Amit Satish Unde

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Research and Development Lab
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Research Interests

Broad Areas: Image and video processing, compressive sensing, computer vision, and multimedia security.
Specific Areas: Secure source coding scheme for wireless camera sensors, multiview video coding, compressive sensing based recovery algorithms, and low complexity video summarization techniques

Education

National Institute of Technology Calicut, Kerala, India
Ph.D, Secure Communication [**January 2015 - present**]
Guide: Prof. Deepthi P. P.
CGPA: 8.85/10

National Institute of Technology Calicut, Kerala, India
Master of Technology, Signal Processing [**2010 - 2012**]
CGPA: 8.67/10

Dr. J. J. Magdum College of Engineering Jaysingpur, Maharashtra, India
Bachelor of Technology, Electronics Engineering [**2005 - 2009**]
Percentage: 69 %

GATE Score

Subject: EC, Year: 2010, Percentile: 99

Teaching Experience

Assistant Professor, Vishwakarma Institute of Technology Pune
Courses offered: *Signals and Systems*, *Digital Signal Processing*, *Coding and Data Compression*

Teaching Assistant, National Institute of Technology Calicut
Assisted in conducting experiments for the following labs:
Signal Processing Lab, *Basic Electronics Lab*, *Electronics Circuits Lab*, and *Logic Design Lab*

Research Projects

Secure Source Coding Scheme for Wireless Camera Sensors:

- **Rate-distortion Analysis** - Analyzed the rate-distortion performance of block compressive sensing (CS) based imaging system using structured sensing matrices to investigate the choice of sensing matrix for compression and energy efficient CS encoder. A uniform scalar quantization is employed followed by Huffman coding. It is established that the AC CS measurements using structurally random matrices (SRM) are Laplacian distributed irrespective of the statistical characteristics of the original images. Demonstrated the compression efficiency of SRM with fixed Huffman coding utiliz-

ing a priori knowledge of the distribution of CS measurements to overcome the drawback of high computational complexity associated with the custom Huffman coding. It is also shown that the probability distribution of CS measurements using binary permuted block diagonal (BPBD) matrix retains statistical information of the original images. Evaluated the compression efficiency of BPBD matrices with fixed length coding.

- **Data Confidentiality** - Investigated the resistance of CS-based cryptosystem against known-plaintext attacks (KPA). Demonstrated infeasibility of KPA in extracting any useful information due to existence of huge number of indistinguishable solutions to the true sensing matrix. Evaluated the resistance of CS-based encryption scheme against chosen-plaintext attacks (CPA). Observed that CS-based cryptosystem can be easily vulnerable to CPA using subset sum problem. Proposed artificial-noise-assisted CS based lightweight encryption system with low structural complexity. Proposed to randomly corrupt a bit stream resulting from entropy coding of quantized CS measurements by adding a bit stream from synchronous intentional error vector. Presented a methodology for an efficient implementation of the proposed system with optimized hardware design.
- **On-Line Discovery of Salient Content of Video** - Proposed a low complexity methodology to detect the salient content of video prior to compression, aiming to reduce both the transmission cost and power consumption. The proposed method is motivated by the video summarization technique and is based on motion activity descriptor between DC images of original video frames. The video frames that guarantee minimum target level of motion activity are extracted. The adaptive thresholding criterion to filter the only optimum number of representative video frames is also proposed. The computational complexity of the proposed method is analyzed.

Compressive Sensing Based Recovery of Images and Video:

- **Individual and Joint Recovery Algorithms for Correlated Images**- Proposed an iterative re-weighted l_1 norm minimization reconstruction algorithm for block compressive sensing of images in conjunction with the smoothing operator. The use of l_1 norm is encouraged in order to exploit the desired signal sparsity while an image smoothing is imposed simultaneously to eliminate the blocking artifacts. The recovery algorithm for the joint reconstruction of multi-view images and successive video frames for effective utilization of the high correlation between them is proposed. The correlation between multiple images is exploited through the joint sparsity model which promotes the common sparsity structure.
- **Compressed Domain Motion and Measurements Estimation** - Proposed compressed domain motion and measurements estimation techniques to exploit the high correlation between successive video frames at the decoder. The proposed motion estimation technique is motivated from the restricted isometry property of the sensing matrices which guarantee to approximately preserve the distance between any two K-sparse signals. It seeks the best matching measurement vector for motion estimation as opposed to block matching in conventional video coding. In the proposed measurement estimation technique, efficient utilization of bandwidth is achieved by skipping some measurements at the transmitter side. The skipped measurements are estimated at the receiver by exploiting the correlation between CS measurements of the non-key frame and corresponding motion predicted frame using multiple regression model.

Publications **Journals**

1. Amit Satish Unde and Deepthi P. P.. "Rate-distortion analysis of structured sensing matrices for block compressive sensing of images," *Signal Processing: Image Communication*, Elsevier, vol. 65, pp. 115 - 127, 2018.
2. Amit Satish Unde and Deepthi P. P., "Fast BCS-FOCUSS and DBCS-FOCUSS with augmented Lagrangian and minimum residual methods," *Journal of Visual Communication and Image Representation*, Elsevier, vol. 52, pp. 92-100, 2018.
3. Amit Satish Unde and Deepthi P. P., "Block compressive sensing: Individual and joint reconstruction of correlated images," *Journal of Visual Communication and Image Representation*, Elsevier, vol. 44, pp. 187-197, 2017.

Coursework Decision Modeling, Theory of Error Control Coding, Linear Systems Theory, Digital Image Processing, Wavelets: Theory and Constructions, Adaptive Signal Processing, Information Theory

SKILLS MATLAB, C

Internship Experience **Travancore Analytics Trivandrum**, Kerala, India [**June 2011 - April 2012**]
Advisor: Premprakash V. A.
Project: Segmentation, Registration and Fusion of Medical Images

Reference
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