Vinnu Bhardwaj
On optimal routing and power allocation for D2D communications

We propose algorithms for finding the optimum multi-hop routes and corresponding transmit powers that maximize the throughput between a pair of device-to-device (D2D) nodes, under a constraint on the maximum interference caused to the cellular network. Our solution involves two steps. In the first step, we determine the set of feasible D2D links, based on the interference constraint. In the second step, we use the celebrated Dijkstra's algorithm to find throughput-optimal routes between a given pair of D2D nodes under two scenarios: a) The Fixed Rate Scheme and b) The Fixed Power Scheme. The dependency of the net D2D throughput on the system parameters such as target SINR is analyzed for both the schemes, and a procedure to find the optimum parameter setting is proposed. The performance of the algorithms is illustrated using computer simulations. The results show that, depending on the network topology, a significantly higher throughput can be achieved by using multi-hop paths compared to using single-hop, direct D2D communication.

Patha Sahas Kumar
Performance Analysis of Dynamic Point Selection in Cellular Systems

In this thesis, we develop an analytical model to characterize the throughput gains obtained by Dynamic Point Selection (DPS) compared to static scheduling. First, we consider a system with two cells and in which the channel power gains from the Base Stations (BSs) to the User Equipment (UEs) are independent and identically distributed (i.i.d.). We propose and analyre the performance of one-switch DPS algorithm for a modified proportional fairness (MPF) scheduler. Next, we extend the analysis to a system with nineteen cells and in which the UE channel power gains are not i.i.d. Lastly, we verify that the trends predicted by our model for DPS mirror those for the conventional PF scheduler.

Nihesh Rathod
Performance Analysis of Wireless Devices for Campus-wide IoT Network

To select an appropriate technology for the deployment of an Internet-of-Things (IoT) network inside the Indian Institute of Science (IISc) campus, we first compare available wireless technologies based on their data sheets. After selecting two of the best available sub-GHz devices, we characterize them by performing controlled lab experiments. Next we test these sub-GHz modules in different real world environments such as open ground, straight road, moderately and densely wooded area, inside a concrete building and on building rooftops. We then compare their performances for characterization of the wireless channels in different environments. In the end, we propose a sensor and network plan towards monitoring water resources inside the IISc campus.

Amaresh Kumar Sahu
Analysis of Dispersion on Gaussian modulated Pulse in Fiber Optic Communication System

In our study, in this thesis we analyze for dispersion compensation , the OSNR requirement .Our analysis shows increase in OSNR with post compensation. We also analyzed the chirped Gaussian pulse transmission in optical fiber which shows a better pulse broadening. Results of the processing, presented confirm that higher bit rate transmission will become feasible in the future using DSP for transmission impairments compensation.

Amit K Margupta
Optimization of Mach-Zehnder Modulator for Inter-Satellite Communication

In this work, Various types of electro-optics modulators have been studied and finally zeroed down the focus on Mach-Zehnder Modulators (MZM). Investigations has been carried out on the ef- fect of variation of bias voltage (either arm of MZM), splitting ratio and modulation chirp on the performance of MZM. All the parameters are analysed for a free-space transmission distance of 1000-1400Kms for four different configurations assumed for the operation of MZM. The designing of MZM is a critical field and it need to be investigated a lot for proper transmission and modula- tions. MZM has been designed for two different configurations, viz.; using S-bend waveguide and using Y-splitter/combiner. The dimensions of both the configurations are being optimized with the help of simulation tools available. A method of generation of QPSK constellation scheme using MZM is also proposed and system performance for the same was...
evaluated for a bit rate of 10Gbps. Simulations were carried out for the performance of MZM for QPSK scheme in free-space transmission. Reliability Figure is also estimated for such a transmitter system by assuming optimum redundancy at critical functional block level.

A Praneeth P Vijay Kumar


A Passive InfraRed based Sensor Tower Platform (STP) was designed & developed for applications in wildlife conservation. The objective of this ME project is to identify features (for SVM classifier implemented in STP) for intruder detection & classification. Due to the design of the VPA, energy features provide good classification accuracy for Human vs. Animal classification. Thus, Chirplet parameters are found to be good for Intruder vs Clutter classification. The implementation of the feature extraction algorithms is another major challenge in this project. Weighted energy and correlation features were found to give good classification results and feasible for implementation.

Gaurav Kumar Agarwal P Vijay Kumar

Codes with Hierarchical Locality and High-Rate Access-Optimal MSR Codes with Polynomial Sub-Packetization Level

Data in distributed storage system is stored across multiple storage nodes, which are individually unreliable and so fail quite often. This report talks about some erasure coding solutions which repair these failures efficiently. In literature, various metrics have been proposed to measure the efficacy of the repair, such as the amount of data "downloaded" in repair (also known as, repair bandwidth), the amount of data "accessed" at the helper nodes, and the number of the helper nodes "contacted". The first metric subtly differs from the second, as in the first, computations at the helper nodes are free of cost and only the net data transmitted from the helper nodes matters. In the second metric total data accessed at the helper nodes is the point of concern. Codes studied under first two metrics are regarded as " Regenerating Codes" while the ones studied under the third metric are termed as "Codes with Locality". We talk about two recent results in this area of distributed storage; codes with hierarchical locality which is an extension to the notion of codes with locality, and construction of High-Rate Regenerating codes at an optimal point known as MSR point.

Abhinav Das N V Navin Kashyap

Sampling from a Target Probability Distribution on a Two Dimensional Magnetic Recording Medium

We study a method to sample a Two Dimensional Magnetic Recording medium from any target distribution. So as to maintain simplicity, granular tiling model of the medium is used. For this model a Markov Chain Monte Carlo sampling method is implemented, which is the main tool for this work. The sampled data is used to analyze the performance of Generalized Belief Propagation (GBP) detector on the medium. This is an extension of the work done by Khatami et al. We also study the convergence analysis of the Markov chain. Mixing time of the Markov chain is useful for practical applications. An upper bound for the mixing time is estimated, assuming uniform distribution as stationary distribution of the Markov chain.

BATHULA CHAKRAPANI A CHOCKALINGAM

Message passing receiver for Generalized Space-Frequency Modulation

Generalized space-frequency modulation (GSFM) is an attractive scheme for multi-antenna wireless communications. GSFM uses both spatial domain and frequency domain to encode bits through indexing. In GSFM scheme, information bits are mapped through antenna indexing in the spatial domain, subcarrier indexing in the frequency domain, and M-ary modulation. After index mapping, the signal is modulated using orthogonal frequency division multiplexing (OFDM) and is transmitted through the selected antennas. GSFM can offer better rates using less transmit radio frequency (RF) chains compared to conventional MIMO-OFDM. In this work, we address the problem of low complexity encoding and decoding of large dimensional GSFM signals. The encoding procedure uses the combinatorial number system for mapping/demapping of antenna and frequency indices. For the decoding of GSFM signals, we propose a detection algorithm based on message passing. The proposed algorithm is termed as 'Layered message passing (LaMP)' algorithm. Low computational complexity of the LaMP algorithm is achieved by detecting the modulation bits and the subcarrier indexing bits in two different layers. Good bit error performance of the LaMP algorithm is achieved by detecting the antenna indexing bits using the subcarrier activity in the frequency domain.

Yellisetty Surekha Vinod Sharma, Utpal Mukherji

Quality of Service Routing Algorithm in Multi-Hop Wireless Networks
We consider a model of multi-hop wireless network where nodes are stationary. Link is ON for a fraction of time and when link is ON it has certain frame error probability. We aim at proving QoS for real time and non-real time flows. We propose a heuristic routing algorithm. We discuss about optimal routing with flow splitting and without flow splitting. We also propose algorithms to reduce blocking. We discuss about multi commodity flow algorithm. We compare the performance of proposed algorithm, algorithms to reduce blocking and multi commodity flow algorithm by simulating arrivals and departures of flows and calculating fraction of flows blocked, average network cost and average ratio of average delays of real time flows.

Sarath A Y
Algorithms for Bandwidth-on-Demand Applications in Software Defined Networks

Software Defined Networking (SDN) is an emerging architecture for communication networks, in which there is a clean separation of the control and data planes. Thus, SDN opens up interest in developing new centralised algorithms for various network resource allocation and management functions. We study the general problem of Bandwidth on Demand (BoD) in Software Defined Networks. We study the static as well as the dynamic BoD problem. We formulate the static BoD problem as a knapsack problem, in which the goal of the network operator is to pack the bandwidth requests into the network so as to maximise a certain objective. In the dynamic BoD setting, we have a stochastic knapsack problem, in which the bandwidth requests arrive at random times, and the goal is to make decisions to accept or reject these requests so as to maximise the long-run average revenue. Finding an exact solution to these problems is computationally hard. Therefore, we propose heuristic algorithms for these problems, and validate our heuristics with numerical simulation. For the dynamic BoD problem, we propose a heuristic based on (i) the reduced load approximation for analysing blocking networks, and (ii) the known optimality of channel reservation for revenue optimal resource sharing on a single link. In order to implement such a heuristic for large networks, we employ well known asymptotic techniques for approximating the blocking probabilities in blocking networks with channel reservation. Numerical examples are provided to show how the approximation techniques perform.

Prateek Vashishta
TBD

PRAVEEN M P
ANALOG SENSING AND COMMUNICATION IN RF ENERGY HARVESTING WIRELESS SENSOR NETWORKS

Radio-frequency (RF) energy harvesting (EH), in which a node harvests energy from electromagnetic waves, is an appealing solution for making wireless sensor networks (WSNs) self-reliant in terms of energy. We investigate the problem of sensing and estimation in a WSN for a practically motivated transmit and receive model. In it, the measurement is communicated by multiple RF EH sensor nodes in an analog manner using phase modulation to the fusion node, which estimates the parameter using a phase-locked loop (PLL) circuit. For the time-sharing based RF EH model, in which the sensor nodes alternately harvests energy and transmits information, and for a general class of stationary and ergodic RF EH processes, we characterize the mean squared error (MSE) of the estimate at the fusion node. We present simple and insightful closed-form expressions for the optimal fraction of time a node spends on harvesting energy and optimal transmit power that together minimize the MSE.

Vinuthna V.
Bayesian Sparse Signal Recovery in the Presence of Colored Noise and Rank Deficient Noise Covariance Matrix

In this work, we address the recovery of sparse and compressible vectors in the presence of colored noise possibly with a rank-deficient noise covariance matrix, from overcomplete noisy linear measurements. We exploit the structure of the noise covariance matrix in a Bayesian framework. In particular, we propose the CoNo-SBL algorithm based on the popular and efficient Sparse Bayesian Learning (SBL) technique. We also derive Bayesian and Marginalized Cramér Rao lower Bounds (CRB) for the problem of estimating compressible vectors. We consider an unknown compressible vector drawn from a Student-t prior distribution, and derive CRBs that encompass the random nature of the unknown compressible vector and the parameters of the prior distribution, in the presence of colored noise and rank-deficient noise covariance matrix. Using Monte Carlo simulations, we demonstrate the efficacy of the proposed CoNo-SBL algorithm as compared to compressed sensing and greedy techniques. Further, we demonstrate the mean squared error performance of the proposed estimator compared to the CRBs, for different ranks of the noise covariance matrix.

TONY M GEORGE
Sound Source Localization in Hubot Communication

T V SREENIVAS
Project concentrates on reducing the number of microphones for localizing a sound source by using a moving array. The behaviour of time delay difference was put through thorough analysis and the results of this study were exploited to get a new arrangement. With this proposed method it was shown that it is possible to localize a sound source in 2D using a pair of microphones with one stationary and other moving around a fixed radius. Moving microphone array was used for localizing a moving sound source, with the microphones mounted on 2 edges of a shaft, using a robot platform.

Sanjeev K K. J. Vinoy
Feasibility/Performance Analysis of Silicon Implementation of RF Energy Harvesting Circuits

This project is on design of high efficiency RF energy harvesting circuit which can operate at RF input power of -20dBm at 2.4GHz and generate a DC output voltage of 2V. Discrete implementation of RF rectifier is done using HSMS2862 Schottky diodes. Simulations of CMOS based RF rectifiers are done using models of MOSFETs from UMC 130nm process technology. RF to DC Power Conversion Efficiency(PCE) is considered as the performance metric. For RF-DC converter, low threshold NMOS based Dickson Charge Pump(DCP) and Gate Cross-Coupled Rectifier(GCCR) configuration are used, impedance matching is done and the circuit parameters are optimized. Low threshold NMOS based rectifier gives a PCE of 42.3% and gate cross-coupled rectifier gives 55% PCE. A low power DC-DC converter is used to boost the RF-DC output voltage to 2V. The overall system efficiency achieved is 25%.

Kavitha R B Sundar Rajan
Number of Optimal Index codes and their Performance over fading channels and with restricted information set

An index coding scheme in which the source (transmitter) transmits binary symbols over a wireless fading channel is considered. Index codes with the transmitter using minimum number of transmis- sions are known as optimal index codes. Dierent optimal index codes give dierent performances in terms of probability of error in a fading environment and this also varies from receiver to receiver. The thesis consists of three works done. In the rst part, the goal is to identify optimal index codes which minimizes the maximum probability of error among all the receivers. A criterion for optimal index codes that minimizes the maximum probability of error among all the receivers is identi ed. For a special class of index coding problems, an algorithm to identify optimal index codes which minimize the maximum error probability is given. Techniques and claims with simulation results are illustrated leading to conclude that a careful choice among the optimal index codes will give a considerable gain in fading channels. In the second part of the thesis , an algebraic formulation of index codes is done from which a lower bound on the total number of index codes possible is found. A criterion to nd optimal index codes with minimum-maximum error probability is found for the special case of single unicast index coding problems. In a general index coding problem, there is a single sender with multiple messages and multiple receivers wanting a set of messages and knowing a dierent set of messages. We consider the case where in-spite of this requirement, each receiver also has a restricted message set assigned to it,out of which it is not supposed to receive any. We nd the possible rates for some special cases of index coding with restricted information by following an interference alignment approach. This forms the last part of the thesis.

Alaka S P A. Chockalingam
MIMO and OFDM Techniques in Indoor Wireless Visible Light Communication

We investigate MIMO and OFDM techniques in indoor wireless visible light communication (VLC) systems. In particular, we focus on spatial modulation, where the index of the active light emitting diode (LED) conveys information in addition to the information bits conveyed by conventional modulation. We first study generalized spatial modulation (GSM) and its performance in multiple input multiple output (MIMO) VLC systems. We then propose a new OFDM scheme suited for VLC systems. Termed as indexed non-DC biased (I-NDC) OFDM, the proposed scheme exploits indexing and achieves better performance at low SNRs compared to existing schemes in the literature. In GSM MIMO, we derive an analytical upper bound on the bit error rate (BER) for maximum likelihood (ML) detection of GSM in VLC systems. Analysis and simulation results show that the derived upper bound is very tight at medium to high signal-to-noise ratios (SNR). The channel gains and the channel correlations influence the performance of GSM such that the best BER is achieved at an optimum LED spacing. Also, for a fixed transmission efficiency, the performance of GSM improves as the half-power semi-angle of the LEDs is decreased. We also compare the performance of GSM in VLC systems with those of other MIMO systems such as spatial multiplexing (SMP), space shift keying (SSK), generalized space shift keying (GSSK), and spatial modulation (SM). Analysis and simulation results show that GSM outperforms the other considered MIMO schemes at moderate to high SNRs. Like in RF communication systems, OFDM can be used in VLC systems. When applied to wireless optical channels, OFDM signaling needs to produce real valued symbols. Several such schemes have been reported in the literature, e.g., DC-biased optical (DCO) OFDM, asymmetrically clipped optical (ACO) OFDM, flip OFDM, and non-DC biased (NDC) OFDM. Among these schemes, NDC OFDM has been reported to achieve the best performance. Here, we propose a new scheme, termed as indexed non-DC biased (I-NDC) OFDM, which brings in the
advantage of indexing to NDC OFDM. The proposed I-NDC OFDM scheme is shown to perform better than NDC at low SNRs.

ATTADA CHANDRAMOULI  B. SUNDAR RAJAN
Optimal Index Codes with Min-Max Probability of Error and Blind Index Codes

An index coding scheme in which the source (transmitter) transmits binary symbols over a wireless fading channel is considered. Index codes with the transmitter using minimum number of transmissions are known as optimal index codes. We identify a criterion for optimal index codes that minimizes the maximum probability of error among all the receivers. For a special class of index coding problem, we give an algorithm to identify optimal index codes which minimize the maximum error probability. We give reason to use 4PSK modulation over BPSK modulation even though both have same bit error probability. We also give index code for three special cases where the transmitter does not have prior knowledge of receivers. we introduce new methods to nd solution for single uniprior and single unicast problems by dividing message set and receiver set into disjoint subsets.

Sandeep Rana (ME Microelectronics)  K J Vinoy
A Battery-less RF Energy Harvesting Scheme for Internet of Things Applications

A RF Harvesting circuit of -12 dbm sensitivity with integrated light and temperature sensors has been fabricated. It is EPC Gen2 compatible and can work in two configurations, Single antenna based and dual antenna based. It being based on RF harvesting, it can act as battery less, wireless sensing IoT endpoint device.