Dr. Jiji C V

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Education

2007 **PhD**, Department of Electrical Engineering, *Indian Institute of Technology Bombay*.
1997 **M.Tech in Communication Engineering**, *Indian Institute of Technology Bombay*.
1988 **B.Tech in Electronics and Communication** , *T K M College of Engineering Kollam*.

Employment

2018-Present **Principal**, College of Engineering, Trivandrum
2017-2018 **Research Dean**, College of Engineering, Trivandrum
2015-2017 **Head of Department**, Department of ECE, College of Engineering, Trivandrum
2009-Present **Professor**, College of Engineering, Trivandrum
2006 **Visiting Researcher**, University of Trento, Italy
1999-2009 **Assistant Professor**, Department of Technical Education, Government of Kerala
1991-1999 **Lecturer**, Department of Technical Education, Government of Kerala
1989-1991 **Electronics Officer**, National Airports Authority
1989 **Engineer-SB**, Institute For Plasma Research, Gandhinagar, Gujarat

Research Areas

Computer Vision
Image Processing
Computational Photography
Signal Processing

Teaching

Graduate Courses: Random Processes & Applications, Digital Filter Design & Applications, Advanced Digital Signal Processing, Multirate Systems and Wavelets, Digital Image Processing, Estimation & Detection Theory, Computer Vision, Research Methodology

Undergraduate Courses: Signals and Systems, Digital Signal Processing, Digital Image Processing, Network Theory, Control System Theory, Communication Engineering, Digital Communication, Electronic Circuits, Electromagnetic Theory, Data Communication, Radar and Navigation, Basic Electronics, Life Skills for Engineers

Invited Talks

- Lecture on Statistical Signal Processing, FDP at Ragagiri School Engineering and Technology, 09/07/2018.
- Probability Fundamentals for AI/ML, Training of Trainers program for ASAP Course on Artificial Intelligence and Machine Learning, MBC, Trivandrum, 18/07/2018.

- Lecture on Project Outcomes as part of FDP on Sponsored Research: Opportunities and Empowerment at College of Engineering Trivandrum on 23/07/2018.
- Introductry Lecture on AI for Deep Learning in Computer Vision, CCE Course at College of Engineering Trivandrum, 23/07/2018.
- Probability and Statistics for AI/ML: Training of Trainers program for ASAP Course on Artificial Intelligence and Machine Learning, IIT Palakkad 22/09/2018.
- Keynote Lecture on Recent Trends in Computer Vision, FDP on Image Processing and Computer Vision, Government Engineering College Kannur, 10/12/2018.
- Fundamentals on probability and Random Processes, FDP on Data Analytics, SCT College of Engineering Trivandrum, 13/12/2018.
- Keynote Lecure on Mathematical Foundations for Communication Engineerig, FDP at T K M College of Engineering Kollam, 07/01/2019.

Publications

2019

- Edison, A. and Jiji, C.V., Automated video analysis for action recognition using descriptors derived from optical acceleration. Signal, Image and Video Processing, Springer (2019).
- Bastian B. T., Jiji C. V., Pedestrian detection using first and second order aggregate channel features. International Journal of Multimedia Information Retrieval, Springer (2019)vol 8, pp. 127-133.
- George, Neetha, Jiji, C.V., Two stage contour evolution for automatic segmentation of choroid and cornea in OCT images. Biocybernetics and Biomedical Engineering , Elsevier (2019)
- Blossom Treesa Bastian, Jaspreeth N, Ranjith S. Kumar, Jiji C. V., Visual inspection and characterization of external corrosion in pipelines using deep neural network, NDT and E International, Elsevier (2019).
- Shine, Linu, Anitha Edison, and C. V. Jiji. A Comparative Study of Faster R-CNN Models for Anomaly Detection in 2019 AI City Challenge. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshops. 2019.
- Parvathy V. S., Jiji C. V., Refraction Corrected Pose Estimation for 3D reconstruction of underwater objects., Tenth International Conference on Computing, Communication and Networking Technologies (ICCCNT), 2019, IIT Kanpur.
- Neetha George., Jiji C. V., Convolutional Neural Network for automatic segmentation of EDI OCT images.Tenth International Conference on Computing, Communication and Networking Technologies (ICCCNT), 2019, IIT Kanpur.
- Deepa P. L., Jiji C. V., Non-uniform deblurring from blurry/noisy image pairs, Accepted for presentation in the Fourth International Conference on Computer Vision and Image Processing (CVIP), MNIT Jaipur, 27-29, September 2019.

2018

- Parvathi, V. S., and Jiji C. V. Multiview 3D Reconstruction of Underwater Scenes Acquired With a Single Refractive Layer Using Structure from Motion.(NCC-2018).

2017

- Anitha Edison and Jiji C. V., Optical Acceleration for Motion Description in Videos. (CVPR Workshops-2017), pp. 39-47
- Bastian, Blossom Treesa, and C. Victor Jiji. Aggregated Channel Features with Optimum Parameters for Pedestrian Detection. (PRemi-2017).
- Bastian, Blossom Treesa, and C. V. Jiji. Enhanced Aggregated Channel Features Detector for Pedestrian Detection Using Parameter Optimisation and Deep Features.(NCVPRIPG-2017).
- Neetha, George, and C. V. Jiji. A Two Stage Contour Evolution Approach for the Measurement of Choroid Thickness in EDI-OCT Images. (NCVPRIPG-2017).
- Sreena, V. G., and C. V. Jiji RGB Patch Clustering for Hyperspectral Image Super-resolution Using Sparse Coding. 2017 Ninth (ICAPR-2017).

2015

- Anitha Edison and C. V. Jiji. HSGA: A novel acceleration descriptor for human action recognition. (NCVPRIPG-2015)
- Anoop K. Johnson and C. V. Jiji. Single shot High Dynamic Range imaging using histogram separation and exposure fusion.(NCVPRIPG-2015)
- Soorya S.Kumar and C. V. Jiji. Histogram of Radon Projections: A new descriptor for object detection. (NCVPRIPG-2015)

2014

- S. Archana , C. V. Jiji, A Novel Poselet Extraction Method and Human Action Recognition using RGBD. (ICVGIP Workshop-2014).
- V.Vibin, C. V. Jiji, A Real Time OpenCV Implementation To Disclose Thoracic Movements During Human Respiration using video magnification. (ICVGIP Workshop-2014).

2013

- Jiji C. V. and Ravi Krishnan Unni, Fusion of Multispectral and Panchromatic Images Based on the Non subsampled Contourlet Transform. International Journal of Image and Graphics (2013) , Volume 13, No:03
- C Muhammed Faasil and C. V. Jiji, Kernel Estimation from blurred edge profiles using radon transform for shaken images. (NCVPRIPG-2013).
- K.V Jobin, C. V. Jiji , P.R Anurenjan , Automatic number plate recognition system using modified stroke-width transform. (NCVPRIPG-2013).

2012

- Sreekanth G. Pai and C. V. Jiji , A stochastic image denoising algorithm using3-D block filtering under a non-local means framework. (ICVGIP-2012).
- Georgin Jacob and C. V. Jiji, Image recovery from partial wavelet coefficients via sparse representation. (ICVGIP 2012).

2011-2004

- Jiji, C. V., Joshi, M. V. and Chaudhuri, S. (2004). Single frame image super-resolution using learned wavelet coefficients. International Journal of Imaging Systems and Technology, 14(3) 105-112.
- Jiji, C. V and Chaudhuri, S. (2006). Single frame image super-resolution throughcontourlet learning. EURASIP Journal of Applied Signal Processing, 2006, 1-11.
- Jiji, C.V., Chaudhuri, S. and Chatterjee, P. (2007) Single frame image super-resolution: should we process locally or globally? Springer Journal Multidimensional Systems and Signal Processing, 18, 123-152.
- Abdu Rahiman V. and Jiji C. V. Face Hallucination using Eigen Transformation in Wavelet Domain. International Journal of Image Processing (IJIP)(2010), Volume(3),Issue(6), 265-282.
- Jiji, C. V. and Chaudhuri, S. (2004). PCA based generalized interpolation for image super resolution. Indian conference on computer vision graphics and image processing ICVGIP,(pp. 139-144), Kolkata.
- C. V. Jiji, Prakash Neethu, Subhasis Chaudhuri: Alias-Free Interpolation. European Conference on Computer Vision, ECCV 2006: 255-266
- V. Abdu Rahiman and C. V. Jiji: Face Hallucination Using PCA in Wavelet Domain. Third International Conference on Computer Vision Theory and Applications, Funchal, Madeira, Portugal VISAPP 2008: 180-187.
- Jiji C. V. and Ravi Krishnan Unni: Fusion of Multispectral and Panchromatic Images using Non subsampled Contourlet Transform. International Conference on Image Processing, Computer Vision and Pattern Recognition, IPCV 2008, Las Vegas Nevada, USA, 608-613

Courses conducted/organised

Faculty Development Programs

- Digital Filter Design:Theory & Practice-2016
- Deep Learning and Its Applications funded by AICTE/QIP -2018

Funded Projects

Ongoing

- CET Student Satellite Project funded by Governmrent of Kerala
- Automatic Traffic Video Analysis funded by Transportation Research Centre, College of Engineering Trivandrum
- Development of LiDAR funded by CERD, Kerala Tecnological University

Completed

- Automated Pothole Detection funded by Transportation Research Centre, College of Engineering Trivandrum
- Computational Photography funded by CERD, Kerala Tecnological University

Awards/Recognition

Best paper Award

National Conference on Computer Vision, Pattern Recognition Image Processing and Graphics (NCVPRIPG 2015) for our paper HSGA: ANovel Acceleration Descriptor for Human Action Recognition

Other Activities and Responsibilities

Member, Faculty of Engineering, University of Kerala (2015-17)

Chairman, Board of Studies (Enginering), University of Kerala (2017-)

Program Committee Member, National Conference on Communications (NCC) organized by IITs, NCC 2018, NCC 2016

Program Committe Member, National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics(NCVPRIPG), NCVPRIPG 2019,2017,2015.

Current Research

Object Detection: The research profoundly focuses on various feature extraction methods to increase the detection accuracy of existing object detection algorithms and in specific we concentrated on pedestrian detection, vehicle detection and low shot object detection. To aggregate channel feature (ACF) framework, we integrated pattern-based features: histogram of sparse codes and improved the detection accuracy onINRIA dataset. Further, we introduced second-order ACF (SOACF) features based on the second-order information in the image. Owing to the complementary nature of detectors based on ACF and SOACF, we merged the two detectors using weighted non-maximum suppression, finally resulting twenty-seven channels with comparable miss rate and computation speed for INRIA, Caltech and KITTI datasets. Next we indulged in studying the effect of hyper parameters on the miss rate of ACF detector for Caltech dataset and experimentally found the best hyper parameter values. Apart from this, we employed the proposed ACF detector as a region proposer in the fast region-based convolutional neural network (Fast R-CNN) framework with AdaBoost classifier and produced the second-best result on Caltech dataset. While for vehicle detection, we in fact focused on the detection of auto-rickshaw categories and proposed a challenging detection dataset for auto-rickshaws. We improvised state-of-the-art detectors like ACF, locally decorrelated channel features (LDCF) detector, Faster R-CNN, feature pyramid network (FPN) and RetinaNet for the proposed auto-rickshaw datasets. Along with these we also proposed an end-to-end pose estimation and detection framework using Faster R-CNN and FPN, which is highly advocated for the case of road scene understanding. Finally, for low-shot detection, we developed a DNN based detection method which employs a fewer number of images with instance-level annotation and depends more on image-level annotation for training. We proposed a three-stage learning pipeline based on RetinaNet framework which employed few instance-level and full image-level annotations for un-seen categories and achieved comparable results on PASCAL-VOC 2007 test dataset.

Human Action Recognition: Human action recognition has been garnering a lot of attention from the computer vision community, and the major challenge in developing an automated action recognition system is capturing the relevant motion information in videos. Modern techniques for describing motion in videos are centered on velocity descriptors derived from optical flow. Realizing that acceleration is as important as velocity for describing motion information, this research concentrated on developing algorithms to compute optical acceleration. Delving deeper into the concept of optical acceleration, acceleration descriptors were derived to represent motion information. To assess the effectiveness of these descriptors for motion encoding, they were applied for human action recognition and abnormal event detection in videos. Experiments on standard datasets proved that acceleration is as important as velocity to represent motion information in videos. The descriptor-based method developed is a cost-effective real-time solution to abnormal event detection problem. Optical acceleration was also used in a deep learning framework to train generative adversarial networks (GAN) for anomaly detection

Dense 3D Reconstruction: Three-dimensional (3D) measurement is one major part of computer vision,an emerging research area. Structure from Motion is one of the 3D measurement methods that can produce the result from multiple images of the scene captured with single camera. Because of its easiness, Structure from Motion has been implemented in various ways on land based applications. However there is a critical problem in that the measurements of objects may not be accurate if the images are blurred due to the presence of fog, rain or refractive interfaces. Especially if the object is underwater, images will be distorted mainly due to refraction and scattering. The research concentrate a refractive structure from motion algorithm for 3D reconstruction of objects under water.

Anomaly Detection: During the last few decades, surveillance cameras have been installed in different locations. Analysis of the information captured using these cameras can play effective roles in event prediction, online monitoring and goal-driven analysis applications including anomalies and intrusion detection. Anomaly means the occurrence of events or behaviors which are unusual, irregular, unexpected and unpredictable and thus different from existing patterns. In first phase of research focus on exploring anomaly in traffic videos. Here, persons travelling on two wheeler without helmet is considered as anomaly. Two wheeler instances are extracted from the traffic videos using machine learning algorithms. The head region of the extracted two wheelers are further segmented and classified using CNN to identify whether the motorcyclist is wearing a helmet or not. In the second phase of anomaly detection traffic accidents are taken as anomaly. Here the goal of the work is to design an algorithm that is able to timely and accurately detect the anomalies from traffic surveillance videos. An unsupervised approach based on background subtraction and object detection is used

OCT Segmentation: Optical coherence tomography (OCT) is a leading biomedical imaging modality capable of generating images of living biological tissues at high resolution. OCT segmentation provides a quantitative tool to help the ophthalmologists to manage the high complexity of the OCT data. A correct segmentation can provide useful information about diseases making diagnosis easy. Segmentation, however, remains one of the most difficult and challenging task. The capability for automatic segmentation and quantification remains limited at present. This research aims to explore the possibility of new algorithms for segmenting OCT images and finally to develop an intelligent system for automatic classification and detection of retinal diseases

High Dynamic Range Image Generation: The real-world scenes in our daily life have a very wide range of luminance values. But the normal digital photographs (Low Dynamic Range (LDR) Images) are not able to capture the full dynamic range of the scene of view. Here comes the importance of High Dynamic Range (HDR) Imaging. HDR imaging is the process of capturing scenes with larger intensity range than what conventional sensors can capture. It can faithfully capture the details in dark and bright part of the scene. The common method for the acquisition of HDR image is based on multiple exposure principle. The basic idea behind this principle is to capture multiple images having Low Dynamic Range (LDR) of the same scene with different exposures. Then a single HDR image is generated by merging the exposure bracketed LDR frames. The main issues in HDR imaging using multiple exposure combination technique are Misalignment of input images, Noise in data sets and Ghosting artifacts. The misalignment and noise in the dataset make the HDR image blurry. The magnitude of noise is mostly dependent on the selection of exposures for merging and on the weights used to average their pixel values. Ghosting problem is a severe limitation due to any object movement in the scene. Even a very small or limited movement will produce noticeable artifacts in HDR image. So, the detection and removal of ghosting artifacts are important. Misalignment and noise in dataset can complicate the problem of detection and correction of these artifacts. In the present work it is proposed to make a detailed study of various HDR imaging techniques and develop algorithms having better performance in terms of image quality and enhanced dynamic range by addressing issues like Ghosting artifacts, Misalignment of images, Noise in dataset etc.

Super resolution of hyper-spectral images: Hyperspectral Images are used for aerial and space imagery applications including target detection, tracking, agricultural and natural resource exploration etc. Hyperspectral Imaging sensors measure the radiance of the materials within each pixel area at a very large number of contiguous spectral wavelength bands. The resulting reflectance representation can be used to identify specific materials in a scene. The atmospheric scattering, Second illumination, Changing view angles and sensor noise degrade the quality of these images. Super-resolution Image reconstruction offers the promise of overcoming the inherent resolution limitation of imaging sensors. We propose to develop new and efficient super-resolution algorithms addressing the associated issues in the field of Hyperspectral Imaging. Objective of the work were to develop a new superresolution framework for joint spectral-spatial information enhancement for Hyperspectral Images and explore the possibility of Deep level learning technique for Hyperspectral Image Superresolution.

Image Deblurring: Blind image restoration is the process of estimating both the true image and the blur kernel from the degraded image characteristics, using either partial information or no information about the imaging system. Now a days, different algorithms are used for removing various types of image blurs. Among them blind deconvolution algorithms play an important role. Blind deconvolution is the problem of recovering a signal and a degradation kernel from their noisy convolution. This problem is found in diverse fields such as astronomical imaging, medical imaging, audio signal processing and image processing. In classical image restoration methods, that assume a known blur kernel, are not suitable for many real image processing situations. The major challenge in this field is that there exists a poor compromise among computational complexity, convergence properties and portability of the algorithm for the existing blind deconvolution methods. The relative importance of each of the above factors depends on the particular imaging application. The challenge is to design a method that exhibits the most appropriate compromise among computation complexity, reliability, and portability for a given application. In the present work, it is proposed to make a detailed study of various blind deconvolution algorithms used for image deblurring and develop algorithms that will exhibit better performance compared to the existing ones.