



Report on One Week FDP (Hybrid mode) on

“Recent Advances and Research Trends in Microwave, Millimeter Wave Antennas and RF Communication Systems”

Event Type : FACULTY DEVELOPMENT PROGRAM (FDP)

Date / Duration : 4th – 9th May, 2026 (ONE WEEK)

Resource Persons :

1. Dr. Shiv Narayan, Senior Principal Scientist, CSIR-National Aerospace Laboratories, Bangalore
2. Dr. Rajkishor Kumar, Associate Professor, VIT Vellore
3. Dr. Saptarshi Ghosh, Associate Professor, IIT Indore
4. Dr. P. Rakesh Kumar, Associate Professor, Lakireddy Bali Reddy College of Engineering, Mylavaram
5. Dr. Divya Chaturvedi, Assistant Prof, IIIT Pune
6. Dr. Sunil Chinnadurai, Associate Professor, SRM University - AP

Convener : Dr. G.Srinivasulu, Professor & HoD

Coordinators : Dr. K Rani Rudrama, Associate Professor
Ms. M V L Bhavani, Sr. Asst. Professor

Co-Coordinator : Dr. P. Rakesh Kumar, Associate Professor

Total no of Participants: 134 (Internal Count=37 & External Count=97)

Objective of the event: The Faculty Development Program (FDP) on "Recent Advances and Research Trends in Microwave, Millimeter Wave Antennas and RF Communication Systems" was organized with the following objectives:

- To provide participants with knowledge of recent developments in microwave, millimeter-wave, and RF communication technologies.

- To familiarize faculty members, researchers, and students with emerging antenna design techniques and applications.
- To promote awareness of current research trends in wireless communication systems, aerospace applications, IoMT, and 6G technologies.
- To facilitate interaction with experts from reputed academic institutions and research organizations.
- To encourage research and innovation in antenna engineering and RF system design.

Outcome of event:

The FDP successfully achieved its intended objectives and resulted in the following outcomes:

- Participants gained comprehensive knowledge of advanced antenna technologies and modern RF communication systems.
- The sessions enhanced understanding of frequency selective surfaces, dielectric resonator antennas, meta surface antennas, and reconfigurable antennas.
- Participants were exposed to emerging applications of antennas in aerospace systems, healthcare diagnostics, IoMT, and next-generation 6G networks.
- The FDP provided valuable insights into current research challenges and future directions in microwave and milli meter-wave technologies.
- The program strengthened research interest and encouraged collaborative research activities among faculty members and scholars.

Description / Report on Event:

The one-week Faculty Development Program (FDP) on “Recent Advances and Research Trends in Microwave, Millimeter Wave Antennas and RF Communication Systems” commenced with an inaugural session organized by the Department of Electronics and Communication Engineering, LBRCE. The program was conducted in hybrid mode from 04th to 09th May 2026.

Day 1 – 04.05.2026

On Day 1, The inaugural session was graced by Dr. B. Ramesh Reddy, Vice Principal, LBRCE, and Dr. G. Srinivasulu, Head of the Department of ECE. Addressing the gathering, Dr. G. Srinivasulu emphasized the importance of staying updated with the latest developments in microwave engineering, antenna technologies, and RF communication systems. He highlighted the need for multidisciplinary research and encouraged faculty members, researchers, and students to explore emerging technologies and innovative applications in wireless communications. In his inaugural address, Dr. B. Ramesh Reddy appreciated the initiative taken by the department in organizing the FDP and emphasized the significance of continuous learning and research in rapidly evolving communication technologies. He

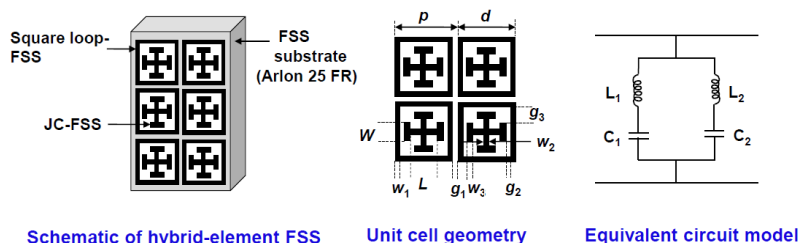
mentioned that the FDP would provide an excellent platform for participants to interact with experts from reputed institutions, gain exposure to recent advancements, and strengthen their research capabilities in the areas of microwave, millimeter-wave, and RF communication systems.

Following the inaugural session, the first technical session was delivered by **Dr. Shiv Narayan, Senior Principal Scientist, CSIR–National Aerospace Laboratories, Bangalore**, on **“Frequency Selective Surfaces for Aerospace Applications: Antenna, Radome and Radar Absorbing Structures.”** The speaker discussed the design principles, characteristics, and applications of frequency selective surfaces in aerospace systems. The session provided valuable insights into antenna radomes, electromagnetic shielding techniques, and radar absorbing structures employed in modern aerospace platforms. Participants gained a comprehensive understanding of the role of these structures in improving antenna performance and reducing radar signatures in aerospace applications.



1.1 Advanced FSS Structures (Stealth Applications)

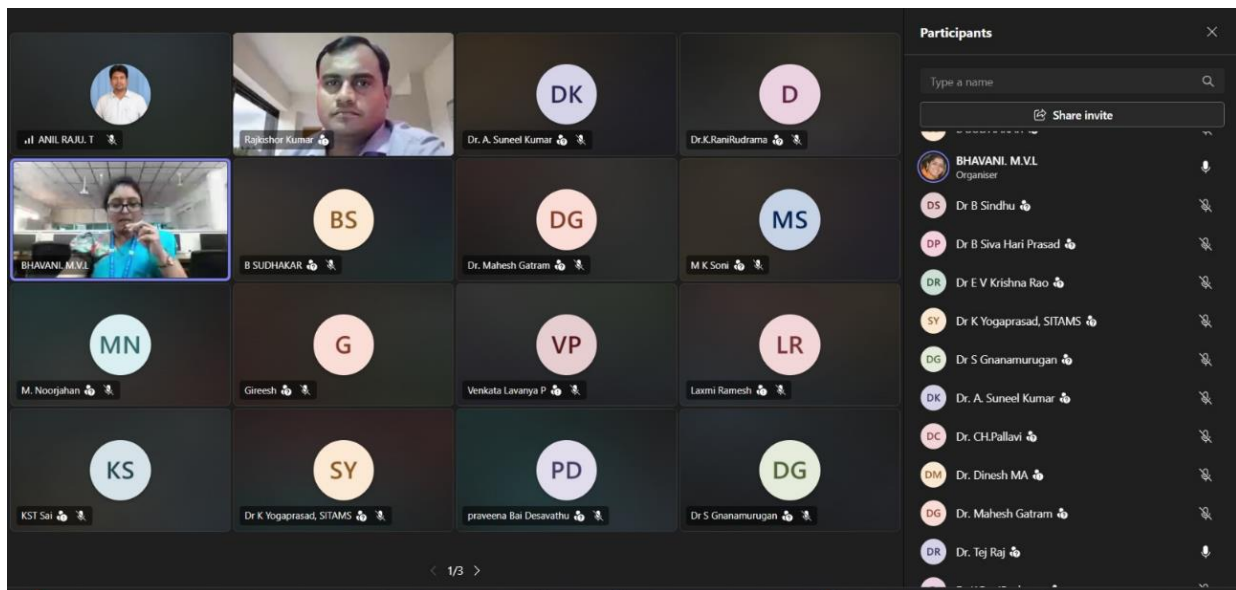
Novel Hybrid-element based FSS Structure



Day 1: Inaugural Session and Expert Lecture by Dr. Shiv Narayan

Day 2 – 05.05.2026

The second session was delivered by **Dr. Rajkishor Kumar, VIT Vellore**, on "**Different Feeding Techniques-Based Circularly Polarized Dielectric Resonator Antennas.**" The lecture focused on dielectric resonator antenna technology and various feeding techniques employed to achieve circular polarization. Participants gained knowledge about antenna performance enhancement and applications in modern wireless communication systems.



SHAPES AND MODE CHARACTERISTICS OF DRA

➤ DRA have various shapes and these shapes are divided into two types.

1. Basic shapes such as hemispherical, cylindrical and rectangular
2. Modified or deformed shapes such as triangular, ring cylindrical, half-split cylindrical, trapezoidal, pentagonal.

Basic Shapes of DRA

The image shows three diagrams of Dielectric Resonator Antennas (DRA) on a ground plane. Each diagram includes a coordinate system (x, y, z) and a 'Far-Field Observation Point' defined by radial distance r and elevation angle θ .

- Hemispherical DRA:** The fundamental modes are TE_{111} and TM_{101} . r (radial), ϕ (azimuth), θ (elevation).
- Cylindrical DRA:** The fundamental modes are $TE_{01\delta}$, $TM_{01\delta}$ and $HE_{11\delta}$. azimuthal (ϕ), radial (r), axial (z).
- Rectangular DRA:** The fundamental modes are TE_{111}^x , TE_{111}^y , and TE_{111}^z , which radiate like short magnetic dipoles in the x -, y - and z -direction, respectively.

5

A smaller version of the Zoom meeting grid from the previous image, showing the same 16 participants in a 4x4 layout. The 'Participants' list on the right is also present.

COUPLING MECHANISM OF DRA

- EM Power must be coupled into or out of the DRA through one or more ports.
- When coupling to a DRA, the source can be modelled as either an electric or magnetic current.
- Various Coupling mechanism is available to coupled the DRA.

❖ **Coaxial Probe**

❖ **Microstrip**

❖ **Conformal Strip**

❖ **Aperture**

❖ **Coplanar Waveguide**

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APPLICATIONS OF DRA AND CP WAVES

❖ **DRA APPLICATIONS**

- In Wireless Applications like
 1. WiMAX System
 2. MIMO wireless System
 3. WLAN and GPS System
- In Wireless portable devices like Digital gadgets
- Wide band applications
- Satellite Communication

❖ **CP APPLICATIONS**

- Polarisation losses due to misalignment
- Phasing Issues
- Mitigation of multipath propagation
- Reduced effect of weather conditions and provide large signal coverage

$PLF = |\hat{\rho}_w \cdot \hat{\rho}_a|^2 = 1$
(aligned)

$PLF = |\hat{\rho}_w \cdot \hat{\rho}_a|^2 = \cos^2 \psi_p$
(rotated)

$PLF = |\hat{\rho}_w \cdot \hat{\rho}_a|^2 = 0$
(orthogonal)

$\hat{\rho}_w$ = unit vector of the wave
 $\hat{\rho}_a$ = Polarization vector
 ψ_p = angle between the two unit vectors

Fig. Polarization loss factors for transmitting and receiving linear wire antennas

19

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Circularly Polarized Dielectric Resonator Antennas Based on Aperture Technique

- ❖ Targets and Objectives
- ❖ Design-I
- ❖ Design-II
- ❖ Summary of the Proposed Structures
- ❖ Contributions

Proposed Antenna-I

Proposed Antenna-II

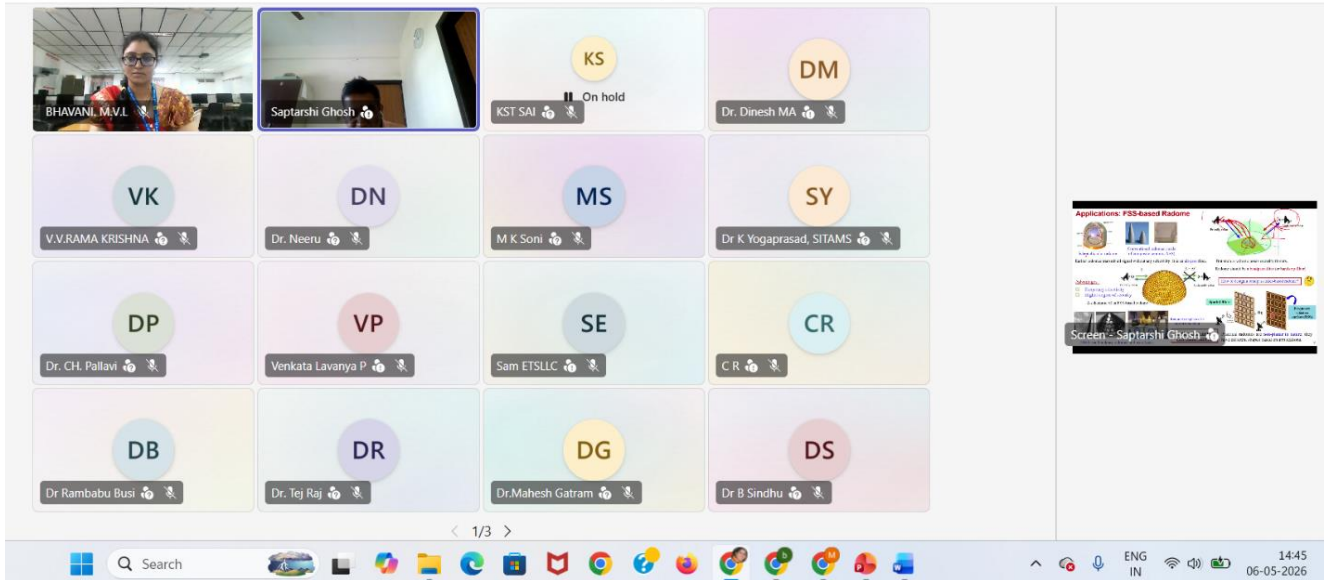
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05-05-2026

Day 3 – 06.05.2026

The third session was conducted by **Dr. Saptarshi Ghosh, IIT Indore**, on "**Recent Advances in Metasurface Antennas for Wireless Communication Systems.**" The speaker explained the fundamentals of metasurface technology and its role in improving antenna characteristics such as gain, bandwidth, and beam steering. Recent research developments and future opportunities in wireless communication applications were also discussed.



A screenshot of a presentation slide. The title is "Recent Advances in Metasurface Antennas for Wireless Communication Systems". Below the title is the logo of Indian Institute of Technology Indore and the name "Dr. Saptarshi Ghosh". Underneath, it says "Associate Professor, Department of Electrical Engineering, Indian Institute of Technology Indore". On the right side of the slide, there is a "Participants" list with a search bar and a "Share invite" button. The list includes: SY (Dr K Yogaprasad, SITAMS), DB (Dr Rambabu Busi), DG (Dr S Gnanamurugan), DP (Dr. CH. Pallavi), DM (Dr. Dinesh MA), DM (Dr. K. H. Murali), DN (Dr. Neeru), DR (Dr. Tej Raj), and G (G.L.N.Murthy). The Zoom interface at the bottom shows the Windows taskbar and system tray icons (14:11, 06-05-2026).

A screenshot of a presentation slide titled "Overview of Metamaterials and Metasurfaces". The slide defines "Metamaterials" as artificial composite materials with structural units smaller than the wavelength. It also defines "Metasurface: 2-dimensional metamaterial". The slide contains several diagrams and equations. A diagram shows a unit-cell driven metasurface with a size $< \lambda/4$. A graph shows the real and imaginary parts of permittivity (ϵ) and permeability (μ) versus frequency. Equations for effective permittivity and permeability are given: $\epsilon_{eff} = 1 - \frac{\omega_p^2}{\omega^2}$ and $\mu_{eff} = 1 - \frac{F\omega^2}{\omega^2 - \omega_0^2}$. The phase constant k is given by $k^2 = \epsilon_{eff} \mu_{eff} \frac{\omega^2}{c^2}$. A list of properties for metasurfaces is provided: Controllable EM properties, positive/negative permittivity and permeability, positive/negative refractive index, and opposite group and phase velocity. Bibliography references are listed at the bottom: [1] J. B. Pendry, et al. Phys. Rev. Lett., 1996. [2] L. B. Pendry, et al. IEEE Transactions on Microwave Theory & Techniques., vol. 47, no. 11, pp. 2075-2084, Nov. 1999. The Zoom interface at the bottom shows the Windows taskbar and system tray icons (14:17, 06-05-2026).

Non-Planar FSS-based Radome

Simulation setup for non-planar surfaces:

Conical shaped radome structure:

Bandstop filter design at X-band (10 GHz)

Fabricated prototypes

Measured S_{21} for elliptical surface

Measured S_{21} for hemispherical surface

The transmission coefficient (S_{21}) response remains relatively same.

However, the unit cells are not uniformly placed on the top, which leads to poor angular stability.

10

14:47
06-05-2026

Metasurface-Assisted Antennas

Artificial magnetic conductor (AMC)-based Antennas:

Gain comparison

Gain improvement: 35%
Bandwidth improvement: 24%

Radiation of the monopole with FSS as reflector

Directivity of the antenna has significantly been improved.

Use of AMC in close proximity of an antenna

Simulation set up of AMC geometries [18]

AMC-backed millimeter-wave antenna

Gain comparison

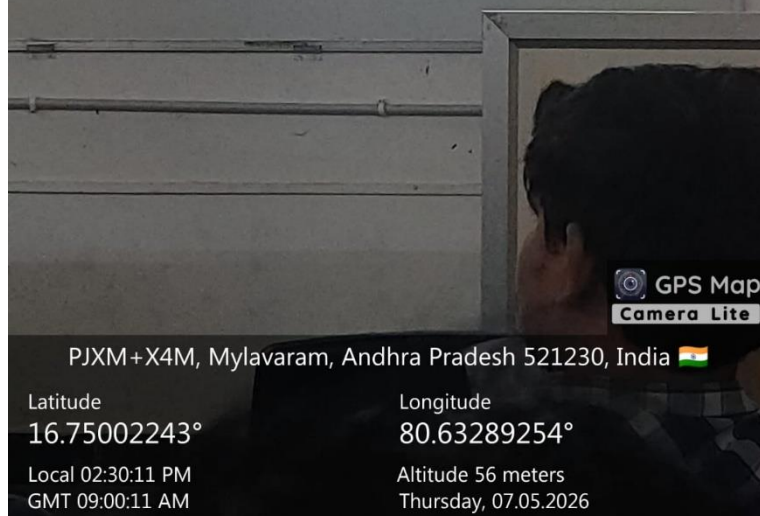
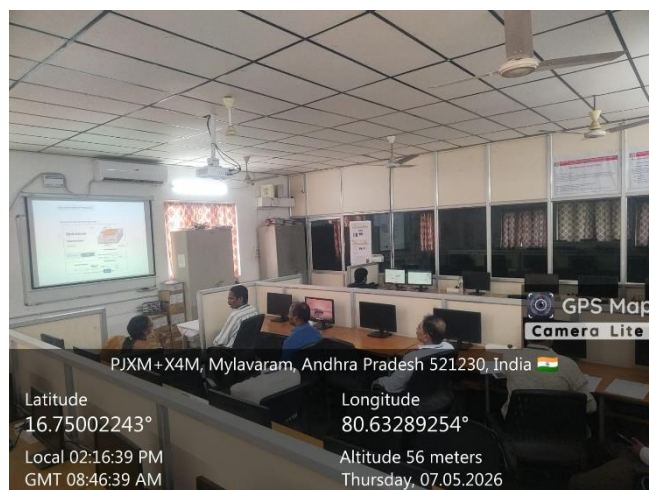
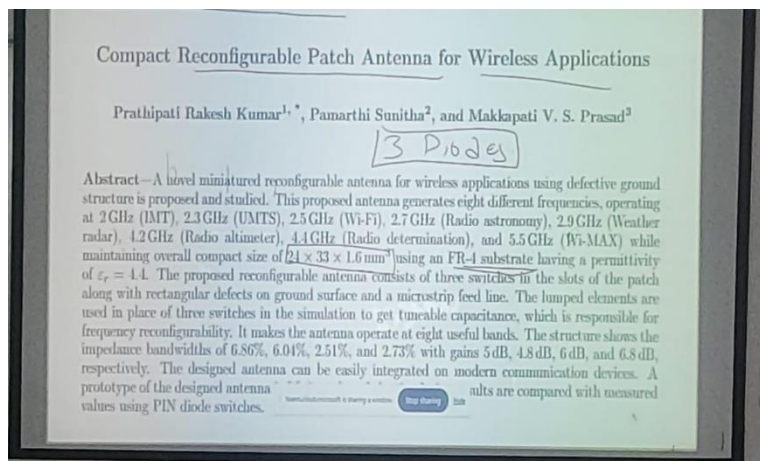
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06-05-2026

Day 4– 07.05.2026

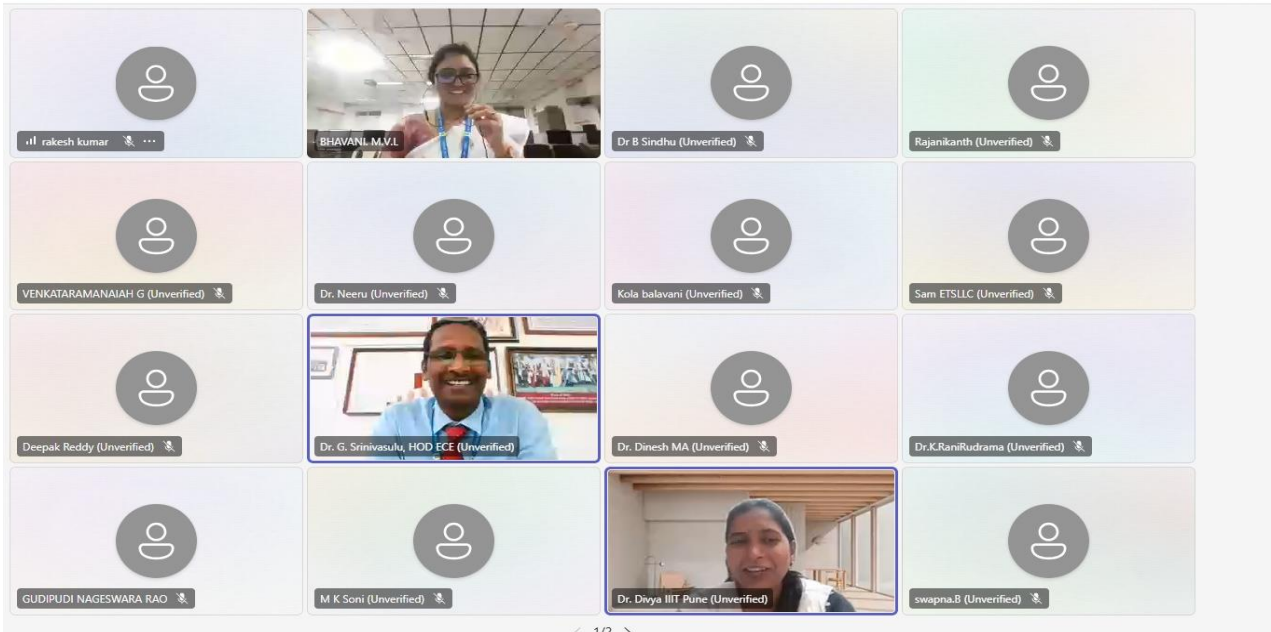
The fourth day session was conducted in offline mode by **Dr. P. Rakesh Kumar**, Associate Professor, Department of ECE, LBRCE, on “Design and Analysis of Reconfigurable Antenna.” The session focused on the fundamental concepts, design methodologies, and performance analysis of reconfigurable antennas. Participants gained insights into frequency, pattern, and polarization reconfigurability and their significance in modern wireless communication systems.

The session also included a **hands-on training component using ANSYS HFSS**, where participants were introduced to the practical aspects of antenna design and simulation. Dr. P. Rakesh Kumar demonstrated the modeling, simulation, and performance evaluation of antennas using HFSS software. The hands-on experience enabled participants to understand the complete antenna design workflow, including parameter optimization, radiation pattern analysis, gain evaluation, and impedance matching techniques. The interactive session enhanced the practical skills of the participants in antenna design and electromagnetic simulation.



Day 5 – 08.05.2026

The fifth day session was delivered by **Dr. Divya Chaturvedi, IIIT Pune**, on **"IoT Enabled Antenna Array Sensors for Non-Invasive Breast Cancer Detection."** The session highlighted the integration of antenna sensor technologies with the Internet of Medical Things (IoMT) for healthcare applications. The speaker discussed microwave imaging techniques and the development of non-invasive systems for early breast cancer detection.



IMPORTANCE OF MICROWAVE IMAGING

- **Microwave Imaging (MI)** for breast cancer detection has gained increasing attention in the last decade due to its potential to be inexpensive and safe for patients due to **nonionizing radiation**.
- It has the potential to be used as a tool for early detection of breast cancer, and a compact and portable system will find application for mass screening of breast cancer, especially in remote areas or in developing countries.
- The MI technique relies on a detectable difference in the dielectric properties of a tumor and the surrounding breast tissue.

There are two approaches in MI:

- **Tomography-based**
- **Radar-based**

- The microwave tomography (MT) approach is a narrowband approach, where the electrical profile of the breast is reconstructed by solving a nonlinear and ill-posed inverse scattering problem.
- Radar-based imaging creates a map of microwave scattering, arising from the contrast in dielectric properties within the breast.

DP

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Participants

Type a name

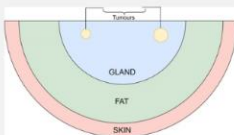
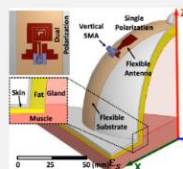
Share invite

In this meeting (39)

- BHAVANI. M.V.L Organizer
- ANJANEYULU NAIK. R
- BS B SUDHAKAR
- DR Deepak Reddy
- DS Dr B Sindhu
- DP Dr B Siva Hari Prasad
- SY Dr K Yogaprasad, SITAMS

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ELECTRICAL PROPERTIES OF BREAST TISSUES

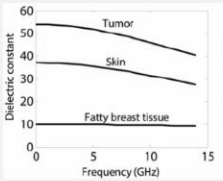
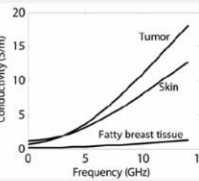



Debye Relaxation Model:

For a single relaxation process, the frequency-dependent dielectric constant is given by

$$\epsilon_r(\omega) = \epsilon_{\infty} + \frac{\epsilon_0 - \epsilon_{\infty}}{1 + (\omega\tau)^2}$$

ϵ_0 = low frequency dielectric const.
 ϵ_{∞} = very high frequency dielectric const.
 τ = relaxation time

DP

DM

KB

1/10

Participants

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- DP Dr B Siva Hari Prasad
- SY Dr K Yogaprasad, SITAMS


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My take on 6G ISAC



Data collection for external applications

- Environmental awareness (human motion/gestures)
- Smart city optimization (monitor traffic and crowds)
- Smart factories (track robots, detect irregularities)
- Surveillance (drone detection, see in darkness)
- Data collection for digital twins and AI



Bistatic sensing in a TDD band

- Primarily: communications
- Secondly: sensing

Network-internal use cases

- Track inactive users (Beamforming, handover)
- Adapt sleep cycles to activity and motion
- Enhanced inter-cell interference cancellation
- Enhanced positioning

Sunil Chinnadurai

Participants

Type a name

Share invite

In this meeting (19)

Mute all

BHAVANI, M.V.L. Organizer

BS B SUDHAKAR

DR Dr E V Krishna Rao

SY Dr K Yogaprasad, SITAMS

DG Dr S Gnanamurugan

DK Dr. A. Suneel Kumar

DM Dr. Dinesh MA

15:12 09-05-2026

Bhavani, M.V.L., Chaturvedi, D., Lanka, T. and Kumar, A. "Development of a CMSIW Antenna Sensor for Tumor Detection Utilizing a Hemispherical Multilayered Dielectric Breast-Shaped Phantom", *IEEE Sensors Journal*, 2024. DOI:10.1109/JSEN.2024.3450990

Divya IIIT Pune

Search

14:51 08-05-2026

PROPOSED ANTENNA-SENSORS WITH PRS POSITIONED AT DIFFERENT DISTANCES FROM THE PHANTOM

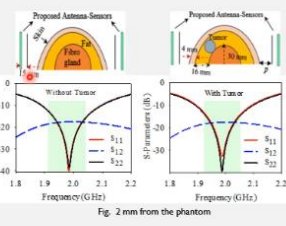
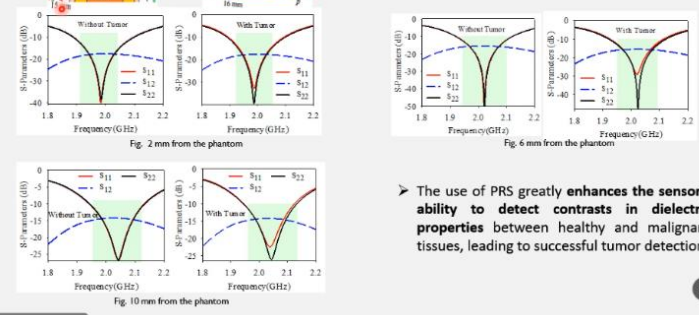



Fig. 2 mm from the phantom

Fig. 6 mm from the phantom

Fig. 10 mm from the phantom

► The use of PRS greatly enhances the sensor's ability to detect contrasts in dielectric properties between healthy and malignant tissues, leading to successful tumor detection

Participants

In this meeting (34)

Mute all

DG Dr S Gnanamurugan

DK Dr. A. Suneel Kumar

DP Dr. CH. Pallavi

DM Dr. Dinesh MA

DP Dr. Divya IIIT Pune

DP Dr. Divya IIIT Pune

DR Dr. Tej Raj

D Dr.KRaniRudrama

G Gayathri

GUDIPUDI NAGESWARA RAO

15:04 08-05-2026

Day 6 – 09.05.2026

The valedictory technical session was delivered by **Dr. Sunil Chinnadurai, SRM University-AP**, on **"ISAC for 6G: Redefining the Role of Antennas in Next-Generation RF Systems."** The speaker introduced the concept of Integrated Sensing and Communication (ISAC) and its importance in future 6G networks. The session explored how antenna technologies will support simultaneous communication and sensing functionalities in next-generation wireless systems. The FDP concluded with an interactive discussion and participant feedback.

ISAC Vision and Evolution Path

F. Liu, Y. Cai, C. Masouros, J. Xu, T. X. Han, A. Hassaniien, Y. Eldar, S. Buzzi, "Integrated Sensing and Communications: Towards Future Dual-functional Wireless Networks", IEEE Journal on Sel. Areas Comms., in press

Sunil Chinnadurai

Participants

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- SY Dr K Yogaprasad, SITAMS
- DG Dr S Gnanamurugan
- DK Dr. A. Suneel Kumar
- DM Dr. Dinesh MA

8°C partly sunny

Search

14:58 09-05-2026

Future Research Directions

AI-Native Beamforming

Replace classical DSP with DNNs — learn channel + sensing jointly, no pilots needed

RIS-Assisted ISAC

Programmable surfaces extend sensing into blind spots — see around corners

Holographic MIMO

Near-continuous aperture arrays — focus RF energy at any 3D point with sub-cm accuracy

V2X + ISAC

One 6G chipset replaces the car's 5G modem AND 77 GHz radar — cooperative sensing

Digital Twin Networks

Distributed ISAC nodes build a live, real-time 3D map of the environment

Secure & Private ISAC

Federated learning + physical-layer security — sense without exposing personal data

IEEE JSAC · IEEE TWC · IEEE Trans. Signal Process. · IEEE Commun. Mag.

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- DN Dr. Neeru
- DR Dr. Tej Raj
- DP Dr.CH Pallavi
- JV J Vidyasri
- KS KST SAI
- RN R Nabeesha
- R Rajanikanth

15:19 09-05-2026

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15:30 09-05-2026