAL INSTITUTIONAL RANKING FRAMEWORK

RANKED 22 AMONG ALL UNIVERSITIES

45 YEARS OF EDUCATIONAL LEADERSHIP

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

InfraRed Imaging Center

INFRARED IMAGING CENTER

ABOUT THE RESEARCH CENTER

The infrared imaging center (IRIC) is developed for non-destructive testing of industrial components, intended for assessing the integrity and quality assurance of aerospace materials like composites, metallic rods, and slabs as well as polycrystalline wafers. This lab develops various thermal wave imaging modalities, and processing algorithms for non stationary thermal wave imaging having a special focus on improving depth resolution and detectability enhancement. We undertake projects from various organizations of both the public and private sectors. We develop user-friendly systems for thermographic NDT of solids and build theoretical foundations to facilitate the scientific exploration of these modalities.

VISION

To be a globally renowned laboratory to facilitate infrared imaging for variety of applications.

MISSION

To develop an indigenous systems and algorithms by undertaking academic and sponsored research with an emphasis on application and innovation that cater to the contemporary industrial requirements through the young talent.

OBJECTIVES

1. To promote inter-disciplinary studies and create needful facilities that enhance inter-disciplinary research and innovation.
2. To create an ambience that is conducive for undertaking sponsored research, internal funded research and offering consultancy services to a wide spectrum of organization.
3. To maintain high standards in achieving research outcomes and proposing novel methods to improve spatial and temporal resolutions and depth scanning capacities in thermal imaging of objects under low stimulation powers.
4. To promote international conferences / Seminars / Workshops / in collaboration with professional bodies for creation of avenues for research exchange

KEY RESEARCH AREAS

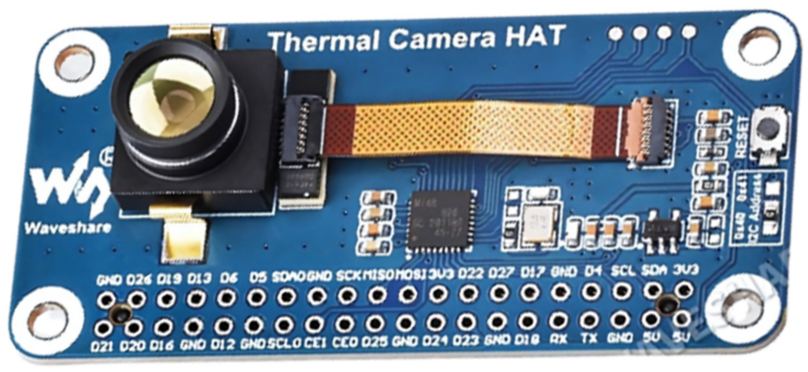
- Subsurface sensing through thermal imaging.
- Industrial vision and automation.
- Condition monitoring and structural health evaluation.
- Compressive thermal wave imaging.
- Deep technologies for spatial and depth resolution in thermal imaging.
- Bio medical imaging through thermal waves.

EQUIPMENT DETAILS

Thermal camera model: FLIR SC 655A

- **Resolution:** 640*480 pixels
- **Detector Type:** Uncooled Microbolometer
- **Spectral Range:** 7.5 – 14.0 µm
- **Thermal Sensitivity (NETD):** <30 mK
- **Frame Rate: 50 Hz (full frame);** up to 200 Hz with windowing
- **Temperature Measurement Range:** –40°C to 150°C and 100°C to 650°C**Accuracy:** 32°C or 32% of reading
- **Lens Options:** Various lenses available, including close-up lenses for microscopic imaging
- **Interface:** Gigabit Ethernet, USB
- **Power Supply:** 12/24 VDC, 24 W max
- **Dimensions:** 216 73 75 mm
- **Weight:** Approximately 0.92 kg

Raspberry Pi-Based Infrared Imaging System



- **Camera:** FLIR Lepton IR Camera
- **Processor:** Raspberry Pi 4
- **Purpose:** Portable thermal imaging in long IR range for NDT.
- **On-site inspections for industrial and scientific purposes.**
- **Quick thermal imaging in remote locations.**

FLIR Lepton IR Camera

Enhanced IR sensor: greater resolution and sensitivity than common thermopile arrays

- **160 x 120 active pixels**
- **Thermal sensitivity**
- **Low operating power:** 140 mW typical, 650 mW during shutter event
- **Low power standby mode**

Micro thermal imager: uncooled thermal imaging for small electronics

- 56° lens
- Integrated digital thermal image processing
- Integrated shutter
- Fast time to image (<0.5 seconds)

EQUIPMENT DETAILS

Halogen Lamp

- **Purpose:** Produces light with higher luminous efficacy and colour temperature.
- **Application:** Provides controlled stimulation in modulated thermal wave imaging of solids.
- High luminous efficacy.
- Compact and durable design.
- Controlled thermal stimulation in scientific imaging systems.

Control Unit

Gigabit Ethernet (GigE):

- **Data Streaming Rates:** Full-frame (640 480 pixels) at 50 Hz

USB 2.0 High-Speed (USB2 HS):

- **Data Streaming Rate:** 16-bit 640 480 pixels at 25 Hz
- **Connector Type:** USB Mini - B
- **Supply Voltage:** 6–24 VDC, max. 200 mA

IRNDT Experimental setup

- **Purpose:** Controls and coordinates signals for facilitating IRNDT base software on the processing unit.
- **Components:** Infrared camera, Halogen lamps, Thermogram processing unit, Software interface.

TEAM MEMBERS IRIC

Dr. G V Subbarao,
Professor In ECE&
Professor Incharge- IRIC
Signal Processing for Infrared imaging
h-index:18, Citations:1252, Publications: 96

Dr. S Koteswararao
Professor in ECE &
Former Scientist H, DRDO
Underwater target tracking expert
h-index:17, Citations:1101, Publications: 208

Dr. D V A Rama Sastry
Assoc. Professor In M E
Infrared imaging for condition
monitoring applications
h-index:6, Citations:110, Publications: 110

Dr Suman Maloji
Professor & Head-Department in ECE
Vice Principal, KL College of Engineering
h-index:13, Citations:537, Publications: 83

Dr. B.Suresh
Assoc. Professor In ECE
Signal Processing for Infrared imaging
h-index:8, Citations:238, Publications: 34

Dr. M. Parvez
Assoc. professor, ECE
Signal Processing for Infrared imaging
h-index:9, Citations:180, Publications: 28

Mr. S S Banda
Asst. Professor In ECE
ML & DL for Infrared imaging
h-index:3, Citations:7, Publications: 6

OUR COLLABORATORS

Dr. R. Mulaveesala,
Professor, SenSE, IIT Delhi

Dr, Junyan Liu,
Professor,
Department of Mechatronics,
Harbin institute, China.

Dr. V. Vavilov,
Professor,
Tomsk Polytechnic,
Mosko, Russia.

Dr. Fei Wang,
Associate Professor,
Department of Mechatronics,
Harbin institute, China

Dr. Baloji Naik,
Scientist.E,
NMRL, India

Dr. Ramprasad Bhaskaran,
Scientist.E,
LPSC, Bangalore.

SCHOLARS INFORMATION

Ph.D's Awarded

NAME OF THE SCHOLAR	TITLE OF THE THESIS
B.Suresh	A thermographic System for Enhanced Subsurface Detail Visualization Through Automatic Detection
Sk. Subhani	Quantitative Thermal Wave Detection and Ranging for Non-Destructive Testing of Solids
A. A.V. Lakshmi	A Machine Learning Based Thermographic System To Characterize The SubSurface Anomaly For Solids
Md. M. Pasha	Compressed Thermal Wave Detection and Ranging For Subsurface analysis of Solids
V.G.Tilak	Deep Learning Based Automatic Qualitative and Quantitative System for Composite Material Inspection Using QFMTWI

Scholars Working

REGD.NO	NAME OF THE SCHOLAR
15304041	Ch. Rajlakshmi
183040065	G V P Ch Sekhar
2002041047	Y. Nagaprasanthi
2202040103	B. Saisandeep
2302040008	Sk. Aashik
2302040010	M. Naga Swapna

HIGHLIGHTS OF RESEARCH CENTRE WORKS

- The infrared imaging centre (IRIC) was developed in 2015 with funds from inhouse funding of KLEF and DST-SERB sponsored research grant DST-SERB/SB/S3/EECE/0139/2013, with state of art uncooled infrared imaging camera Flir A 655SC, A set of halogen lamps and other control equipment to facilitate thermal wave imaging of aerospace and industrial materials intended for assessing the integrity and quality assurance.

- Lab acquired a research grant of about 1.10 crore through external funding from four research projects and produced 5 Ph.D.'s in infrared imaging and about 30 B.Tech projects.

- Faculty and scholars published about 100 articles in peer reviewed journals including journals from publishers like Elsevier, Springer etc., publishers and Journals from professional societies like IEEE, BiNDT, AIP, IOP etc.,

- IRIC also support industrial consultancy for testing and quality assurance of industrial components from various private agencies and govt agencies like HAL LPSC etc., It is involved in pioneering research in developing nonstationary thermal wave imaging and processing techniques facilitating enhanced depth and spatial resolutions to improve subsurface analysis feature analysis and quantitative studies.

- IRIC involves in developing theoretical models for quantitative studies in non-stationary thermal wave imaging by proving its uniqueness in this area with its collaborative activities.

SDG GOALS RELATED PUBLICATIONS

Sustainable Development Goals

Goal 3: Good health and well-being	1 document	Goal 17: Partnership for the goals	1 document
Goal 9: Industry, innovation and infrastructure	3 documents		

PROJECTS – SPONSORED, AGENCIES

Projects Completed

TITLE	SPONSORING AGENCY	AMOUNT	DURATION
Depth resolution and sizing studies in thermal wave detection and ranging (TWDAR) File.No: DST-SERB/SB/S3/EECE/0139/2013	DST	32.5 L	2013-2017
Compressive thermal wave detection and ranging (CTWDAR) File.No: RA.30-29/2014-2016-GE-ANP-5573 (SAII)	UGC	33.638 L	2014-2016
Development of a Nonstationary thermal wave imaging-based system for quantitative coating thickness evaluation and subsurface anomaly detection. File.No: NRB/MAT/423/18-19	DRDO-NRB	32.4 L	2018-2023

Ongoing Projects

TITLE	SPONSORING AGENCY	AMOUNT	DURATION
Thermal imaging of Electron beam welds ISRO- RESP-LPSC-005/2023-24	ISRO-LPSC	12.56 L	2023-2025
Performance evaluation of all TMA algorithms for BOT & calculation of MLA & SOA for identified zigging targets NSTL/CARS/2022/05	DRDO-NSTL	36.48L	2022-2025
Submarine to submarine passive target tracking using deep neural Kalman filter NRB/SSB/496/22-23	DRDO-NRB	31.6L	2022-2024
Estimation of trajectory for aerial target and development of end game algorithm for maneuvering of UAV DYSL-AT/CARS/RSQR/AS/2022-23/01	DRDO-DYSL	20.768L	2022-2024

COLLABORATIVE PUBLICATIONS

- Banda, S.S, Ghali, V.S,Vesala, G.T, Mulaveesala, R, “Non-linear frequency modulated thermal wave imaging for subsurface analysis,” Infrared Physics and Technology, 2024, 138, 105248.

- Li, R, Bu. C, Zhang. H, Wang. F, Ghali, V.S. Vavilov.V.P, “Dynamic infrared scanning thermography based on CNN: a novel large-scale honeycomb defect detection and classification technique,” Journal of Thermal Analysis and Calorimetry, 2024.

- Vesala, G.T., Ghali, V.S., Sastry, D.V.A.R., Naik, R.B, “ Deep anomaly detection model for composite inspection in quadratic frequency modulated thermal wave imaging,” NDT and E International, 2022, 132, 102710.

- Vesala, G.T., Srinivasarao, G., Ghali, V.S., Sastry, D.V.A.R., Naik, R.B, “ Non-Stationary Thermal Wave Mode Decomposition: A Comparative Study of EMD, HVD, and VMD for Defect Detection, “Russian Journal of Non destructive Testing, 2022, 58(6), pp. 521–535.

- Vesala, G.T., Ghali, V.S., Rama Sastry, D.V.A., Naik, R.B, “Thermal Wave Mode Decomposition for Defect Detection in Non-Stationary Thermal Wave Imaging,” Mapan - Journal of Metrology Society of India, 2023, 38(1), pp. 133–145.

PATENTS

- System and method for estimation of thickness of coating using quadratic frequency modulated thermal wave imaging, Patent Application No: 201941016189, Dt of filing: 27-04-2019.

- Apparatus and equipment for doctors, hospitals and laboratories, Application No: 392325-001, Dt of filing: 13-08-23.

CONSULTANCY

- Thermographic characterization of delamination in CFRP composite laminates.
- Locating delamination in UPVC material
- Identifying the scratches and cracks
- Submarine to submarine passive target tracking using Deep neural Kalman filter
- Performance Evaluation of all TMA Algorithms for BOT & Calculation of MLA & SOA for Identified Zigging targets.
- Estimation of trajectory for aerial target and development of end game algorithm for manoeuvring of UAV.

PROMINENT PUBLICATIONS

- Banda, S.S, Ghali, V.S,Vesala, G.T, Mulaveesala, R, “Non-linear frequency modulated thermal wave imaging for subsurface analysis,” Infrared Physics and Technology, 2024, 138, 105248.

- Li, R, Bu. C, Zhang. H, Wang. F, Ghali, V.S. Vavilov.V.P, “Dynamic infrared scanning thermography based on CNN: a novel large-scale honeycomb defect detection and classification technique,” Journal of Thermal Analysis and Calorimetry, 2024.

- Vesala. G.T, Ghali. V.S, Prasanthi. Y.N, Suresh. B, “Parametric Study of Anomaly Detection Models for Defect Detection in Infrared Thermography,” Russian Journal of Nondestructive Testing, 2023, 59(12), pp. 1259–1271.

- Pasha. M.M., Ghali.V.S, Vesala, G.T, Suresh. B, “Compressive Thermal Wave Imaging for Subsurface Analysis,” Russian Journal of Nondestructive Testing, 2023, 59(2), pp. 215–227.

- Parvez. M, Ghali, V.S, Santulli, C, “Deep learning-based sustainable subsurface anomaly detection in Barker-coded thermal wave imaging,” International Journal of Advanced Manufacturing Technology, 2023, 127(7-8), pp. 3625–3635.

- Vesala, G.T., Ghali, V.S., Sastry, D.V.A.R., Naik, R.B, “ Deep anomaly detection model for composite inspection in quadratic frequency modulated thermal wave imaging,” NDT and E International, 2022, 132, 102710.

- Vesala, G.T., Srinivasarao, G., Ghali, V.S., Sastry, D.V.A.R., Naik, R.B, “ Non-Stationary Thermal Wave Mode Decomposition: A Comparative Study of EMD, HVD, and VMD for Defect Detection, “Russian Journal of Non destructive Testing, 2022, 58(6), pp. 521–535.

- Vesala, G.T., Ghali, V.S., Rama Sastry, D.V.A., Naik, R.B, “Thermal Wave Mode Decomposition for Defect Detection in Non-Stationary Thermal Wave Imaging,” Mapan - Journal of Metrology Society of India, 2023, 38(1), pp. 133–145.

- Subhani, S., Chandra Sekhar Yadav, G.V.P., Ghali, V.S, “Defect characterisation using pulse compression-based quadratic frequency modulated thermal wave imaging,” IET Science, Measurement and Technology, 2020, 14(2), pp. 165–172.

- Parvez M, M., Shanmugam, J., Ghali, V.S, “ Decision tree-based subsurface analysis using Barker coded thermal wave imaging,” Infrared Physics and Technology, 2020, 109, 103380.

- Vijaya Lakshmi.A, Ghali. V.S, Subhani. Sk, “Automated quantitative subsurface evaluation of fiber reinforced polymers,” Infrared Physics and Technology, 2020, 110, 103456.

- Subhani. S, Ghali. V.S, “Measurement of thermal diffusivity of fiber reinforced polymers using quadratic frequency modulated thermal wave imaging,” Infrared Physics and Technology, 2019, 99, pp. 187–192.

- Subhani, S.K., Suresh, B., Ghali, V.S, “ Quantitative subsurface analysis using frequency modulated thermal wave imaging,” Infrared Physics and Technology, 2018, 88, pp. 41–47.

- Subhani, S.K., Suresh, B., Ghali, V.S, “Empirical mode decomposition approach for defect detection in non-stationary thermal wave imaging,” NDT and E International, 2016, 81, pp. 39–45.

- Ghali, V.S., Suresh, B., Hemanth, A, “Data fusion for enhanced defect detectability in non-stationary thermal wave imaging,” IEEE Sensors Journal, 2015, 15(12), pp. 6761–6762, 7219361.

No. of Publications-IEEE, SCI, SCIE, WoS and Scopus - 85

OTHER ACHIEVEMENTS

- Dr. G V Subbarao Received Indian government's "UGC Research award" in 2014.
- Dr. B. Suresh received best thesis award from SPNL Technologies, Pvt Limited in 2021.
- Dr. B. Suresh received "Award of Excellency in Research" from Novel Research Academy in 2022.
- Dr. B Suresh received best "Young researcher award" from Rajaram Mohan Roy national Agency in 2022.
- Dr. B Suresh received "India prime 100 researchers" award Foxclues in 2021.
- Developed an indigenous compact thermal imaging system for insitu NDT applications.

CONTACT DETAILS

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