SURAJ SANJAY JOG

Curriculum Vitae

CONTACT INFORMATION

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EDUCATION

2012-2016 **Indian Institute of Technology Bombay**, Mumbai, India
Bachelor of Technology with Honors in Electrical Engineering
Cumulative Performance Index: 9.24/10
Minor in Computer Science and Engineering

RESEARCH EXPERIENCE

Industrial Research Projects

Summer 2015 **Metric Learning using Supervised Random Forest**
Siemens Corporate Research and Technology, Bangalore
Guide: Dr. Amit Kale, *Research Group Head, Imaging and Computer Vision Team*

Background Many applications in computer vision depend on the efficacy of correctly matching SIFT-like descriptors and hence the goal here was to learn a distance metric that is highly robust against transformations under which feature descriptors provide little invariance.

Results

- Developed a novel metric learning framework using a Supervised Random Forest integrated with WTA-Hash, which exploits the fact that in high dimensional space, partial order statistics provides higher resilience against perturbations in numerical values of feature descriptors associated with geometrical transformations like noise
- Extracted local feature descriptors for images using gradient-based weak learners, integrating them with SIFT features in an interleaved fashion to achieve 3% (average) reduction of False Positive Rate compared to state-of-the-art, at 95% True Positive Rate
- Currently co-authoring a research paper based on above work to be submitted to machine learning and computer vision conferences in 2016

Academic R&D Project

Ongoing **Game Theoretic Analysis of Probabilistic Spectrum Sharing Model**
Networking Lab, Indian Institute of Technology Bombay, India
Guide: Prof. D. Manjunath & Prof. Jayakrishnan Nair, *Department of Electrical Engineering, IIT Bombay*

Background Spectrum holding per cellular telephony service provider in India is significantly lower than the world average. The spectrum is also severely fragmented across bands. Regulators have recently recognized that such spectrum fragmentation is a source of inefficiencies for service providers and have allowed sharing of spectrum among the providers. In this project we propose and analyse spectrum sharing strategies between 2 providers (P_1 and P_2) with N_1 channels and N_2 channels respectively.

Results

- Proposed a probabilistic spectrum sharing strategy where provider P_1/P_2 accepts calls from provider P_2/P_1 with probability x_1/x_2, given the scenario that provider P_2/P_1 has no free channels to accept the call himself. The sharing strategy is denoted by (x_1, x_2).
- Theoretically proved that for any sharing strategy (x_1, x_2), there exists a non-empty set of sharing strategies $(x_1 + \epsilon, x_2 + \theta\epsilon)$ with $(\epsilon > 0, \theta > 0)$, such that every strategy in this set is better for both providers as compared to the original strategy (x_1, x_2).
- Consequently proved that the set of Pareto Stable Sharing Strategies (optimal sharing strategies) will involve at least one provider always accepting calls from the other, i.e. $x_i = 1$ for at least one i in {1,2}.
- Currently analyzing the Nash Bargaining Solution for the above model and devising an algorithm to obtain the same

Undergraduate Thesis

ONGOING **2-Dimensional Segmentation techniques in Bird Call Recognition Systems**
Digital Audio Processing Lab, Indian Institute of Technology Bombay, India
Guide: Prof. Preeti Rao, *Department of Electrical Engineering, IIT Bombay*

Background 2D segmentation is carried out in both the frequency and time domain (spectrogram domain) as opposed to the traditional time domain based segmentation methods. The aim is to separate out bird sounds from environmental noise by using a segmentation method that increases the Hit Rate while reducing the False Positive Rate of syllable detection.

Results

- Derived optimal parameters for feature extraction from spectrogram, and implemented a Supervised Random Forest based machine learning model achieving a prediction accuracy of more than 95% for bird syllables
- Demonstrated the efficacy of Random Forest in rejecting extraneous noise and animal sounds when similar sounds were presented as negative examples in training data
- Validated the ability of Random Forest in detecting syllables of birds species that were not present in the training set
- Currently exploring a novel segmentation technique where the 2D segmentation method serves as a pre-processing step for 1D time domain segmentation, hence increasing the accuracy of the syllable onset and offset detections, and reducing the False Positive Rate

ACADEMIC COURSE PROJECTS

AUTUMN 2015 **Small Vocabulary Isolated Word Recognition** | Speech Processing
Guide: Prof. Preeti Rao

- Implemented a classification algorithm for spoken digit recognition from audio clips using a bag-of-frames approach
- The training model used was codebook clustering based on K-means and testing was done using template matching with Dynamic Time Warping. Recognition accuracy of 95% was achieved on a database of six speakers

AUTUMN 2015 **Noise Filtering in Financial Data Processing** | Advanced Topics in Signal Processing
Guide: Prof. Velmurugan Rajbabu

- Implemented various noise filtering methods to study underlying trends in the time series of Return on Investment values of financial stock data
- Analyzed performance of each method, and explained superior performance of Tikhonov Regularization based noise filtering compared to other eigen-filtering methods
- Obtained results comparable to state-of-the-art and suggested modifications

Autumn 2014 **Processor Design** | Microprocessors Lab
Guide: Prof. Virendra Singh & Prof. D.K. sharma

- Designed and implemented a synthesizable code for a non-pipelined RISC processor (LC-3b ISA) using VHDL and tested on FPGA using SignalTap tool
- Designed and implemented a 6-stage pipelined processor with forwarding and hazard control using VHDL

Spring 2014 **Hardware Implementation of motion controlled DX-Ball** | Digital Circuits Lab
Guide: Prof. Jayanta Mukherjee

- Implemented the game DX-Ball on a CPLD Board through VHDL coding, with GUI of the game displayed on a VGA screen
- Utilized I2C communication protocol to interface the Accelerometer with the CPLD board, thus realising the motion control feature by using the accelerometer inputs

SCHOLASTIC ACHIEVEMENTS

- Secured All India Rank **24** in **IIT-JEE** 2012 among 0.5 million candidates
- Secured All India Rank **24** in **All India Engineering Entrance Examination (AIEEE)** 2012 among more than 1 million candidates
- Secured All India Rank **13** in **KVPY Scholarship Examination** 2011 among 0.2 million candidates, the scholarship being awarded by the Department of Science and Technology, Govt. of India
- Among **National Top 1%** in the first round examination of the **Indian National Physics Olympiad** 2011-12 among 43,000 candidates
- Among **National Top 1%** in the first round examination of the **Indian National Astronomy Olympiad** 2011-12 among 11,600 candidates

SCHOLARSHIPS

Cargill Global Scholar India **2014-2017**

- One of the ten awardees of the prestigious Cargill Global Scholarship funded by Cargill Inc. (largest private corporation in the US), selected from a pool of 400 candidates from premier engineering colleges of India
- Participated in a five day sponsored seminar on developing leadership and networking skills in Amsterdam, along with 56 other scholars from across five nations
- Presented a report in the seminar on "Health and Nutrition Status in India", highlighting the key challenges faced and provided suggestions for prospective business angles for Cargill Inc.

WORK EXPERIENCE

Teaching Assistant for Undergraduate course, Electricity and Magnetism **Spring 2015**

- Conducted tutorial sessions and solved queries and doubts for a batch of 50 students
- Volunteered to conduct help sessions for academically weak students
- Assisted professors in setting examination questions and evaluating answer scripts

Research Intern at Tetrahedrix Engineering Private Limited India **Summer 2014**
Project: *Developed Speaker Recognition System customized for Indian Speakers*

- Reviewed literature on speaker and speech recognition systems including machine learning concepts and statistical models like GMM and HMM that are successful in the speaker recognition domain
- Explored Speech/Speaker recognition software like CMU Sphinx, Janus and Alize
- Proposed alternatives to standard methodology to achieve higher success rate among Indian Speakers

TECHNICAL SKILLS

Programming Languages	C/C++, Python, VHDL, Assembly Language for 8051 Microcontroller
Packages	MATLAB, LABView,Altera Quartus, Keil, Ngspice, Eclipse, Praat, LaTeX
Hardware	CPLD (Altera MAX V), Intel 8051, Arduino

RELEVANT COURSES

Electrical Core	Markov Chains and Queuing Systems, Speech Processing, Advanced Topics in Signal Processing, Estimation and Identification, Digital Signal Processing, Control Systems, Digital Communication Systems, Microprocessors
Computer Science	Digital Image Processing, Foundations of Machine Learning, Convex Optimization, Operating Systems, Data Structures and Algorithms, Discrete Mathematics, Design and Analysis of Algorithms
Mathematics	Probability and Random Processes, Linear Algebra, Ordinary and Partial Differential Equations, Complex Analysis, Data Analysis and Interpretation
Miscellaneous	Hindustani Classical Music Appreciation, Sound and Music Design

POSITIONS OF RESPONSIBILITY

Institute Cultural Mentor, Music **2013-2014**

- Nominated to mentor a batch of 880 freshmen in vocals and instrumentals
- Conducted introductory sessions to musical instruments and helped beginners pursue their passion
- Organized Institute-level music competitions, giving freshmen a platform to showcase their talents

EXTRA-CURRICULAR ACTIVITIES

Cultural Activities

- Awarded **Cultural Freshmen of the Year** (2012-13) from a batch of **880** freshmen in IIT Bombay
- Runner-up in MI IDOL 2012 (Hindi Solo Singing Event) out of 200 contestants at Mood Indigo 2012 (Cultural Festival of IIT Bombay – Largest in Asia) and awarded a T-Series Recording Contract
- Qualified to the **Top 40** contestants from the Mumbai Auditions in **Indian Idol Season 6** (Singing Reality Show)
- Secured First Position in the MDGC (Inter Hostel Dramatics Competition of IIT Bombay) 2013 and performed at the prestigious **National Centre for the Performing Arts (NCPA)**, Mumbai
- Received training in **Indian Classical Vocal Music** and the **Tabla** (popular Indian percussion instrument) for over 9 years

Miscellaneous

- Secured **First Position** in the **National Level Chess tournament** (2003 and 2006) in Oman
- Completed a summer course on “Basics of Entrepreneurship”