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Notice for the PhD Viva-Voce Examination

Ms Devika Menon M K (Registration Number: 1770091), PhD scholar at the School of Engineering and Technology, CHRIST (Deemed to be University), Bangalore will defend her PhD thesis at the public viva-voce examination on Friday, 06 December 2024 at 11.00 am in the CDI Conference Room, III Floor, Block V, Bangalore Kengeri Campus, Bengaluru 560074.

Title of the Thesis	:	**Non-Invasive Early and Precise Detection of Breast Tumor with Novel UWB Radar Pulse**
Discipline	:	**Electrical and Electronics Engineering**
External Examiner - I	:	**Dr S Srinivasa Rao** Professor National Institute of Technology Warangal National Institute of Technology Warangal, Telangana
External Examiner - II	:	**Dr Ramesha C K** Professor Birla Institute of Technology and Science NH 17B, Bypass Road, Zuarinagar Goa - 403726
Supervisor	:	**Dr Joseph Rodrigues** Professor Department of Electrical and Electronics Engineering School of Engineering and Technology CHRIST (Deemed to be University) Bengaluru - 560074 Karnataka

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Registrar

Place: Bengaluru
Date: 28 November 2024

ABSTRACT

Impulse Radio Ultra-Wideband (IR-UWB) is a promising breast cancer detection technique due to its high resolution, non-ionizing radiation, effectiveness in dense tissues, and cost efficiency compared to traditional methods. In this research work, a shaped Ultra-Wideband (UWB) Gaussian pulse of seventh order is employed in a radar-based breast cancer detection system. A sharp transition bandpass Finite Impulse Response (FIR) filter is designed in this work for safe, deep penetration and optimal transmission through the heterogeneous breast. The pulse shaper filter design has a sharp transition with a low side lobe level and can be tuned to any variable center frequency. This design is suitable for shaping very short-duration pulses, achieving higher data rate and less interference issues. Also, the pulse tightly fits the Federal Communication Commission (FCC) spectral mask, thus achieving higher spectral utilization efficiency and meets the signal safety standards for transmission through the breast. The shaped pulse fed to the antenna of the radar system provides higher antenna radiation efficiency and radiating power due to the concentration of power in the main lobe.

The research work has employed both bistatic and monostatic radar systems to detect tumors using time and frequency domain analysis of backscattered signals, which exhibit distinct changes in electric field intensity, indicating the presence of a tumor. Simulation results show significant changes in the electric field intensity for normal and malignant breast tissue for tumor sizes ranging from 4 mm to 0.5 mm. Specific Absorption Rate (SAR) analysis shows higher energy absorption in cancerous tissues, helping to accurately locate tumors. The study has also observed increased SAR in older age groups due to higher dielectric contrast between normal and malignant tissues. The research work has employed Computer Simulation Technology Microwave Studio (CSTMWS) for surgically extracted numerical breast model and simulating tumor detection radar setup. The results obtained with an experimental setup in the anechoic chamber consisting of monostatic radar with fabricated tumor affected heterogeneous breast phantom, closely confirm the simulation results.

Keywords: Breast Phantom, Cole-Cole Model, Early Breast Cancer Detection, Federal Communication Commission Mask, Localization of Tumor, Scattering Parameter, Specific Absorption Rate, Ultra-Wideband Gaussian Pulse, Ultra-Wideband Pulse Propagation, Ultra-Wideband Pulse Shaping Filter, Ultra-Wideband Radar

Publications:

1. **M. K. D. Menon** and J. Rodrigues, "Efficient Ultra Wideband Radar Based Non Invasive Early Breast Cancer Detection," in IEEE Access, vol. 11, pp. 84214-84227, 2023, doi: 10.1109/ACCESS.2023.3303333.
2. Rodrigues, J., **Devika Menon M.K**, Lonappan, L., & Lucy J.Gudino. (2020). Spectral Efficient Pulse Shaping for Impulse Radio Ultra Wideband Communications. Helix - The Scientific Explorer | Peer Reviewed Bimonthly International Journal, 10(02), 226-231.
3. **Devika Menon, M. K.**, and Joseph Rodrigues. "Pulse Shaper Design for UWB-Based Medical Imaging Applications." In Communication and Intelligent Systems: Proceedings of ICCIS 2021, pp. 897-907. Singapore: Springer Nature Singapore, 2022.
4. **M. K. Devika Menon**, J. Rodrigues and L. J. Gudino, "Synthesis of UWB Pulse Shaper for Efficient Pulse Propagation in Human Tissue," 2020 12th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP), Porto, Portugal, 2020, pp. 1-5, doi: 10.1109/CSNDSP49049.2020.9249543.
5. Rodrigues J, Lonappan L, **Menon D** and Gudino L.J, "Narrowband and Wideband Directional Beamformer with Reduced Side Lobe Level," 2019 International Conference on Data Science and Communication (IconDSC), 2019, pp. 1-4, doi: 10.1109/IconDSC.2019.8816958