

ST.FRANCIS INSTITUTE OF TECHNOLOGY

BIBLIOGRAPHY OF PH.D.THESIS

LEARNING AND INFORMATION RESOURCE CENTRE

www.sfit.ac.in

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

**TITLE:FACE RECOGNITION USING
ORTHOGONAL TRANSFORMSAND VECTOR
QUANTIZATION TECHNIQUES(2010)**

Acc. No. DT1

AUTHOR:MS.KAMAL SHAH

GUIDE:DR.H.B.KEKRE

Abstract

This thesis is an attempt to unravel the problem of human face recognition. Face recognition is a biometric authentication method that has become more and more relevant in the recent years. Face recognition is a popular research area where there are different approaches studied in the literature.

In this thesis face recognition problem is handled by applying Principal Component Analysis (PCA), Various Orthogonal transforms and different Vector Quantization (VQ) codebook generation techniques. The eigenvectors are the principal component of the set of images. Each face can be closely represented by a linear combination of the Eigen faces. The Eigen face method tries to find a lower dimensional space for the representation of the face images. Here to reduce the dimensionality instead of utilizing all the Eigen faces for recognition purpose only small number of Eigen faces is selected according to the energy contain which is close to total energy of original face. This particular method helps to reduce the dimensionality efficiently. The main drawback of PCA is scalability. As dataset changes the whole eigenspace distribution also changes. To avoid this difficulty various orthogonal transforms like Discrete Cosine Transform, Discrete Sine Transform, Walsh Hadamard Transform, Slant Transform, Wavelet Transform and newly proposed Kekre's Transform are applied on controlled standard ORL database and unconstrained local database prepared by using Indian origin faces of 50 male and 50 female. The concept of image energy compaction in low frequency coefficients is explored here. Instead of using total image energy and all the

transformed coefficients for comparing a test image with the stored database only selected number of coefficients according to desired energy of image is utilized for recognition purpose. To reduce computational time and complexity the separability property of transforms is utilized. Here instead of applying the transform on entire image only rows or columns of the image is converted to the transform domain and it is called Row Feature Vector or Column Feature Vector respectively. By this particular approach the computation time has reduced drastically compared to the full transform which makes the algorithm more suitable for the real time applications.

The Vector Quantization is considered to be a good data compression technique. The key to VQ is the good codebook generation. Here the new technique for codebook generation is introduced as Kekre's Fast Code Book Generation (KFCG). As name suggested this method is faster to another existing codebook generation techniques like LBG and K-Means.

In this thesis various algorithms have been applied for face recognition using standard ORL database and locally generated database of Indian faces. Relative performance of various transforms such as PCA, DCT, DST, WHT, Wavelet Transform, Slant Transform and Kekre's Transform have been evaluated for full transforms, Row Feature vectors and column feature vector method. Various codebook generation techniques like LBG, K-Means and KFCG are also applied on same databases and the performance of all these codebook generation technique is studied.

Face recognition parameters like accuracy of recognition, speed, compactness, robustness against noise and occlusion as well as False Acceptance Ratio (FAR) and False Rejection Ration (FRR) are compared for PCA, other transforms and all VQ techniques.

Finally it is concluded that KFCG technique of VQ has given the best performance among all the algorithms.

**TITLE: OPTIMAL SEARCH ALGORITHMS FOR
MOTION ESTIMATION (2010)**

Acc. No. DT2

AUTHOR: JAYASWAL, DEEPAK

GUIDE: ZAVERI, MUKESH

Abstract

This thesis investigates the important component of video codec needed for compression, the motion estimation (ME) and compensation model. In this research work for motion estimation we address the key performance issue that include design of motion models that are acceptable at different bit-rate and for different types of motion such as rotational, zooming and deformation of object. In particular we discuss various block matching motion estimation algorithm (BMA) for efficient prediction and video coding. Block based motion estimation has been widely adopted by several important international standards such as Motion Picture Expert Group (MPEG), Advanced Television Standard Committee (ATSC), Digital Video Broadcasting (DVB) and International Telecommunication Union (ITU). It has been extensively utilized in compression algorithms for ME. The motion estimation process in video codec is time consuming, complex, uses memory; require more computational power, and has constraints on the type of motion involved. Motion Estimation is used in video encoder to create a 'model' that matches the current frame as closely as possible based on one or more previously transmitted ('reference frame') frame. Motivated by the need for fast and accurate motion estimation for compression, storage, and transmission of video as well as other applications of motion estimation an Optimal Search algorithms for estimating motion (OSME) from video image sequences have been proposed.

The thesis introduce the importance of motion estimation algorithm in time domain using generic block diagram of video codec along with the key performance issues of ME algorithm. To understand the tradeoff between different techniques for motion estimation, the limitation and benefits of motion estimation algorithms a detailed literature review is presented.

In this thesis we propose two algorithms in suboptimal category, namely Two Level Search (2LS) and Hybrid Search (HS) for motion estimation. From simulation result and analysis it has been shown that these proposed algorithms are best suited for deriving motion vector for ME and are computationally efficient and provides PSNR as good as Full Search algorithm. These algorithms are very useful for video telephony, video conferencing like applications. Next, we have proposed Fast Adaptive Search based motion estimation algorithms which provide elegant solution for various issues like scalability, coding performance, complexity and rate distortion performance. Moreover, we performed investigation and experiments to find all possible ways so as to improve the accuracy and speed of the motion tracking.

**TITLE: ALGORITHMS AND
ARCHITECTURES FOR DISCRETE
HARTLEY TRANSFORM**

Acc. No. DT3

AUTHOR :SHAH, GAUTAM A.

Project Guide RATHORE,T.S.

Abstract

Discrete Hartley transform (DHT) is attractive mainly due to its real-valued kernel and identical forward and inverse transforms. This dissertation focuses two aspects of DHT: (i) development of fast algorithms, and (ii) development of architectures to implement the algorithms to compute DHT.

The elements of the DHT matrix can be computed using the direct method in which each element of the matrix is computed based on its definition. Computationally fast position-based method is developed and implemented. In the method, the characteristics of the DHT matrix and its sub-matrix are identified. They are utilized to assign values to some elements, and compute only a few elements using the definition. These elements are then utilized to obtain the remaining elements based on their positions. An algorithm utilizing this method is developed which is faster in computing the elements than the direct method based on its definition.

New radix-2 decimation-in-time and decimation-in-frequency algorithms are developed. Their distinct feature is that they explicitly introduce multiplying structures in the signal flow-diagram. The summing structures are modified to perform only addition and subtraction. They exhibit a signal flow-diagram with butterflies identical for each stage which make them suitable for implementation. The multiplying structures take care of all the multiplications and their related additions. The analytical expressions for the operation counts of these algorithms are derived and shown to require less number of multiplications. Similar exercise is carried for radix-4 DHT. It is found that radix-4 is faster than radix-2. The work is extended to develop the signal flow diagram of the split-radix DIT algorithm which utilizes combination of radix-2 and radix-4. Finally, a general-radix algorithm computes DHT for an arbitrary value of N , where either radix-4, radix-

Basic analog circuits are designed to perform the summing structure and multiplying structure operations and their sensitivities are computed. Architectures to implement radix-2, radix-4 and split radix algorithms are developed. Being modular they can be scaled for large values of N . They process the data simultaneously at each stage and are, therefore, faster than those based on the multiply and accumulate approach. These architectures are tested by simulating them using Orcad PSpice and hardware modules for small values of N are mounted on the breadboard and tested by applying various input sequence patterns to obtain the desired outputs.

SFIT

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

**TITLE: BINS APPROACH TO
CONTENTBASED IMAGE RETRIEVAL**

Acc. No. DT4

AUTHOR: SONAWANE, KAVITA VINAY

Project Guide Dr. H.B. KEKRE

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

SFIT LIRC

Abstract

The title of the system itself clearly states that it promotes the retrieval of images from large size databases based on image "Contents". Fast growth of advancement in technology moving towards generation of various multimedia databases. It encourages the need of maintaining and accessing these databases fast and efficiently. CBIR works in the same area where various application fields like Architectural Engineering, Medical , Crime branch, Arts and Design, marketing and trading and many more are eager to have the new techniques to be explored that will provide high accuracy and completeness.

In this research, we have contributed with the novel techniques with advantages over existing ones from the same domain. All the approaches proposed, designed, implemented and evaluated are from the spatial domain of image processing. We have made an attempt to explore all core phases of CBIR in unique way.

1. Feature Extraction
2. Similarity Measure
3. Query Specification
4. Performance Evaluation

1. Feature Extraction: In this phase, feature extraction mainly deals with bins approach based on partitioning of histograms by means of linear partitioning and centre of gravity. It explores the 64, 27 and 8 bins approaches by considering the significance of R, G and B relationship. It also proposes and recommends the effective use of histogram modification techniques namely histogram equalization, Polynomial function, Linear equation and Log function in image retrieval for the first time. Feature vectors extracted from bins data are mainly presenting the 'Color and texture contents'. Color contents (Red, green and Blue) are

treated separately while extracting from bins data. Texture features are obtained in the form of first four statistical moments namely Mean, Standard deviation, Skewness and Kurtosis.

- 2. Similarity Matching:** Experimentation and evaluation with first five orders of MinkowskiDistance was tried and first two orders we have found to a give better results. Thus these two measures namely, 'Absolute Distance' and 'Euclidean Distance' are used throughout this work along with 'Cosine Correlation Distance'.
 - 3. Query Specification:** A novel idea of firing a 'Average Query' (instead of individual query approach) to the CBIR system is proposed, experimented and evaluated in this research that deals for the reduction in computational complexity along with improvement in the retrieval results.
 - 4. Performance Evaluation:** In this section, we have introduced a new parameter named 'Longest string' giving advantages to the CBIR users along with proving the effectiveness of the CBIR system in unique way. All proposed algorithms in this work are evaluated by using three parameters namely Precision Recall Cross over Point (PRCP), LSRR (Length of String to Retrieve all Relevant Images) and the new one i.e. LS (Longest String).
- **Color Spaces:** With the idea to improve results further different linear color spaces namely, XYZ, YCbCr, Kekre's Bi-orthogonal color spaces (LXY and L'X'Y'), YIQ, Kekre's LUV and YUV have been tried. It is observed that there is an improvement in the results is obtained for YCbCr, K'LUV, YIQ and YUV. However LXY and L'X'Y' have given better results for some parameters. Whereas for XYZ the results are poor.

**Title: SNOWMELT RUNOFF MODEL FOR
HIMALAYAN BASIN USING REMOTE
SENSING AND GIS TECHNIQUES**

Acc. No. DT5

Author: CHELAMALLU, HARI PRASAD

**Project Guide: Prof. G. VENKATRAMAN, Prof.
M.V.R. MURTI**

Abstract

Major part of the world's fresh water is stored in the form of snow and glaciers and these are potential sources for perennial rivers. Ganga, Yamuna and Brahmaputra are the major rivers in North India originating from glaciers and seasonal snowmelt in the Himalayas. These rivers are the key contributors to hydroelectric power generation, irrigation and drinking water, thus creating an impact on the socio-economic status of North India. The current phase of glaciology study concentrates on snowmelt runoff modeling which is still in the development stage in India. These studies involve collection of data from remote areas at very high altitudes. It is desirable to apply Remote Sensing and GIS principles to find proper snowmelt runoff models which suit the Himalayan conditions. Current study involves the selection of appropriate (suitable) remote sensing images for developing snow cover maps and identification of a suitable hydrological model which can utilize Remote Sensing and GIS techniques to predict the snowmelt runoff for Himalayan basins.

Daily snow cover maps MOD10A1 of MODIS Terra images were retrieved for the period from 2004 to 2007, and compared with ground snow depth measurements from the Snow and Avalanche Study Establishment (SASE) observatories in Himalayas. Comparison of snow maps with in situ data shows good agreement and based on location and season, the accuracy of these maps varies from 70.29% to 97.65%. It has been observed that the accuracy of MODIS snow cover maps increases as the snow depth increases. As more than 40% MODIS MOD10A1 snow cover data is affected by cloud cover at Upper Bhagirathi study basin and consequently it has been found accuracy of these maps is least accuracy at Bhojwasa compared to other regions of Himalayas. Hence, MODIS MOD10A2 (V005) product has been considered for the hydrology studies of Upper Bhagirathi river basin. The validation studies of MOD10A2 snow cover maps using higher resolution images (LISS III) has been observed to be more than 90%. Therefore, snow depletion curves for the study basin are generated by using MODIS MOD10A2. Meteorological data analysis and correlation studies have been carried out to understand relations of meteorological parameters and snow cover with snow/glacier melt runoff. Precipitation, temperature, cloud cover, evaporation, wind speed and wind direction data are collected from the observatories located at 3 km

downstream (at Bhojwasa) from the Gangotri glacier snout. These data are analyzed and various statistical parameters are obtained. Further, values of critical temperature (3 °C) and temperature lapse rate values (0.30 to 0.51 °C/100m) have been derived from the analysis of meteorological data. Good positive correlation is observed between discharges with antecedent discharge and temperature and negative correlation is observed between discharges with snow cover. It is also pointed out that weighted average temperature of $(0.8T_{max} + 0.2T_{min})$ shows better correlation with discharge than any other type of temperature (i.e. maximum, minimum, mean) correlations. Poor positive and negative correlation is observed between discharge versus precipitation and wind speed.

Statistical regression analysis has been carried out and the relationship between discharge with temperature and snow cover is formulated. The simulated discharge by using this regression equation shows a good agreement with observed discharge (R^2 around 0.90). Further Snowmelt runoff models (SRM and SNOWMOD) are employed by using the derived values of monthly critical temperature and lapse rates from meteorological data analysis, daily snow cover depletion curves from MODIS MOD10A2, topographical information from DEM and other parameters by manual calibration according to the basin requirements. These models are calibrated with the data for two years (2006-07) and validated for the years 2008 and 2009. Based on four years observations, stream flow simulation accuracy of SNOWMOD model is better than SRM model in the volume as well as daily projection. The results of the regional climate scenario from published literature are provided as input to these models (SRM and SNOWMOD) and stream flow simulations are carried out for the years 2030, 2050 and 2080 under different SRES scenarios to understand the impact of global climate change on regional hydrology. SNOWMOD model simulations (ranging from 35.7% to 120%) show higher rate of change of stream flow, as compared to SRM model simulations (ranging from 8.2 % to 35.3%) during the snow melting seasons based on various SRES scenarios and periods.

Keywords: Snowmelt runoff model (SRM), MODIS, forecast, Gangotri, SNOWMOD.
LISS III, Remote Sensing, GIS

**Title: DIGITAL MODULATION TECHNIQUES
TO OPTIMIZE THE QUALITY OF INDOOR
UWS COMMUNICATION**

Acc. No. DT6

Author: GOMES, JOANNE

Project Guide Dr. B.K. MISHRA

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

SFIT LIRC

Joanne Gomes, "Digital Modulation Techniques to Optimize the Quality of Indoor UWB Communication." Ph.D. Thesis, SNDT University Mumbai, 2013.

Abstract

The multitude of wireless systems now a day's support high data rate services that allow the deployment of multimedia application involving voice, data, pictures and video over the wireless network. The increasing demand for high speed communication between portable wireless devices has focused the research on the wireless technologies that communicate faster with less power consumption. In Wireless Personal Area Networks (WPAN) such as home networks, the cable free connection between different Consumer Electronic (CE) devices is realized by the use of Wireless-Universal Serial Bus (W-USB). In this context Ultra-Wide-Band (UWB) has proved to be the most suitable technology to implement W-USB for short range wireless communication. UWB is considered as a fast, power-efficient, low-cost and non-interfering wireless alternative for inter-device communications. Federal Communications Commission (FCC) has allowed UWB systems to operate in a wide unlicensed spectrum of 3.1 GHz to 10.6 GHz which has revived research interest in the forty year old concept of UWB.

The objective of this research work is to design digital modulation techniques for Impulse-Radio (IR) UWB transceiver system to optimize the quality of inter-device W-USB communication at the Physical layer of the home network in terms of speed and accuracy. Since most of the CE devices in home network are portable, such an application requires the UWB system characterized by low cost, low complexity and low power consumption hardware.

The proposed modulation techniques based on hermite pulses are modeled in MATLAB Simulink and are analyzed for their high speed data communication performance with low complexity. The performance analysis of N -dimensional Pulse Shape Modulation (N -PSM) scheme, as a bandwidth efficient method, is presented for indoor UWB communication. Two extended modulation schemes called N -dimensional Pulse Shape and Position Modulation

(N -PSPM) and Differential Pulse Shape Modulation (D-PSM) are designed and evaluated for their high speed communication performance.

The very large bandwidth of UWB signals facilitates the use of long error correcting codes to attain low bit error rates resulting in increased accuracy of data communication. The (n, k) cyclic codes of t bit error correcting capability with special case of $t = k$ are redefined and employed here for UWB communication with their low cost encoder/decoder implementation. All the transmitted information bits (k) are corrected at the receiver when the received code word is in error by a number of bits equal to or less than t bits. The cyclic codes with low code rate (≤ 0.25) having error correcting capability up to five bits are devised here to optimize the accuracy of UWB communication.

The designed techniques are finally tested for the application of video transmission. N -PSM scheme applied here, enhances the original system data rate by N times and proves to be bandwidth efficient high speed modulation technique for UWB communication. Similarly the N -PSPM scheme designed, is an alternate way to achieve high speed communication with better power efficiency whereas D-PSM technique designed, provides non-coherent UWB communication with high data rate.

Keywords: *All Data Correcting Codes; Home Network; N-PSM; N-PSPM; D-PSM; UWB-Transceiver; Wireless Video Transmission*



ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

**Title: AUTOMATED IDENTIFICATION OF
DIABETIC EYE DISEASES USING DIGITAL
FUNDUS IMAGES**

Acc. No. DT7

Author: NORONHA, KEVIN

Project Guide: Dr. K. PRABHAKAR NAYAK

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

SFIT LIRC

Abstract

Diabetes mellitus is caused due to the increased glucose level in the blood, affecting vital organs if not treated at the early stage. Human eyes are one such organ affected by diabetes causing diabetic retinopathy (DR), diabetic maculopathy (DM) and glaucoma. DR is basically a micro complication of microvasculature of retina, wherein the tiny blood vessels gets damaged due to increased blood sugar. The visible symptoms begin to manifest on the retina in the form of micro aneurysms (MA) which appear like small red dots. If the glucose level in the blood is not controlled then the fragile capillaries may rupture and causing hemorrhages, hard exudates, cotton wool spots etc. As DR advances it may affect the functioning of the macula resulting in diabetic maculopathy (DM) which may cause significant visual loss among DR patients. DM is characterized by the appearance of hard exudates in macular region and increase in the retinal thickness. When the fluid rich in fat and cholesterol leaks out of the damaged vessels of the retina to the macula, it affects the macular functionality. Again early detection and corrective treatment is the key to prevent loss of vision amongst DM patients. Glaucoma is next to DR in terms of people losing their vision worldwide. It adversely affects the functioning of the optic nerve and thereby causing damage due to the increase in the intraocular pressure (IOP) leading to the visual field loss. Recent studies indicate that there is a relation between prevalent diabetes and incident of glaucoma in diabetic patients. Although there is no cure for glaucoma presently, timely, comprehensive medication and treatment can prevent loss of vision. Symptoms of glaucoma are not always obvious; hence patients seek treatment only when the condition has progressed significantly. Early detection and remedial treatment will decrease the chances of vision loss in glaucoma subjects.

In cities usually people are aware of the complications of such diseases and therefore resort to regular screening of their eyes. However in rural areas where there is scarcity of healthcare facilities, mass screening of patients during scheduled camps can help in identifying prevalent eye disorders. Computer Aided Diagnosis (CAD) can play a prominent role in mass screening of DR, DM and glaucoma. CAD techniques can help to diagnose the patients affected by DR, DM and glaucoma even without the presence of an ophthalmologist. In this thesis, we propose such a CAD technique to identify eye diseases such as DR, DM and glaucoma using digital fundus images.

In the decision support system for automated detection of DR, we have classified the fundus images into normal and DR. We have used Discrete Wavelet Transform (DWT) and Support Vector Machine (SVM) classifier for automated detection of normal and DR classes. The wavelet based decomposition is performed up to the second level and eight energy features were extracted. Two energy features from the approximation coefficients of two levels, and six energy values from the details in three orientations (horizontal, vertical, and diagonal) are evaluated. These features are fed to the SVM classifier with various kernel functions (linear, radial basis function, polynomial of order 2 and 3) to evaluate the highest classification accuracy. We have obtained the highest average classification accuracy, sensitivity and specificity of more than 99% with SVM classifier (polynomial kernel of order 3) using *three* DWT features. We have also proposed an integrated index called Diabetic Retinopathy Risk Index (DRRI) using clinically significant wavelet energy features to identify normal and DR classes using just one number. We feel that, this (DRRI) can be used as an adjunct tool by the doctors during the eye screening to cross check their diagnosis. We have also classified fundus images into normal/Non

proliferative diabetic retinopathy (NPDR)/ Proliferative diabetic retinopathy (PDR) using higher order spectra (HOS) cumulants and Naïve Bayesian classifier with an accuracy of 90.74%.

In the automated classification of DM, we have classified the retinal fundus images into normal, non-clinically significant macular edema (NCSME) and clinically significant macular edema (CSME) suspect classes using texture parameters. Texture features are extracted based on the first order statistics, GLCM (Gray Level Co-occurrence Matrix) and run length matrix. The statistically significant features are then fed to two classifiers namely support vector machine (SVM) and Fuzzy-Sugeno (FS) classifier to choose the best classifier for automated diagnosis. The proposed technique is validated using 300 images, 100 images of each *normal*, *NCSME* and *CSME*. We have obtained the best results using FS classifier with an average accuracy of 86.67%, average sensitivity of 100%, and average specificity of 100% using ten-fold cross validation. The proposed automated system can aid clinicians as an adjunct tool in the process of diagnosing diabetic maculopathy during the mass screening of DR subjects and to detect the early stages of DM.

In the computer aided diagnosis of glaucoma we have used 510 fundus images to classify in to normal and glaucoma classes. Various features namely mean, variance, skewness, kurtosis, energy, and Shannon, Rényi, and Kapoor entropies are extracted from the Gabor transform coefficients. These extracted features are subjected to Principal Component Analysis (PCA) in order to reduce the dimensionality of the features. Subsequently these features are ranked using various ranking methods namely: Bhattacharyya space algorithm, t-test, Wilcoxon test, Receiver Operating Curve (ROC), and entropy. In this work, t-test ranking method has yielded the highest performance with an average accuracy of 93.10%, sensitivity of 89.75% and specificity of 96.20% using 23 features with Support Vector Machine (SVM) classifier. We have also

proposed a Glaucoma Risk Index (GRI) developed using principal components to classify the two classes using just one number. We have further classified the fundus images into normal/mild/moderate-severe using HOS cumulants and Naïve Bayesian classifier with an accuracy of 92.65%. This proposed system can help in the mass screening of glaucoma.

SFIT LIRC

**Title: COMPLEX QUERY JOIN
OPTIMIZATION IN PARALLEL
DISTRIBUTED ENVIRONMENT**

Acc. No. DT8

Author: JADHAV, VAISHALI PRASHANT

**Project Guide: DR(MRS) SUNITA M
MAHAJAN**

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

SFIT LIRC

Abstract

Query optimization is a deep rooted area of research. This research area has gained prominence due to increasing demand of complex queries and large databases. Among the different query operators of SELECT-PROJECT-JOIN (SPJ) queries, JOIN is the predominant operator. Usually it is the key operator in query optimization as it gives the final result in JOIN operation on multiple relations or tables.

As a complex query is composed with many JOIN operations and JOIN operation itself is time consuming, we need to minimize the time required for JOIN operation. Our main research focus is to reduce the execution time and network cost (in terms of amount of data transfer on network) of JOIN operation of a complex query on large databases.

Our research used parallel distributed environment for query optimization. The elementary JOIN types considered for research are SEMI JOIN, BLOOM JOIN, POSITIONAL ENCODED REDUCTION FILTER (PERF) JOIN and DISTINCT ENCODED REDUCTION FILTER (DERF) JOIN. There are certain issues to be solved in above JOIN operations such as transmission of uncompressed data, collision problem, transmission of duplicate values, extra time to remove duplicate values etc. Our research focused on these research issues of above mentioned JOINS.

In distributed environment, different machines have different binary data representations such as little endian or big endian. So while transferring data in compressed format such as byte array, the machines may read data differently. It is called as 'binary data incompatibility' problem. While transmitting compressed data on network, there is need to provide security

to that network data. So 'security' and 'incompatibility of binary data representation' are other issues we considered during our research.

To reduce the optimization time we use the parallelization concept and to reduce the network cost (in terms of amount of data to be transferred on network) we use different data compression techniques. For avoiding binary data incompatibility problem, we converted binary data into network byte order (NBO) and with Advanced Encryption Standard (AES) algorithm, security problem is solved.

We develop four parallel optimizers in intra-operator and inter-query parallelization mode with shared nothing architecture. In intra-operator parallelism, single query with JOIN operator is executed on multiple processors. In inter-query parallelism, multiple queries with JOIN are executed on multiple processors. For achieving parallelism, the various load balancing schemes such as round-robin, equi-depth, total-sum and stratified allocation are used.

Different types of queries such as star, chain, cycle and clique are considered during experimentation. The databases such as TPC-H, AdventureWorks, Northwind and PUB are used for testing the performance of a query. The performance metrics used for evaluation are execution time, memory utilization, amount of data to be transferred, speed-up and efficiency. The four parallel optimizers developed are

- **NBO PARALLEL TWO WAY SEMI JOIN WITH BYTE ARRAY**
- **NBO PARALLEL COLLISION FREE INTELLIGENT BLOOM FILTER JOIN**
- **NBO PARALLEL POSITION ENCODED REDUCTION FILTER (PERF) JOIN**
- **NBO PARALLEL DISTINCT ENCODED REDUCTION FILTER (DERF) JOIN**

Based on evaluations, best optimizer can be found for the specific type of the query.

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

**Title: COVERAGE AND CONNECTIVITY
MODELLING IN MOLECULAR
COMMUNICATION BASED NANO MACHINE
NETWORKS**

Acc. No. DT9

Author: RAUT, PRACHI SANDESH

Project Guide: DR NISHA SARWADE

ABSTRACT

Incessant demand for pervasive and energy efficient smart systems has fuelled research on development of nano scale networks. An interconnection of nano machines (Size: 1-100 nm) meant to perform sensing, actuating, simple computations and communication is envisioned to provide revolutionary solutions for Internet of Nano Things, Body Area Nano Networks, neuronal therapy and drug delivery, brain-machine interface, environmental monitoring and bio-diversity control *etc.* However, owing to their small size and limited capabilities, nano machines (NMs) must use an alternative paradigm for communication.

Molecular communication (MC) appears to be the best technique for communication between NMs. It provides easy integration with biological systems which use molecular signaling too (For example, calcium signaling used for intra-cellular communication). Moreover, MC is energy efficient (uses chemical energy) and is able to work in aqueous medium. But diffusive transport of molecules is stochastic in nature and has a large delay. Also, NMs are expected to communicate with each other as well as with the macro-world under diverse operating conditions. It is known that molecules tend to degrade when exposed to certain environmental states. Physical obstructions present in the surroundings create an anomaly in diffusive transport of molecules developing an effect called sub-diffusion. Therefore, feasibility of obtaining reliable and error-free transmission of information in MC based NM networks needs to be investigated thoroughly.

This research was aimed at performance estimation of MC based NM networks by mathematical modelling of connectivity and coverage. The models were simulated to understand effects of various architectural and environmental parameters. Using these results, an optimization problem was proposed and solved to determine most conducive values for inter-node distance and symbol time. Moreover, closed form expressions for connectivity and coverage are determined as a function of temperature and physical obstruction concentration by curve fitting. Insights gained from this study led to development of an inter-symbol interference (ISI) mitigation technique which is adaptive and helps in providing optimum connectivity under dynamic environmental conditions.

At the outset, this thesis has successfully accomplished the research goals and contributed towards development of MC based NM networks by rigorous study of performance metrics and suggesting ways of obtaining sustained performance under variable operating conditions.

SFIT LIRC

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

**Title: FRACTAL VIDEO COMPRESSION
USING FAST CROSS-CORRELATION BASED
TECHNIQUES**

Acc. No. DT10

Author: CHAUDHARI,RAVINDRA E

Project Guide: DR S B DHOK

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

SFIT LIRC

Abstract

Video compression continues to be an important area of research due to popularity of high resolution-high quality video transmission on internet and mobile devices. The storing, processing and transmitting of large amount of raw video data results in complex tasks. The fractal based video compression technique has grabbed much attention in recent years because it is potentially capable to achieve very high compression ratio. It also provides interesting interpolation feature to increase the spatial resolution of video frames. It is based on the property of self-similarity and it can compress the video sequences very efficiently because of large temporal correlation within the video frames. But the main drawback of this method is that it takes large amount of time to search for this self-similarity and thus make it unsuitable for real-time applications.

To overcome the drawback of large compression time, two new fractal video compression algorithms are proposed in this research work. These algorithms are based on fast cross correlation techniques using quadtree partitions to improve the compression efficiency. The first proposed algorithm, namely fractal video compression using FFT based Normalized Cross Correlation (NCC) is designed for reducing encoding time with standard RMS similarity measure. The second algorithm, namely, fractal video compression using fast normalized covariance based similarity measure is designed to further reduce the encoding time using simplified similarity measure. The speed of both proposed algorithms is again accelerated by exploiting the properties of Discrete Fourier Transform (DFT) for isometry transformation operations in fractal encoding. The normalized cross correlation module is a primary contributor to the gain in compression efficiency but it is also the most computationally expensive part in proposed fractal video coder. For real-time applications, we have also proposed an optimized parallel and pipelined architecture for the efficient implementation of this complex NCC module in hardware.

In the proposed fractal video compression using FFT based normalized cross correlation algorithm, the cross correlation is implemented in the frequency domain using FFT to increase the searching speed. The FFT based implementation results in

single computational operation for entire search window instead of repeated computations for large number of overlapped blocks. The denominator part of NCC becomes computationally complex due to repetitive energy calculations for quadtree partitioning of blocks. These calculations are minimized by pre-computing the energy of small size blocks for the entire reference frame. The energy of any higher size block is then quickly calculated in terms of these pre-computed energies. To compare the performance of this proposed algorithm, we implemented two existing fractal encoding algorithms: New Cross-Hexagon Search algorithm (NHEXS) and Circular Prediction Mapping/Non-Contractive Inter-frame Mapping (CPM/NCIM). The experimental result shows that the proposed method can significantly raise the encoding speed compared to NHEXS and CPM/NCIM algorithms. The compression ratio and PSNR of the proposed method are also far better than those for NHEXS and CPM/NCIM.

The proposed fractal video compression using fast normalized covariance based similarity measure algorithm uses computationally efficient similarity measure along with FFT based implementation. This algorithm gives better coding efficiency as compared to first proposed algorithm and it is also compared with standard H.264 coder for video compression. The experimental result shows that encoding time for proposed algorithm is less than that for H.264 with comparable compression ratios and visual quality. All the covariance coefficients are normalized by using standard deviation of overlapped blocks and these are efficiently calculated in one computation by using two different proposed approaches, namely FFT based approach and sum-table based approach. Their experimental performance parameter results are almost equal to each other in all aspects, except that the memory requirement for sum table approach is very high compared to FFT based approach.

In the proposed parallel and pipelined architecture for the implementation of normalized cross correlation module, the cross correlation is implemented in the frequency domain using single path pipelined architecture of 2D-FFT with polyphase sequential subband decomposition technique. The architecture of NCC module is designed using Verilog HDL with fixed-point data type representation. The simulation result shows that the proposed pipelined architecture of NCC is more efficient in terms of computation complexity, hardware and memory requirement.

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

**Title: SOFTWARE ENGINEERING
CHALLENGES FOR SYNCHRONIZING
ENTERPRISE RESOURCE PLANNING AND
BUSINESS INTELLIGENCE SOFTWARE
PACKAGES**

Acc. No. DT11

Author: ANSARI,NAZNEEN IQBAL AHMED

Project Guide DR G T THAMPI

ABSTRACT

Organizations possess legacy systems and applications that are valuable assets and significant to current business operations. One of the main challenges in today's organizations is how to efficiently and effectively integrate legacy systems and applications with other systems and applications.

If an organization has previously implemented enterprise resource planning (ERP) and intends to integrate a business intelligence (BI) system, then ERP-BI integration might be a challenging task because of several factors. However, challenges can be conquered with proper planning, and organizations can obtain massive benefits from their investments in ERP and BI systems.

Limited literature is available for integrating ERP and BI systems. Most of the studies emphasize on factors that influence the adoption of BI by ERP systems. This research work investigates relationships, benefits and challenges in integrating disparate software systems.

Effort of the research work is to identify software challenges that are involved in making two disparate software packages (i.e., ERP and BI) speak to each other by synchronizing them. However, synchronization involves tremendous complexity. Well-established software engineering (SE) procedures and principles need to be leveraged to achieve the abovementioned task. This research work is expected to identify and model the task involved and seeks solution either with middleware or hardcore coding.

Disparate systems have different platforms. Therefore, in order to integrate disparate systems with different platforms and infrastructures, integration technologies and solutions are required. Various approaches of integrating disparate enterprise systems are comprehensively studied and different solutions are examined. The research work investigates contemporary SE challenges in coupling disparate ERP and BI systems.

It proposes twelve SE principles and a five-phase software process model for coupling disparate enterprise systems. By applying SE procedures and principles, a template with thirty-five steps is created to merge two disparate software solutions.

This thesis discusses case studies to demonstrate application of middleware in coupling software products in domains like healthcare, energy consumption, big data, and retails.

Therefore, this research work is conducted to cover the technical details of integrating disparate enterprise systems. In this work, a significant amount of literature is reviewed, and different ERP–BI enterprise software system integration prototypes are investigated. Various software tools and popular integration technologies are scrutinized.

The research work also proposes an ERP–BI integration model. By considering different aspects of integration, this research work is a great asset to architectures, developers, and system integrators to integrate disparate enterprise systems.

SFIT

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

**TITLE: MODELLING QUANTUM CRYPTOGRAPHY
FOR UNCONDITIONALLY SECURE GLOBEL KEY
DISTRIBUTION**

Acc. No.: DT12

AUTHOR: LOPES, MINAL AJIT

PROJECT GUIDE: Dr. NISHA SARWADE

Abstract

Classical and modern cryptography is considered as a strong backbone of today's secure communication. But with the advances in quantum computing technology, these algorithms are anticipated to become obsolete in near future. In recent years, Quantum Cryptography (QC) have been proved superior, eliminating the inherent problems of classical encryption techniques. The beauty of quantum cryptographic methods are that they can be proven secure, now and indefinitely into the future, relying solely on the validity of the laws of physics for their proofs of security. This is something which is impossible for nearly all current classical cryptographic methods to claim. QC can be used with any classical cryptography algorithm to achieve absolutely secure communication. Many research groups thus have explored Quantum Key Distribution (QKD) (an application of QC) extensively due to its unconditional security and inherent eavesdropping detection. With the advances in technology, QC is now seen as the solution for global key distribution through fiber optic and free space optical communication. Feasibility of underwater quantum key distribution is also reported making it global in true sense.

Quantum cryptography has an interdisciplinary nature and needs to mitigate many technological challenges. Through research experiments it is evident that existing QKD systems are complex. The parameters like single photon generation, photon repetition rate, transmission distance, detector efficiency greatly restrict the secure key generation rate of QKD. This report thus aims at development of QKD model for global key distribution and its verification. Subsequently, a simulation approach is used for optimizing the QKD transmission for parameters such as QKD protocol, secret key rate, secure communication distance and speed of encryption.

It is realized that QKD remains vulnerable due to imperfect real system implementations. One of the major threat is due to weak coherent photon pulse generator used instead of single photon generators. This causes an eavesdropper to execute a photon number splitting attack on QKD and violate its unconditional security. It is observed that decoy state method overcomes the photon number splitting attack and additionally improves performance of QKD. To address this problem, a model for Decoy state QKD protocol is developed, which ensures enhanced secret key rates and secure distance. Typically a two-state (vacuum + very weak coherent state) decoy QKD protocol is analyzed and verified against the experimental parameters. It was noticed that a decoy state protocol can be optimized in secret key rate if it is used with global lower bound equation for privacy amplification. Thus such model is developed and verified for its optimum performance. It is observed that global lower bound equation for privacy amplification improves secret key rates as well as secure transmission distance significantly.

Current research in QKD aims at its deployment with fiber optic and free space connectivity only, whereas in recent years QKD based on photons have made a great progress both in theoretical and experimental research. Consequently, QKD can as well be used to provide security for underwater wireless optical communication. Keeping these research problem in mind, this report also develops an underwater QKD model and investigates its feasibility. The optical absorption and scattering properties of underwater media pertinent to underwater free space quantum key distribution (QKD) channel model are reviewed. The attenuation of photons, quantum bit error rate and the sifted key generation rate of underwater quantum communication is obtained with the vector radiative transfer theory and Monte Carlo method. It is

observed from simulations that secure underwater free space QKD is feasible in the clearest ocean water with practical transmission rates of approximately 740kbps for low bit audio and video information.

SFIT LIRC

ST.FRNCIS INSTITUTE OF TECHNOLOGY (ENGINEERING COLLEGE)
SVP ROAD, MT.POINSUR, BORIVALI (WEST), MUMBAI 400103
www.sfit.ac.in

**TITLE: ADAPTIVE ERROR CONCEALMENT IN VIDEO
CODE**

Acc. No.: DT13

AUTHOR: AHMED, ANSARI VAQAR

PROJECT GUIDE: DR.UDAY PANDIT KHOT

Abstract

The increasing demand of electronic gadgets in multimedia applications expects high transmission efficiency and better video quality. Various coding standards have been evolved for past two decades for improving transmission efficiency and efforts have been made for optimizing the architectures of various Error Concealments (EC) used in video codecs for improving video quality. The traditional EC algorithms are dependent on large block size, significant edge details, iterative process and hence results in computational complexity. Also, due to fluctuation in bandwidth, particular EC cannot retrieve entire lost macro-blocks (MBs). An efforts have been made in developing an adaptive EC predictor which can recover more significant features or structures of entire lost MBs in video-codec compression scheme. Being open source, the work is focused on baseline profile of AVC/H.264 coded and later the work is generalized for recent video codec. Most of the research on temporal error concealment algorithms deals with the average Motion Vector (MV) of the whole available MBs and not pixel based MV recovery. Due to this such algorithms can not handle the integrity of moving objects/partitions and MVs of available pixels that belong to the estimated object/partition are forced to be identical which may leads to wrong recovery of MVs. Pixel-based Motion Vector with Partition (PMVP) and Spiral Pixel Reconstruction (SPR) algorithms can able to handle multi-directional object movements eventually in temporal domain. Hence, PMVP and SPR algorithms are used as a ground work in this research. The PMVP algorithm predicts MVs of lost macro-blocks (MBs) based on the distance between the lost pixels and the available pixels of the surrounding MBs. The PMVP algorithm is modified by using Mahalanobis distance (MD) rather than Euclidean distance (ED) for better MVs recovery. This modified pixel-based motion vector with partition (MPMVP)

gives 1.2% improvement in *PSNR* compared to PMVP. Later, the MPMVP algorithm is upgraded by two different strategies: One by using voting priority of available MVs based on the probabilities of similar directions giving 6.2% improvement in *PSNR* and second by considering separate horizontal and vertical directions of available MVs in voting priority which gives 8.6% improvement in *PSNR* at the cost of slight increase in execution time. Similarly, modified spiral pixel reconstruction (MSPR) algorithm based on directional edge recovery method using MD from available pixels of surrounding MBs is developed, leading to 3% and 9% improvement in *PSNR* compared to existing SPR and PMVP algorithms, respectively.

The motion vectors are generated at the transmitter end in codec-encoder and it is required to reconstruct the frame at the receiving end in codec-decoder. The information available about the MVs at transmitting end can help to find the importance of most repeated MBs in temporal domain. Repeated MBs need to be protected more. Hence there is need of Pre-Transmission Algorithm (PTA) at transmitting end. Now the repeated MBs need not be compressed in PTA. PTA segments video frames into regions of unequal importance with the help of motion vector analysis before coding them independently. PTA with convolutional neural network (CNN) and fuzzy reasoning is developed which will help selecting an appropriate EC for reconstruction. The fuzzy reasoning is supported by Hungarian optimization. The selection of suitable EC technique is done based on quantization parameter, packet loss rate and execution time adaptively. Such an adaptive ECs using PTA gives 20.4%, 3.47% and 6.66% increase in *PSNR* for “coastguard”, “foreman” and “flower garden” video sequences, respectively with respect to PMVP. The Developed adaptive ECs are also applied on HD standard video data samples. The adaptive EC technique is further generalized so as to be suitable for all types of video codecs, even for HEVC/H.265.

Keywords: *Video Processing, Video Compression, Convolutional Neural Network, Fuzzy logic, Optimization, Adaptive Error Concealment, Error Resilience, H.264/HEVC Codec*

**TITLE: BOTNET DETECTION IN LOW LATENCY
ANONYMOUS COMMUNICATION**

Acc. No: DT:14

AUTHOR: MANE/YOGITA DEEPAK

PROJECT GUIDE: UDAY PANDIT KHOT

ABSTRACT: The Botnet is the network of personal computers with malicious software that are connected through the internet and controlled by Bot Master. It is the most catastrophic cyber-security threat such as phishing, spamming, DDoS attack, capturing usernames and password through the attack, stealing private data of users, or any other kind of malware which compromised the website. To decrease the detection capability of command and control (C&C) server, Bot Master has chosen to keep botnet with centralized communication topology along with the Tor network. Tor network constructs encoded/encrypted virtual circuit from source to destination to distribute network services without revealing its identity. Tor Traffic monitoring is difficult as the packets are traveling from source to destination in an encrypted fashion to conceal its identity from destination. The contribution of this research work is to provide a secure network service against Application Layer based DDoS attacks for Tor users and to detect and deactivate Tor based Bot. As the Tor Browser is highly secure

identity. Tor Traffic monitoring is difficult as the packets are traveling from source to destination in an encrypted fashion to conceal its identity from destination. The contribution of this research work is to provide a secure network service against Application Layer based DDoS attacks for Tor users and to detect and deactivate Tor based Bot. As the Tor Browser is highly secure and doing practical experiments on it is not advisable as it additionally raises ethical issues which could affect the functionality and performance of the Tor browser. It may also put the network-users in a position where the failure of Tor's secrecy has serious outcomes. So, Private Tor networks (PTN) with Trusted Middle Node on physical or virtual machines with dedicated resources have been created. The Trusted Middle node is identified by calculating trust value based on free CPU, Free RAM and number of cores or processors available in each System or Nodes. This will provide full control of software for performing experiments. The research work proposes a technique for not only detecting the bot but also ensuring the presence of bot. In existing techniques, Bots are getting detected only after webserver gets overloaded with number of requests which causes large delay to detect the activity of Bot. The contribution in this research work leads to detect the Bot as soon as it exists in the system. This will help in the start of preventive action at the earliest. Contribution towards research works shows the detection and deactivation of Application Layer based Bots such as "Tor's Hammer" and "Hammer.py" as early as possible. Application layer based (L7) attacks are serious yet challenging to detect because of their secretiveness and appearing to request legitimacy as it does not

saturate the network bandwidth like Volume based attack as well as not consuming system resources like Protocol based attack. The purpose of these Bots is to perform DDoS Attack. Here, the detection framework is based on Delta time $T\Delta$, which is the time between two threads or requests in milliseconds. During normal operation, the $T\Delta$ is normally above 100 ms and when attack do exists, the $T\Delta$ is mostly in between 0 to 10 ms. Therefore, it becomes essential to detect and deactivate the Bot as early as possible within this span of $T\Delta$. The Average True Positive rate (TPr) and Accuracy of the proposed technique is 95.92%, the Average False Negative rate (FNr) and Error Rate is 4.08 %.

Keywords: Botnet, Bot, LTN, PTN, DDoS, Tor'shammer, Hammer.py, Delta time, Attacktime, TPr, FPr, Accuracy, Error Rate.

**TITLE: Investigation of Probabilistic Sensing Based
Coverage in Wireless Sensor Networks**

Acc. No: DT 15

AUTHOR: Nitika Rai

PROJECT GUIDE: Rohin D. Daruwala

ABSTRACT: In recent times, wireless sensor networks (WSN) are recognized as an established technology for an extensive range of applications that spans across critical ones like natural disaster prevention and battlefield surveillance to others like environmental monitoring, precision agriculture and industrial process monitoring and further, its expansion across a plethora of consumer applications like healthcare monitoring, home automation, vehicle tracking and automated automobile maintenance to name a few. The resource constraints of sensor nodes and the inherent properties of WSN pose a challenge to implement Quality of Service (QoS) to the maximal extent. Most of the research work carried out in the field of WSN is focused on designing routing protocols, medium access control (MAC) protocols, node scheduling algorithms, data aggregation and fusion techniques to name a few and further its analysis based on the QoS parameters. Investigation of QoS parameters extensively carried

focused on designing routing protocols, medium access control (MAC) protocols, node scheduling algorithms, data aggregation and fusion techniques to name a few and further its analysis based on the QoS parameters. Investigation of QoS parameters extensively carried out in the literature includes energy efficiency, reliability, throughput, packet delivery ratio, latency, network lifetime, bandwidth, scalability, latency and congestion. However, most of the research reported is carried out with an assumption that the number of nodes deployed in the area of interest is sufficiently large in number. Instead, in the preliminary phase of any WSN design, the crucial requirement that needs to be addressed is estimation of the optimum number of sensor nodes that are required to be deployed in a given network area such that spatial and temporal coverage requirement of the application is satisfied, or these sensor nodes collectively provide maximum coverage in a given economic constraint. The two aspects, viz. selection of node deployment scheme and the quantity of sensor nodes needed for implementing a given application are the two fundamental issues that must be considered for any WSN design and/or analysis. The quantification of these factors can be represented in the form of a critical QoS parameter, viz. Network coverage. It depicts the measure of effectiveness with which the sensor nodes deployed in the given network area can cover it. The sensing capabilities of the nodes can be modeled and represented using node sensing models. These models can be further used for prediction of coverage fraction that can be expected for a known quantity of nodes deployed in a given network area. Typically, a disk based binary sensing model is

assumed for coverage analysis. However, the characteristics associated with the sensing device and the environment related factors can affect the effective sensing radius of a sensor node. These parameters being stochastic require modeling using probabilistic sensing models. It is been realized that these sensing models can be revisited to be explicitly used as a design parameter which will have an added practical significance. The design methodology can be used for estimation of optimal density of sensor nodes that can be randomly deployed to achieve the required network area coverage, or for computation of requisite number of nodes to be deterministically positioned in the field of interest which forms a part of our research work. The existing sensing models are limited to consideration of a subset of factors; either environmental parameters or the characteristics associated with the sensing device. Hence, these models provide a suggestive estimation which leads to a study that is incomplete. The need of a realistic sensing model is much felt and has not been satisfactorily reported. Hence, we propose a new sensing model and further extend our analysis to include k-coverage and node failures in order to enable its applicability to WSN systems that require enhanced robustness and reliability. In case of randomly deployed networks, the coverage holes may not be uniformly spaced even though the desired coverage fraction is achieved, which may in some cases lead to a defunct network. Hence, there exists a need to investigate coverage efficiency post deployment and thereafter design algorithm/ schemes for its maximization. Additionally, improvisation of the achieved coverage fraction or reduction in the number of sensor nodes that can attain the given coverage fraction

can be done by exploiting mobility of nodes. Hence, we further extend our work to design an efficient algorithm for maximization of coverage efficiency that exploits complete/partial mobility of nodes in a homogeneous network. Alternatively, the algorithm is modified for holistic/zonal deployment of a heterogeneous network (a fraction of nodes being mobile while others are static). Hence, the focus of this research work is to carry out investigation and analysis of probabilistic sensing-based network coverage and to recommend a holistic approach that can be employed for design, evaluation and implementation of an effective WSN.

TITLE: Semantic Annotation and Retrieval of Music Signals

Acc. No: DT: 16

AUTHOR: Santosh Vinod Chapaneri

PROJECT GUIDE: Deepak J. Jayaswal

ABSTRACT: Since the semantic concept of music mood is very subjective, it is a challenging problem to characterize the affective music content using computational methods. In this research work, a framework is proposed for the prediction of structured regression to learn the music mood along the arousal and valence mood dimensions in the continuous space using a computationally efficient single twin Gaussian process regression model. Also, to address the subjectivity aspect of music mood, we propose an Expectation-Maximization (EM) algorithm for obtaining the consensus from responses of multiple annotators by learning their behaviors. The audio features are learned using the variational Bayesian mechanism from the Gaussian mixture model and the chord level features are also extracted for improving the estimation of the valence dimension. The proposed method is able to achieve significantly improved performance than the existing methods for learning the multi-dimensional target of music mood jointly. The general problem of covariate shift is also addressed in this research work, and we solve

this problem using Frank-Wolfe optimization principles. Two algorithms are proposed for correcting the covariate shift by learning the weighted importance, which results in most sparse solutions with improved computational efficiency. For correcting the covariate shift in the setting of structured regression, we modified the Gaussian process based on Sharma Mittal divergence and provide detailed derivations of the methodology. The proposed methods are analyzed on two important applications from different domains: estimation of the music mood estimation as well as estimation of the human pose with superior performance relative to the state-of-the-art techniques. Further, novel audio features based on the Fisher kernel principle are proposed, which are not yet applied for solving the problem of estimation and retrieval of music mood. The audio Fisher vectors are locally aggregated for the onset detected music segments that retain the musical continuity across time. For the regression modeling, we use the deep architecture having multiple layers of Gaussian processes and propose an algorithm for learning the Deep Gaussian Process regression to create the mapping from the novel aggregated Fisher vector features with the arousal and valence mood dimensions. The proposed method of aggregated Fisher vector features and the DGP regression model outperforms the state-of-the-art methods for both tasks of mood estimation and music retrieval. The proposed methods in this research work achieve a statistically significant improvement compared to existing methods for various benchmark datasets for addressing the semantic concept of estimation and retrieval of mood from music signals.