

Mahesh Raveendranatha Panicker *PhD*

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Brief Biography

Mahesh Raveendranatha Panicker received his B. Tech. degree in Electrical and Electronics Engineering from Rajiv Gandhi Institute of Technology (Govt. Engineering College, Kottayam) in 2003 (First rank in the Mahatma Gandhi University) and Ph.D. degree from School of Computer Engineering, Nanyang Technological University (NTU), Singapore in 2009. From August 2003 to July 2005, he was a lecturer with Saintgits College of Engineering (Mahatma Gandhi University), Kerala. From August 2008 to July 2010, he was a post-doctoral fellow with centre for high performance embedded systems, NTU, Singapore. In August 2010, he started his career in industry with General Electric (GE) Global Research Centre, Bangalore. He was lead research engineer with GE till April 2017. From May 2017 till May 2018, he was senior chief engineer with Samsung Research Institute, Bangalore. He was Assistant Professor of Electrical Engineering at IIT Palakkad from June 2018 to November 2021. Currently he is an Associate Professor with the department of Electrical Engineering at IIT Palakkad.

Mahesh is a Senior Member with IEEE, Six Sigma Green Belt certified and a TRIZ practitioner. He is a recipient of the Early Career Research Award from Science and Engineering Research Board, Government of India in 2019. He has won GE wide technical excellence awards in 2013 and 2015. He has also won silver award for ten or more patents with GE. During his stay in GE, Mahesh has worked on a range of projects, which include portable foetal ECG platform, compressor blade health monitoring program, real-time detection of rotor imbalance in GE transportation locomotive engines, detection of corrosion under insulation in oil/gas pipelines in refineries, nuclear reactor rebar corrosion detection, fMRI-based neuro analytics, GE's software beamforming platform for diagnostic ultrasound imaging and low-cost portable 3D ultrasound.

Mahesh's research interests include signal processing and machine learning, reconfigurable computing, and area efficient low power systems with applications in diagnostic ultrasound imaging, biomedical circuits and systems, multi-standard wireless communications and industrial prognostics. Mahesh has published his research findings in 16 international journals, 44 international conferences and 11 patents. Highlights of major research and translational projects are available at <http://www.pulseecho.in/>. He is an Associate Editor for Springer Circuits Systems and Signal Processing, Guest Associate Editor for Frontiers in Signal Processing, Review Editor for Frontiers in Neurorobotics. He is also a regular Reviewer for many of IEEE, Elsevier, Springer, Wiley and Frontiers Journals. He was the Vice Chair, IEEE Engineering in Medicine and Biology Society (EMBS) Kerala Chapter in 2020-2021 and the Chair - Sponsorship Committee, IEEE International Symposium on Biomedical Imaging (ISBI) 2022.

In IIT Palakkad, Mahesh was appointed as the first Head of the Department of Electrical Engineering effective October 2021 for a period of three years. Mahesh has served as a member of Board of Academic Studies and Industry Collaboration and Sponsored Research.

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1 EDUCATION

Ph.D., 2009

School of Computer Engineering, Nanyang Technological University, Singapore

Dissertation topic: Reconfigurable low complexity digital filter banks for software radio receivers (Advisor: Professor Vinod Achutavarrier Prasad)

Bachelor of Technology - B.Tech., 2003 *(First Rank in the University)*

Department of Electrical and Electronics Engineering, Rajiv Gandhi Institute of Technology (Govt. Engineering College), Mahatma Gandhi University, Kerala, India Project topic: Microprocessor based Autonomous Robot (Advisor: Professor Dinesh Gopinath)

2 SUMMARY OF WORKING EXPERIENCE

Total Work Experience – 16 years (Teaching: 6 years, Industry: 10 years)

Nov 2021 – Till Now: Associate Professor and Head of the Department, Electrical Engineering, Indian Institute of Technology, Palakkad.

Instructor for courses in B. Tech Electrical Engineering and M. Tech System on Chip Design. Involved in research and development of advanced signal processing, analytics, and imaging techniques for diagnostic ultrasound systems. Highlights of major research and translational projects are available at <http://www.pulseecho.in/>.

June 2018 – Nov 2021: Assistant Professor in Electrical Engineering, Indian Institute of Technology, Palakkad.

Instructor for courses in B. Tech Electrical Engineering and M. Tech System on Chip Design. Involved in research and development of advanced signal processing, analytics, and imaging techniques for diagnostic ultrasound systems.

May 2017 – May 2018: Senior Chief Engineer at Ultrasound Systems, Healthcare and Medical Equipments (HME), Samsung Research Institute, Bangalore, India.

Involved in research, development and productization of advanced signal processing, analytics, and imaging techniques for diagnostic ultrasound systems.

Aug 2010 – April 2017: Lead Engineer at Software Sciences and Analytics Research, GE Global Research, John F Welch Technology Centre, Bangalore, India.

Helped in establishing diagnostic ultrasound imaging lab in GE Global Research, Bangalore and in establishing collaboration with General Imaging business, GE Healthcare, Milwaukee. Involved in development of advanced analytics, signal processing algorithms/systems for applications in health care, energy, oil and gas and transportation domains. Filed 10 patents and involved in many of the popular GE products such as diagnostic ultrasound systems, non-invasive neonatal/foetal heart rate monitoring, compressor blade health monitoring (BHM) and Tier4 locomotive prognostics.

Aug 2008 – Jul 2010: Research Fellow at Centre for High Performance Embedded Systems (CHiPES), NTU, Singapore.

Involved in development of novel reconfigurable low complexity spectrum sensing algorithms and archi-

lectures for military and cognitive radios.

Nov 2007 – Dec 2007: Sponsored Internship at SUPELEC in the Signal, Communication et Electronique Embarquee (SCEE) team as part of Merlion Project Grant (Dossier No. 9.03.07), France-Singapore Cooperation Platform in Science and Technology.

Involved in development of novel spectrum sensing architectures for cognitive radio.

Aug 2005 – Jul 2008: Teaching Assistant at School of Computer Engineering, NTU, Singapore.

Handled sessions in Instrumentation and Data Acquisition Lab and Digital Systems Lab.

Aug 2003 – Jul 2005: Lecturer at SAINTGITS College of Engineering, Mahatma Gandhi University, Kerala, India.

Taught basic and advanced courses in Electrical and Electronics Engineering.

3 TEACHING

3.1 Current Courses

- Microprocessor Systems: Design and Interfacing (Theory and Lab)
- Digital Image Processing (Theory and Lab)
- Digital Circuits Laboratory

3.2 Past Courses

- Sensor Arrays and Imaging
- Analog and Digital Communications
- Control Systems Lab
- Concepts in Engineering Design
- Introduction to Engineering

3.3 New Courses Developed

- Microprocessor Systems: Design and Interfacing (B. Tech Year 2, Core) (*Heavy hands on approach where students will first implement an 8-bit microcomputer using logic gates and then learn microprocessor systems and interfacing using ARM Cortex M0+ core on FRDM KL25Z series SoC*) [Online Lectures]
- Digital Image Processing (B. Tech Year 4/Graduate Level, Elective) (*Course deals with real-life dataset (e.g., student acquired dataset, industry CT data, COVID19 Lung Ultrasound Images)*) [Online Lectures]
- Sensor Arrays and Imaging (Graduate Level, Elective) (*A unique course on sensor arrays for imaging with emphasis on ultrasound. The course covers the basics of wave physics, transducer physics and image reconstruction algorithms*) [Online Lectures]

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- Digital Circuits Laboratory (B. Tech Year 2, Core) (*Designed the experiments including Verilog implementation on Zybo Zynq board*)

3.4 Teaching Feedback Scores:

Year	Course	Number of Students	Score (Out of 10)
Aug-Nov, 2018	EE3050: Analog and Digital Communications	33	8.9
	EE3125: Control Systems Lab	31	8.8
Jan-May, 2019	EE2080: Microprocessor Systems - Design and Interfacing	33	9.1
Aug-Nov, 2019	EE5005: Digital Image Processing	22	8.73
	EE2170: Digital Circuits Laboratory	55	NA*
Jan-May, 2020	EE2080: Microprocessor Systems - Design and Interfacing	47	NA*
Aug-Nov, 2020	EE5005: Digital Image Processing	49	9.22
	EE2170: Digital Circuits Laboratory	43	NA*
Jan-May, 2021	EE2080: Microprocessor Systems - Design and Interfacing	43	8.69
	EE5527: Sensor Arrays and Imaging	15	9.61
July-Nov, 2021	EE5005: Digital Image Processing	72	8.86
Jan-May, 2022	EE2080: Microprocessor Systems - Design and Interfacing	43	8.7

*Not Available due to COVID-19 schedule

4 RESEARCH

4.1 Technology Interests:

- Machine/Deep Learning for Imaging/Reconstruction
- Digital Signal Processing
- Reconfigurable Energy Efficient Circuits and Systems

4.2 Domain Interests:

- Diagnostic Ultrasound Imaging and Image Processing
- Underwater Acoustic Imaging and Image Processing
- Industrial Prognostics and Health Monitoring

4.3 Publications: *Please refer Section 6 for detailed list of publications*

- Published **59 papers** in international refereed journals and international conferences.
- Number of International Journal Papers: 15, Number of International Conference Papers: 44

4.4 Patents: *Please refer Section 7 for detailed list of patents*

- Number of Patents: **11** (7 US patents granted and 4 Indian patents filed)

4.5 Research Grants:

On-going (Active) Research Grants:

No.	Title	Funding Organization	Amount	Duration	Role
1	Automatic Target Detection using Simulated Side Scan and Multi-beam Echo Sounder Images	Defense Research Development Organization (DRDO)	INR 19,65,408	Aug 2022-May 2024	PI
2	Robust receive beamforming algorithm for underwater sonar imaging system for Mine Like Object Detection in the presence of reverberation	Defense Research Development Organization (DRDO)	INR 9,89,218	July 2022 – June 2023	PI
3	Cognitive Ultrasound Imaging	NVIDIA Corporation	Developer board worth USD 10,000	NA	PI
4	Aberration Correction for Diagnostic Ultrasound Imaging	GE Healthcare	Internship Student Funding (3 students / year), ML350 Compute	June 2022 – July 2027	PI

Past (Completed) Research Grants:

No.	Title	Funding Organization	Amount	Duration	Role
1	Investigation of a portable, affordable, and self-guided bedside ultrasound system for tissue and blood velocity imaging	Early Career Research (ECR) award, Science and Engineering Research Board (SERB), India	INR 49,01,830	March 2019 - June 2022	PI
2	An automated lung ultrasound workflow for diagnostic assistance in COVID-19 and beyond	COVID19 Special Core Research Grant, Science and Engineering Research Board (SERB), India	INR 12,02,960	Aug 2020 - Aug 2021	PI
3	Automated Lung Ultrasound for COVID-19 Screening and Monitoring	CSR Fund - Federal Bank Limited, India	INR 6,00,000	May 2020 - October 2020	PI
4	Development of a Real Time Spectral Analysis and Filtering System Based on Lyrtech SFF	Temasek Laboratories/DSO National Labs, Defence Science and Technology Agency (DSTA), Singapore	SGD 64,000	Sep 2008 - Sep 2009	Co-PI

4.6 Graduate Research Student Supervision:

Master of Science (By Research) Students: 1

No.	Name	Start Year	Thesis Title	Current Status
1	Madhavanunni A. N.	2018	Portable Vector Flow Imaging for Ambulatory Scenarios	Converted to PhD in June 2020

Ph.D. Students: 4

No.	Name	Start Year	Thesis Title	Current Status
1	Gayathri M.	2018	Cognitive Ultrasound - Towards Tissue Adaptive Software Beamforming in Ultrasound Imaging	Thesis Writing (1 Transaction, 5 International Conferences)
2	Madhavanunni A. N.	2020	Portable Vector Flow Imaging for Ambulatory Scenarios	Progressing (1 Journal, 4 International Conferences)
3	Pisharody Harikrishnan Gopalkrishnan	2019	Novel Transducer Array Designs for High Frame Rate Ultrasound Imaging	Progressing (1 Patent, 1 International Conference)
4	Mimisha M Menakath	2020	Underwater High Frame Rate Acoustic Imaging	Progressing (3 International Conferences)

4.7 Achievements of PhD Students and Undergraduate Final Year Project Students:

- Ph.D. Student, Harikrishnan Pisharody, elected as a Finalist in the Student Paper Competition for the International Symposium on Biomedical Imaging (IEEE ISBI 2022). *Paper: Harikrishnan Pisharody and Mahesh Raveendranatha Panicker, "Extending The Capability Of Linear Array Ultrasound Probe To Concave Array Using Low-Cost Acoustic Lens For High Frame Rate Focused Imaging", in Proc. of IEEE ISBI 2022, Kolkata, Mar. 2022.*
- Ph.D. Student, Madhavanunni A N, elected as a Finalist in the Student Paper Competition for the 43rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (IEEE EMBC 2021). *Paper: Madhavanunni A.N. and Mahesh Raveendranatha Panicker, "An Angle Independent Depth Aware Fusion Beamforming Approach for Ultrafast Ultrasound Flow Imaging", in Proc. of 43rd IEEE EMBC 2021, Nov. 2021.*
- Ph.D. Student, Madhavanunni A N, has won the 2020 Robert F. Wagner All Conference Best Student Paper Finalist Award at the SPIE Medical Imaging Conference at Houston, USA, September 2020. *Paper: Madhavanunni A.N. and Mahesh Raveendranatha Panicker, "Triangulation based vector flow imaging with non-steered plane waves for transverse flows", in Proc. of SPIE Medical Imaging 2020, Houston, Feb 2020.*
- Ph.D. Student, Gayathri M, was one of 10 Finalists of the 3 Minute Thesis competition organized as part of IEEE's flagship symposium in Medical Imaging-IEEE ISBI 2021. *Paper: Gayathri M and Mahesh Raveendranatha Panicker, "Towards diffuse beamforming for specular reflectors: A pixel level reflection tuned apodization scheme for ultrasound imaging," in Proc. of IEEE ISBI 2021, Nice, France, April 2021.*
- B. Tech project student, Roshan P Mathews, won **Undergraduate Research and Innovation Awards 2021** at IIT Palakkad for excellence in undergraduate research.

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- Internship students, Arjun and Aniket Singh Rajput, won **Undergraduate Research and Innovation Awards 2022** at IIT Palakkad for excellence in undergraduate research.

4.8 Translational Research:

- Recent work employing lung ultrasound as a continuous monitoring tool to help clinicians in COVID19 which is deployed and available at <http://www.pulseecho.in/alus/>. The work was covered in detail by the national daily The Hindu, the national magazine The Week and in the Doordarshan News.
- An automated multi-scale image contrast enhancement algorithm for industrial CT scans has been developed and under evaluation by experts from <https://vcxrayindia.com/>.
- MOUs signed with University of Alberta, GE Healthcare Bangalore and Sree Chitra Tirunal Institute for Medical Sciences & Technology, Trivandrum (SCTIMST) for automated image analysis for ultrasound systems.

5 PROFESSIONAL SERVICE

5.1 Administrative Appointments:

- Head, Department of Electrical Engineering (Oct 2021 – Till Now)
- Member, Board of Industry Collaboration and Sponsored Research, Indian Institute of Technology Palakkad (July 2018 – July 2021)
- Member, Board of Academic Studies, Indian Institute of Technology Palakkad (June 2019 – July 2020)
- Stream Co-ordinator, Electrical Engineering, Indian Institute of Technology Palakkad (June 2019 – July 2020)
- Institute Coordinator DRDO-MoE PhD Fellowship (May 2020 – Till Now)
- Convenor, Centre for Computational Imaging, Indian Institute of Technology Palakkad

5.2 Professional Activities:

- Six Sigma Green Belt Certification
- MATRIZ TRIZ Level 2 Certification (TRIZ Practitioner)
- Senior Member, IEEE
- Associate Editor, Springer Circuits, Systems and Signal Processing
- Review Editor, Frontiers in Neurorobotics
- Associate Editor (Guest) and Review Editor, Frontiers in Signal processing
- Vice Chair, IEEE Engineering in Medicine and Biology Society (EMBS) Kerala Chapter, 2020-2021

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- Chair - Sponsorship Committee, IEEE International Symposium on Biomedical Imaging (ISBI) 2022
- Executive Committee Member, National Institute of Electronics, and Information Technology (NIELIT) Calicut
- Review Board Member, NPOL Kochi
- Regular mentor for internship students funded by Indian Academy of Sciences (1 student in 2019, 1 student in 2020, 3 students in 2021)
- Department Advisory Committee member for
 - Electrical Engineering, Rajiv Gandhi Institute of Technology Kottayam
 - Electrical Engineering, Government Engineering College Idukki
 - Instrumentation and Control Engineering, NSS College of Engineering Palakkad
 - Biomedical Engineering, Sahrudaya College of Engineering Thrissur
- Member, Technical Committee on Brain-Machine Interface Systems, IEEE Systems, Man and Cybernetics Society
- Member, IEEE Signal Processing Society
- Member, IEEE Circuits and Systems Society
- Member, IEEE Engineering in Medicine and Biology Society
- Member, IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society
- Session Chair, Biomedical Systems, IEEE Region-10 Conference, TENCON 2020 and TENCON 2019
- Program Committees of International Symposium on Electronic System Design (ISED) 2011-2014, International Conference on Eco-friendly Computing and Communication Systems (ICECCS 2013), International Conference on Advances in Computing and Communications (ACC 2013)
- Track Chair, IEEE International Conference on Information, Communications and Signal Processing (ICICS 2009)
- Reviewer of IEEE Transactions on Neural Networks and Learning Systems, IEEE Transactions on Industrial Informatics, IEEE Transactions on Multimedia, IEEE Transactions on Human-Machine Systems, IEEE Sensors, IEEE Transactions on Biomedical Circuits and Systems, IEEE Access, IEEE Transactions on Signal Processing, IEEE Transactions on Circuits and Systems - I and II, IEEE Transactions on Vehicular Technology, IEEE Transactions on VLSI Systems, IET Transactions on Signal Processing, Elsevier Pattern Recognition, Springer Journal of Signal Processing Systems for Signal, Image and Video Technology and International conferences such as BioCAS, EMBC, ISCAS, ICCS, ICICS, TENCON, SPCOM.

5.3 Invited Talks:

- “Video Summarization”, CapsNetwork Training School-2, NTNU Norway, 29th April 2022
- “Learning based beamforming algorithms for ultrasound imaging”, Forum on “Trends in Multi Scale Signal and Image Processing for Biomedical Instrumentation”, IEEE SPS Kerala Section, 17th Dec 2021.
- “Automated lung ultrasound for Covid19 and beyond”, FDP on Advancements of Digital Health and Medical Innovations during Pandemic, Model Engineering College Kochi, 7th Dec 2021.
- “Transmit Receive Beamforming in Ultrasound Imaging”, Virtual Workshop on Instrumentation and Signal Processing in Biomedical Imaging and Rehabilitation, IIT Gandhinagar - 25th Oct 2021.
- “Diagnostic Ultrasound– The Journey from Imaging to Therapy and Beyond,” IEEE Malabar Hub Webinar Series #62 - 05th Aug 2021.
- “Introduction to Convolutional Neural Networks and Applications in Image Processing,” 3-day Workshop on Generative Adversarial Networks (GANArt 2021) @ NIT Calicut, 20 - 22, May 2021.
- “Diagnostic Ultrasound Imaging Systems Overview and Advances”, 7th National Seminar on ADVANCES IN SCIENTIFIC AND INDUSTRIAL INSTRUMENTATION (ASCI), CUSAT, 24th March 2021.
- “Neural Networks for Diagnostic Ultrasonic Imaging”, ATAL FDP on Applications of AI in Healthcare”, Model Engineering College Kochi, 25th Feb 2021.
- “Introduction to Convolutional Neural Networks and Applications in Image Processing”, ATAL FDP on Machine Learning and Deep Learning: A Hands -On Approach, CUSAT, 9th December 2020.
- “IoT for Biomedical (Imaging)”, ATAL FDP on Secure Internet of Things (IoT), IIT Palakkad, 19th October 2020
- “Lung Ultrasound Imaging for COVID19, From Physics to Neural Networks”, IEEE Computer Society and IEEE Student Chapter Webinar, NIT Trichy, 15th August 2020.
- “Deep learning and Biomedical Applications”, Faculty Development Program on Artificial Intelligence and Machine Learning for Biomedical Applications”, Sahrudaya College of Engineering, 17th July 2020.
- “Digital Signal Processing -Journey from Physical Models to Statistical Models”, Workshop on Implementation of Signal Processing Algorithms on DSP Processors”, PSG Coimbatore, 16th December 2019.
- “From the physical world to the digital world: enabling machine learning driven by domain knowledge”, IEEE SPS Kerala Section - Colloquium on ML with Signal Processing for Data Analytics”, CUSAT, Kochi, 28th September 2019.
- “Signal Processing in The Era of Big Data”, National Conference on Communication, Computing and System Design (NC33SD’19), PSGiTech, Coimbatore, 19th March 2019.

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- “Compressive Sampling - A Paradigm Shift in Digital Signal Processing”, Workshop on Advances in Signal and Image Processing, GITAM University, Visakhapatnam, Feb 2014.
- “Advances in Industrial Digital Signal Processing”, Technical Quality Improvement Program (TQIP) for Faculty on Advances in Digital Systems, Cochin University of Science and Technology (CUSAT), Kochi, June 2011.
- “Reconfigurable Low Complexity Digital Filters”, Military Radio Lecture Series, NTU, Singapore, Feb 2009.
- “Reconfigurable Low Complexity Spectrum Sensing”, Visitor Lecture Series, SUPELEC, Rennes, France, Dec 2008.
- “Reconfigurable Low Complexity Digital Filter Banks for Software Radio Receivers”, Graduate Students Workshop organized by IEEE CAS society, Singapore, September 2007.

6 PUBLICATIONS

Google scholar Citation: 1093, h-index: 15 (as on 23 Sep 2022)

Scopus Citation: 661, h-index: 13 (as on 23 Sep 2022)

Journals:

Published:

1. Roshan P Mathews, Mahesh Raveendranatha Panicker, Abhilash R Hareendranathan, Yale Tung Chen, Jacob L Jaremko, Brian Buchanan, Kiran Vishnu Narayan, Kesavadas C, Greeta Mathews, “Unsupervised multi-latent space reinforcement learning framework for video summarization in ultrasound imaging”, accepted in *IEEE Journal of Biomedical and Health Informatics*. arXiv link: <https://arxiv.org/abs/2109.01309>
2. Abhilash Rakkunedeth Hareendranathan, Arpan Tripathi, **Mahesh Raveendranatha Panicker**, Yuyue Zhou, Jessica Knight and Jacob L Jaremko, “Domain-Aware Contrastive Learning for Ultrasound Hip Image Analysis,” in *Elsevier Computers in Biology and Medicine*. Accepted August 2022. <https://doi.org/10.1016/j.compbimed.2022.106004>
3. Madhavanunni A. N. and **Mahesh Raveendranatha Panicker**, “A Nonlinear High-Resolution Beamforming for Plane Wave Ultrasound Flow Imaging,” in *Elsevier Computers in Biology and Medicine*. 147, 105686 (2022). <https://doi.org/10.1016/j.compbimed.2022.105686>
4. Rohith Reddy Rachala and **Mahesh Raveendranatha Panicker**, “Hand-Drawn Electrical Circuit Recognition Using Object Detection and Node Recognition”, in *Springer Nature Computer Science*, 3, 244 (2022). <https://doi.org/10.1007/s42979-022-01159-0>
5. Arjun, Rajpoot, Aniket Singh, and **Mahesh Raveendranatha Panicker**, “Subject independent emotion recognition using EEG signals employing attention driven neural networks”, in *Elsevier Biomedical Signal Processing and Control*, 75 (2022): 103547. <https://doi.org/10.1016/j.bspc.2022.103547>

6. Roshan P Mathews, **Mahesh Raveendranatha Panicker** and Abhilash R Hareendranathan, “vid-SAMGRAH: A PyTorch framework for multi-latent space reinforcement learning driven video summarization in ultrasound imaging”, in *Elsevier Software Impacts*, 100185 (2021). <https://doi.org/10.1016/j.simpa.2021.100185>
7. Gayathri M and **Mahesh Raveendranatha Panicker**, “Towards A Pixel-Level Reconfigurable Digital Beamforming Core for Diagnostic Ultrasound Imaging,” in *IEEE Transactions on Biomedical Circuits and Systems*, 14, no. 3 (2020): 570-582. <https://doi.org/10.1109/TBCAS.2020.2983759>
8. **Mahesh, R.**, and A. Prasad Vinod, “An area-efficient non-uniform filter bank for low overhead reconfiguration of multi-standard software radio channelizers,” in *Springer Journal of Signal Processing Systems*, 64.3 (2011): 413-428. <https://doi.org/10.1007/s11265-010-0502-9>
9. **Mahesh, R.**, and A. Prasad Vinod, “A low-complexity flexible spectrum-sensing scheme for mobile cognitive radio terminals,” in *IEEE Transactions on Circuits and Systems II: Express Briefs* 58.6 (2011): 371-375. <https://doi.org/10.1109/TCSII.2011.2158167>
10. **Mahesh, R.**, and A. Prasad Vinod, “Low complexity flexible filter banks for uniform and non-uniform channelisation in software radios using coefficient decimation,” in *IET circuits, devices & systems* 5.3 (2011): 232-242. <https://doi.org/10.1049/iet-cds.2010.0010>
11. **Mahesh, R.**, and A. Prasad Vinod, “Reconfigurable low area complexity filter bank architecture based on frequency response masking for nonuniform channelization in software radio receivers,” in *IEEE Transactions on Aerospace and Electronic Systems* 47.2 (2011): 1241-1255. <https://doi.org/10.1109/TAES.2011.5751255>
12. **Mahesh, R.**, and A. Prasad Vinod, “New reconfigurable architectures for implementing FIR filters with low complexity,” in *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems* 29.2 (2010): 275-288. <https://doi.org/10.1109/TCAD.2009.2035548>
13. **Mahesh, R.**, A. Prasad Vinod, Edmund MK Lai, and Amos Omondi, “Filter bank channelizers for multi-standard software defined radio receivers,” in *Springer Journal of Signal Processing Systems* 62.2 (2011): 157-171. <https://doi.org/10.1007/s11265-008-0327-y>
14. Jimson Mathew, **Mahesh, R.**, A. P. Vinod and Edmund M-K. Lai, “Realization of low power high-speed channel filters with stringent adjacent channel attenuation specifications for wireless communication receivers,” in *IEICE Transactions on Fundamentals of Electronics, Communications and Computer Sciences* 91.9 (2008): 2564-2570. <https://doi.org/10.1109/ICICS.2007.4449884>
15. **Mahesh, R.**, and A. Prasad Vinod, “Reconfigurable frequency response masking filters for software radio channelization,” in *IEEE Transactions on Circuits and Systems II: Express Briefs* 55.3 (2008): 274-278. <https://doi.org/10.1109/TCSII.2008.918996>
16. **Mahesh, R.**, and A. Prasad Vinod, “A new common subexpression elimination algorithm for realizing low-complexity higher order digital filters,” in *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems* 27.2 (2008): 217-229. <https://doi.org/10.1109/TCAD.2007.907064>

Under Review

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1. Anito Anto, Linda Rose Jimson, Tanya Rose, Mohammed Jafrin, **Mahesh Raveendranatha Panicker**, “Software Package for Automated Analysis of Lung Ultrasound Videos,” Under Review in *Elsevier SoftwareX* arXiv link: <https://arxiv.org/abs/2208.00620>
2. Gayathri M and **Mahesh Raveendranatha Panicker**, “A Tiered Sub-Aperture Directivity Indexing Technique for Specularity Visualization in High Frame Rate Ultrasound Imaging,” Under Major Revision in *IEEE Transactions on Instrumentation and Measurements*. arXiv link: <https://arxiv.org/abs/2107.08069>
3. Jinu Joseph, **Mahesh Raveendranatha Panicker**, Yale Tung Chen, Kesavadas Chandrasekharan, Vimal Chacko Mondy, Anoop Ayyappan, Jineesh Valakkada and Kiran Vishnu Narayan, “covEcho-Resource Constrained Lung Ultrasound Video Analysis Tool for Faster Triaging and Active Learning”, Under Review in *Elsevier Computer Program Computer Methods and Programs in Biomedicine Update* (Original version submitted on 01/12/2021). arXiv link: <https://arxiv.org/abs/2206.10183>
4. Adithya Sineesh and **Mahesh Raveendranatha Panicker**, “Exploring Novel Pooling Strategies for Edge Preserved Feature Maps in Convolutional Neural Networks”, Under Review in *Springer Multimedia Systems*. arXiv link: <https://arxiv.org/abs/2110.08842>
5. Arpan Tripathi, Abhilash Rakkunedeth, **Mahesh Raveendranatha Panicker**, Jack Zhang, Naveenjyote Boora, Jacob Jaremko, Yale Tung Chen, Kiran Vishnu Narayan, Kesavadas C, “Physics Driven Domain Specific Transporter Framework with Attention Mechanism for Ultrasound Imaging”, Under Review in *Elsevier Computers in Biology and Medicine*. arXiv link: <https://arxiv.org/abs/2109.06346>
6. Madhavanunni A. N. and **Mahesh Raveendranatha Panicker**, “Beam Multiply and Sum Beamforming for Non-Steered Plane Wave High Framerate Ultrasound Imaging,” Under Review in *Elsevier Biomedical Signal Processing and Control*.
7. Gayathri M and **Mahesh Raveendranatha Panicker**, “A Comparison of Plane-Wave and Synthetic Transmit Aperture Imaging for Specularity Characterisation in Ultrasound Imaging,” Under Review in *IOP Physics in Medicine and Biology*.
8. Mimisha M Menakath, **Mahesh Raveendranatha Panicker** and Hareesh G., “Vertical and Horizontal Linear Array Beamforming for Real Time Underwater 3D Acoustical Imaging,” Under Review in *IEEE Journal of Ocean Engineering*.
9. **Mahesh Raveendranatha Panicker**, Yale Tung Chen, Gayathri M, Madhavanunni A N, Kiran Vishnu Narayan, C Kesavadas and A P Vinod, “An Approach Towards Physics Informed Lung Ultrasound Image Scoring Neural Network for Diagnostic Assistance in COVID-19”, (Under Submission Process). arXiv link: <https://arxiv.org/abs/2106.06980>
10. Sairoop Bodepudi, A N Madhavanunni, **Mahesh Raveendranatha Panicker**, “Patch Based Transformation for Minimum Variance Beamformer Image Approximation Using Delay and Sum Pipeline”, arXiv link: <https://arxiv.org/abs/2110.10220>

Conferences:

1. Mayank Katare, **Mahesh Raveendranatha Panicker**, Madhavanunni A.N. and Gayathri M, “Learning while Acquisition: Active Learning Framework for Beamforming in Ultrasound Imaging,” in *Haq, N., Johnson, P., Maier, A., Qin, C., Würfl, T., Yoo, J. (eds) Machine Learning for Medical Image Reconstruction. MLMIR 2022. Lecture Notes in Computer Science, vol 13587. Springer, Cham. https://doi.org/10.1007/978-3-031-17247-2_12*
2. Roshan P Mathews, **Mahesh Raveendranatha Panicker**, Abhilash R Hareendranathan, Yale Tung Chen, Jacob L Jaremko, Brian Buchanan, Kiran Vishnu Narayan, Kesavadas C, Greeta Mathews, “RL based Unsupervised Video Summarization for US Imaging”, in *In: Aylward, S., Noble, J.A., Hu, Y., Lee, S.L., Baum, Z., Min, Z. (eds) Simplifying Medical Ultrasound. ASMUS 2022. Lecture Notes in Computer Science, vol 13565. Springer, Cham.. https://doi.org/10.1007/978-3-031-16902-1_3*
3. Mimisha M Menakath, **Mahesh Raveendranatha Panicker** and Hareesh G., “k-Wave as a modelling tool for underwater 3D acoustic imaging,” in *Proc. of OCEANS 2022, Hamptons Roads, Oct. 2022.*
4. Mimisha M Menakath, **Mahesh Raveendranatha Panicker** and Hareesh G., “A comparison of time domain vs frequency domain delay and sum beamforming for underwater 3D imaging,” in *Proc. of OCEANS 2022, Hamptons Roads, Oct. 2022.*
5. Pisharody Harikrishnan Gopalakrishnan and **Mahesh Raveendranatha Panicker**, “Extending the capability of linear array ultrasound probe to concave array using low cost acoustic lens for high framerate focused imaging,” in *Proc. of IEEE ISBI 2022, Kolkata, India, March 2022. <https://doi.org/10.1109/ISBI52829.2022.9761480>*
6. Madhavanunni A.N. and **Mahesh Raveendranatha Panicker**, “Lesion detectability and contrast enhancement with beam multiply and sum beamforming for zero angle plane wave ultrasound imaging,” in *Proc. of IEEE ISBI 2022, Kolkata, India, March 2022. <https://doi.org/10.1109/ISBI52829.2022.9761662>*
7. Mimisha M Menakath, **Mahesh Raveendranatha Panicker** and Hareesh G., “Exploring time domain beamforming algorithm for underwater 3D acoustic imaging,” in *Proc. of OCEANS 2022, Chennai, Feb. 2022. <https://doi.org/10.1109/OCEANSCennai45887.2022.9775288>*
8. Arjun, Aniket Singh Rajpoot and **Mahesh Raveendranatha Panicker**, “Introducing Attention Mechanism for EEG Signals: Emotion Recognition with Vision Transformers,” in *Proc. of 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Online, Oct 2021. <https://doi.org/10.1109/EMBC46164.2021.9629837>*
9. Roshan P Mathews and **Mahesh Raveendranatha Panicker**, “Towards Fast Region Adaptive Ultrasound Beamformer for Plane Wave Imaging Using Convolutional Neural Networks,” in *Proc. of 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Online, Oct 2021. <https://doi.org/10.1109/EMBC46164.2021.9630930>*
10. Gayathri M and **Mahesh Raveendranatha Panicker**, “Pixel Intensity Vector Field: An Inside Out Approach of Looking at Ultrasound Reflections from the Lung at High Frame Rates” in *Proc. of 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Online, Oct 2021. <https://doi.org/10.1109/EMBC46164.2021.9629896>*

11. Madhavanunni A.N. and **Mahesh Raveendranatha Panicker**, “An Angle Independent Depth Aware Fusion Beamforming Approach for Ultrafast Ultrasound Flow Imaging,” in *Proc. of 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)*, Online, Oct 2021. <https://doi.org/10.1109/EMBC46164.2021.9630742>
12. Gayathri M and **Mahesh Raveendranatha Panicker**, “Intensity Vector Field: a Tool for Visualization and Characterization of Tissue Reflections in High Framerate Ultrasound Imaging,” in *Proc. of IEEE IUS 2021*, Online, Sep 2021. <https://doi.org/10.1109/IUS52206.2021.9593715>
13. **Mahesh Raveendranatha Panicker**, Yale Tung Chen, Gayathri M, Madhavanunni A N, Kiran Vishnu Narayan, C Kesavadas and A P Vinod, “Employing acoustic features to aid neural networks towards platform agnostic learning in lung ultrasound imaging”, in *Proc. of IEEE ICIP 2021*, Alaska, Sep 2021. <https://doi.org/10.1109/ICIP42928.2021.9506407>
14. Gayathri M and **Mahesh Raveendranatha Panicker**, “Towards diffuse beamforming for specular reflectors: A pixel level reflection tuned apodization scheme for ultrasound imaging,” in *Proc. of IEEE ISBI 2021*, Nice, France, April 2021. <https://doi.org/10.1109/ISBI48211.2021.9433990>
15. Gayathri M and **Mahesh Raveendranatha Panicker**, “Delay Multiply and Sum based Selective Compounding for Enhanced Ultrasound Imaging,” in *Proc. of IEEE TENCON 2020*, Osaka, Japan, Nov. 2020. <https://doi.org/10.1109/TENCON50793.2020.9293944>
16. Mohit Singh, **Mahesh Raveendranatha Panicker**, Rajagopal K V, “Towards Bone Aware Image Enhancement in Musculoskeletal Ultrasound Imaging,” in *Proc. of IEEE TENCON 2020*, Osaka, Japan, Nov. 2020. <https://doi.org/10.1109/TENCON50793.2020.9293757>
17. Gayathri M and **Mahesh Raveendranatha Panicker**, “VLSI architectures for Delay Multiply and Sum Beamforming in Ultrasound Medical Imaging,” in *Proc. of IEEE SPCOM 2020*, Bangalore, July 2020. <https://doi.org/10.1109/SPCOM50965.2020.9179510>
18. Madhavanunni A.N. and **Mahesh Raveendranatha Panicker**, “Directional beam focusing based dual apodization approach for improved vector flow imaging,” in *Proc. of IEEE ISBI 2020*, Iowa City, April 2020. <https://doi.org/10.1109/ISBI45749.2020.9098494>
19. Madhavanunni A.N. and **Mahesh Raveendranatha Panicker**, “Triangulation based vector flow imaging with non-steered plane waves for transverse flows,” in *Proc. of SPIE Medical Imaging 2020*, Houston, Feb 2020. <https://doi.org/10.1117/12.2549253>
20. Samhitha Rachakonda and **R. Mahesh**, “Automated Noise Detection and Classification for Unsupervised ECG Analysis Systems Using CEEMD and Wavelet Packet Decomposition,” in *Proc. of TENCON 2019*, Kochi, Oct 2019. <https://doi.org/10.1109/TENCON.2019.8929450>
21. **Mahesh Panicker**, P. Bhushan, Ek Tsoon Tan, J. Suresh, M. Radhika, M. Luca, M. Rakesh, “Improving neighbourhood voxel correlation in resting state fMRI using BOLD signal decomposition,” in *Proc. of OHBM 2016*, Geneva, Switzerland, June 2016. http://www.humanbrainmapping.org/files/2016/OHBM_2016_Geneva_Abstracts.pdf
22. P. Bhushan, **Mahesh Panicker**, Ek Tsoon Tan, J. Suresh, M. Radhika, M. Luca, M. Rakesh, “Spatiotemporal denoising in resting state fMRI,” in *Proc. of OHBM 2016*, Geneva, Switzerland, <https://iitpkd.ac.in/people/mahesh>

- June 2016. http://www.humanbrainmapping.org/files/2016/OHBM_2016_Geneva_Abstracts.pdf
23. P. Bhushan, **Mahesh Panicker**, M. Radhika, J. Suresh, “Group NMF analysis for resting state fMRI,” in *Proc. of ISMRM 2016*, Singapore, May 2016. <https://cds.ismrm.org/protected/16MProceedings/PDFfiles/3743.html>
 24. **Mahesh Panicker**, P. Bhushan, Ek Tsoon Tan, J. Suresh, “Blind functional clustering of resting state fMRI using non-negative matrix factorization,” in *Proc. of OHBM 2015*, Hawaii, June 2015. <http://www.humanbrainmapping.org/files/2015/2015%20Honolulu%20Abstracts%20FINAL.pdf>
 25. P. Bhushan, **Mahesh Panicker**, Ek Tsoon Tan, J. Suresh, “Optimal wavelet basis selection for resting state fMRI signal analysis,” in *Proc. of OHBM 2015*, Hawaii, June 2015. <http://www.humanbrainmapping.org/files/2015/2015%20Honolulu%20Abstracts%20FINAL.pdf>
 26. Smitha K. G., A. P. Vinod and **R. Mahesh**, “Reconfigurable area and power efficient I-Q mapper for adaptive modulation,” in *Proc. of 54th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS)*, Seoul, South Korea, August 2011. <https://doi.org/10.1109/MWSCAS.2011.6026553>
 27. Smitha K. G., **R. Mahesh** and A. P. Vinod, “Challenges in digital filter bank implementation from a cognitive radio perspective - A review,” in *Proc. of Asia-Pacific Signal and Information Processing Association (APSIPA) Annual Summit and Conference*, Singapore, December 2010. http://www.apsipa.org/proceedings_2010/pdf/APSIPA66.pdf
 28. **R. Mahesh** and A. P. Vinod, “Reconfigurable discrete Fourier transform filter banks for variable resolution spectrum sensing,” in *Proc. of IEEE International Conference on Communication Systems*, November 2010, Singapore. <https://doi.org/10.1109/ICCS.2010.5686666>
 29. **R. Mahesh** and A. P. Vinod, “Reconfigurable discrete Fourier transform filter banks for multistandard channelizers,” in *Proc. of IEEE International Conference on Signal Processing and Communications*, Bangalore, India, July 2010. (SPCOM 2010). <https://doi.org/10.1109/SPCOM.2010.5560538>
 30. S. J. Darak, A. P. Vinod, **R. Mahesh** and E. M-K. Lai “A reconfigurable filter bank for uniform and non-uniform channelization in multi-standard wireless communication receivers,” in *Proc. of the 17th IEEE International Conference on Telecommunications*, Doha, Qatar, April 2010. (ICT 2010). <https://doi.org/10.1109/ICTEL.2010.5478855>
 31. **R. Mahesh**, A. P. Vinod, B. Y. Tan and E. M-K. Lai, “A tree-structured non-uniform filter bank for multistandard wireless receivers,” in *Proc. of IEEE International Symposium on Circuits and Systems*, Taiwan, May 2009. (ISCAS 2009). <https://doi.org/10.1109/ISCAS.2009.5117723>
 32. S. T. Gul, **R. Mahesh**, C. Moy, A. P. Vinod and Jacques Palicot, “A graphical approach for the optimization of SDR channelizers,” in *Proc. of URSI (International Union of Radio Science) General Assembly*, Chicago, USA, August 2008. <https://www.ursi.org/proceedings/procGA08/papers/CPS2p7.pdf>
 33. **R. Mahesh** and A. P. Vinod, “Reconfigurable filter banks for software defined radio receivers – An alternative low complexity design to conventional DFT filter banks,” in *Proc. of URSI*
<https://iitpkd.ac.in/people/mahesh>

- (International Union of Radio Science) General Assembly, Chicago, USA, August 2008. <https://www.ursi.org/proceedings/procGA08/papers/C08p2.pdf>
34. **R. Mahesh**, A. P. Vinod, Christophe Moy and Jacques Palicot, "A low complexity reconfigurable filter bank architecture for spectrum sensing in cognitive radios," in *Proc. of 3rd International Conference on Cognitive Radio Oriented Wireless Networks and Communications*, Singapore May 2008. (CROWNCOM 2008). <https://doi.org/10.1109/CROWNCOM.2008.4562506>
 35. Smitha K. G., **R. Mahesh** and A. P. Vinod, "A reconfigurable multi-stage frequency response masking filter bank architecture for software defined radio receivers," in *Proc. of IEEE International Symposium on Circuits and Systems*, Seattle, USA, May 2008. (ISCAS 2008). <https://doi.org/10.1109/ISCAS.2008.4541360>
 36. **R. Mahesh** and A. P. Vinod, "Coefficient decimation approach for realizing reconfigurable finite impulse response filters," in *Proc. of IEEE International Symposium on Circuits and Systems*, Seattle, USA, May 2008. (ISCAS 2008). <https://doi.org/10.1109/ISCAS.2008.4541359>
 37. Jimson Mathew, **R. Mahesh**, A. P. Vinod and E. M-K. Lai, "Realization of low power high-speed channel filters with stringent adjacent channel attenuation specifications for software radio receivers," in *Proc. of Sixth IEEE International Conference on Information, Communications and Signal Processing*, Singapore, December 2007. (ICICS 2007). <https://doi.org/10.1109/ICICS.2007.4449884>
 38. **R. Mahesh** and A. P. Vinod, "A new low complexity reconfigurable filter bank architecture for software radio receivers based on interpolation and masking technique," in *Proc. of Sixth IEEE International Conference on Information, Communications and Signal Processing*, Singapore, December 2007. (ICICS 2007). <https://doi.org/10.1109/ICICS.2007.4449800>
 39. G. Deepak, **R. Mahesh** and A. Sluzek, "Adaptable area-efficient parallel architecture for grey and color image convolvers," in *Proc. of IEEE International Symposium on Signals, Circuits and Systems*, 2007, pp. 1-4, Vol. 2, July 2007. (ISSCS 2007). <https://doi.org/10.1109/ISSCS.2007.4292788>
 40. **R. Mahesh** and A. P. Vinod, "An architecture for integrating low complexity and reconfigurability for channel filters in software defined radio receivers," in *Proc. of IEEE International Symposium on Circuits and Systems*, pp. 2514- 2517, May 2007, USA. (ISCAS 2007). <https://doi.org/10.1109/ISCAS.2007.378750>
 41. **R. Mahesh** and A. P. Vinod, "Frequency response masking based reconfigurable channel filters for software radio receivers," in *Proc. of IEEE International Symposium on Circuits and Systems*, pp. 2518-2521, May 2007, USA. (ISCAS 2007). <https://doi.org/10.1109/ISCAS.2007.378751>
 42. G. Deepak, **R. Mahesh** and A. Sluzek, "Design of an area-efficient multiplier less processing element for fast two-dimensional image convolution," in *Proc. of 13th IEEE International Conference on Electronics, Circuits and Systems*, pp.467-470, Dec. 2006 (ICECS 2006). <https://doi.org/10.1109/ICECS.2006.379826>
 43. **R. Mahesh** and A. P. Vinod, "Reconfigurable low complexity FIR filters for software radio receivers," in *Proc of 17th IEEE International Symposium on Personal, Indoor and Mobile radio*

communications, pp. 1-5, Finland, Sep. 2006. (PIMRC 2006). <https://doi.org/10.1109/PIMRC.2006.254336>

44. **R. Mahesh** and A. P. Vinod, “A new common subexpression elimination algorithm for implementing low complexity FIR filters in software defined radio receivers,” in *Proc. of IEEE International Symposium on Circuits and Systems*, pp. 4515 – 4518, Greece, May 2006. (ISCAS 2006). <https://doi.org/10.1109/ISCAS.2006.1693633>

7 PATENTS

1. **Mahesh R. Panicker**, Sigmund Frigstad, Pavan Kumar V Annangi, Srinivas Varna, Abhijit Vishwas Patil, Anders Herman Torp, “Method and system for measuring a volume of an organ of interest” U.S. Patent No. US20180085043A1. <https://patents.google.com/patent/US20180085043A1>
2. **Mahesh Raveendranatha Panicker**, Ajay Kumar Behera, Venkatesh Rajagopalan, Venkatarao Ryali, Vivek Venugopal Badami, Budhaditya Hazra, “Methods and systems to monitor health of rotor blades” U.S. Patent No. US20150184536A1. <https://patents.google.com/patent/US20150184536A1>
3. **Mahesh Raveendranatha Panicker**, Ajay Kumar Behera, Venkatesh Rajagopalan, Venkatarao Ryali, Vivek Venugopal Badami, Budhaditya Hazra, “Methods and systems to monitor health of rotor blades,” U.S. Patent No. US20150184533A1. <https://patents.google.com/patent/US20150184533A1>
4. **Mahesh Raveendranatha Panicker**, Aninda Bhattacharya, Akshay Krishnamurthy AMBEKAR, Bret Dwayne Worden, “Methods and systems to determine rotor imbalance.”, U.S. Patent No. US20160169765A1. <https://patents.google.com/patent/US20160169765A1>
5. Selaka Bandara Bulumulla, Joseph Alfred Iannotti, James Patrick Carneal, **Mahesh Panicker**, “Systems and methods for inspecting reinforced concrete structures”, U.S. Patent No. US9194819B2. <https://patents.google.com/patent/US9194819B2>
6. Anthony Furman, Aninda Bhattacharya, Matthew John MALONE, **Mahesh Raveendranatha Panicker**, “System and method of determining bearing health in a rotating machine”, U.S. Patent No. US9574965B2. <https://patents.google.com/patent/US9574965B2>
7. Aninda Bhattacharya, Bret Dwayne Worden, Ajay Kumar Behera, **Mahesh Panicker**, Wrichik Basu, Matthew John MALONE, Arwa Hatim Ginwala, “Methods and system for a turbocharger” U.S. Patent No. US20170122230A1. <https://patents.google.com/patent/US20170122230A1>
8. **Panicker, Mahesh R.**, et al. “Method of inspection for corrosion under insulation - Part I-System”
9. **Panicker, Mahesh R.**, et al. “Method of inspection for corrosion under insulation - Part II-Algorithms”
10. Rajesh VV Langoju, **Mahesh Raveendranatha Panicker**, Abhijit Vishwas Patil. “System and method for imaging deeper tissues” India Patent No. 201741016384 https://ipindia.gov.in/writereaddata/Portal/IPJournal/1_3684_1/Part-2.pdf

<https://iitpkd.ac.in/people/mahesh>

11. Harikrishnan Pisharody Gopalkrishnan, **Mahesh Raveendranatha Panicker**, Gayathri Malamal, Madhavanunni A N, “Array Adaptive Ultrasound Apparatus for Variable Field of View Imaging” India Patent No. 202141036310.