

Calculation of Interaction Force between colloids in high concentrated electrolyte solution



By: Akanksha Lakra (BE/10316/15)

Chemical Engineering (7th semester)

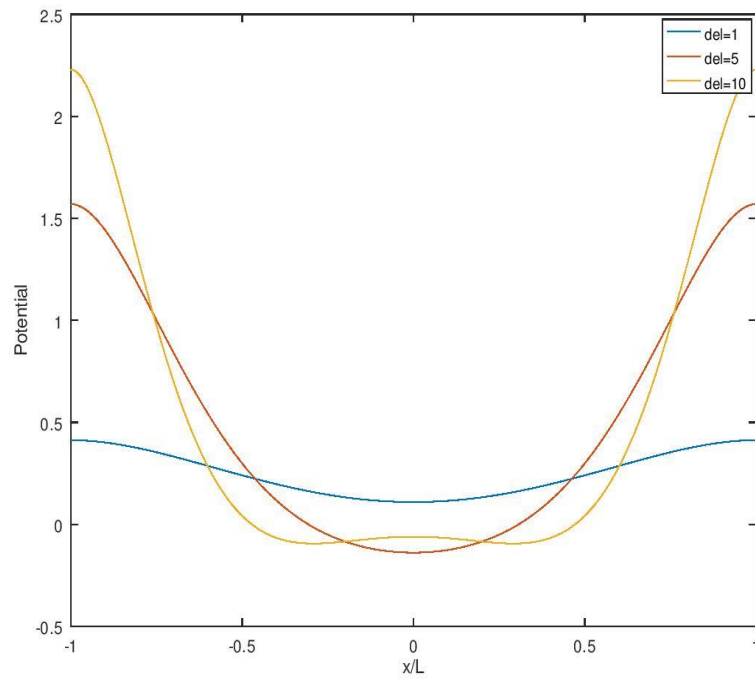
Instructor : Prof. Aditya Khair

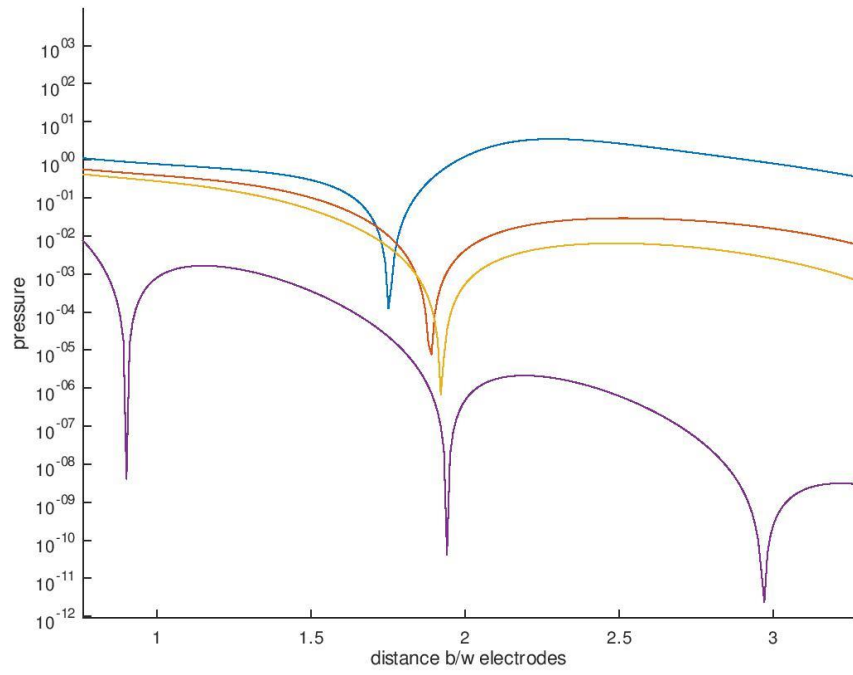
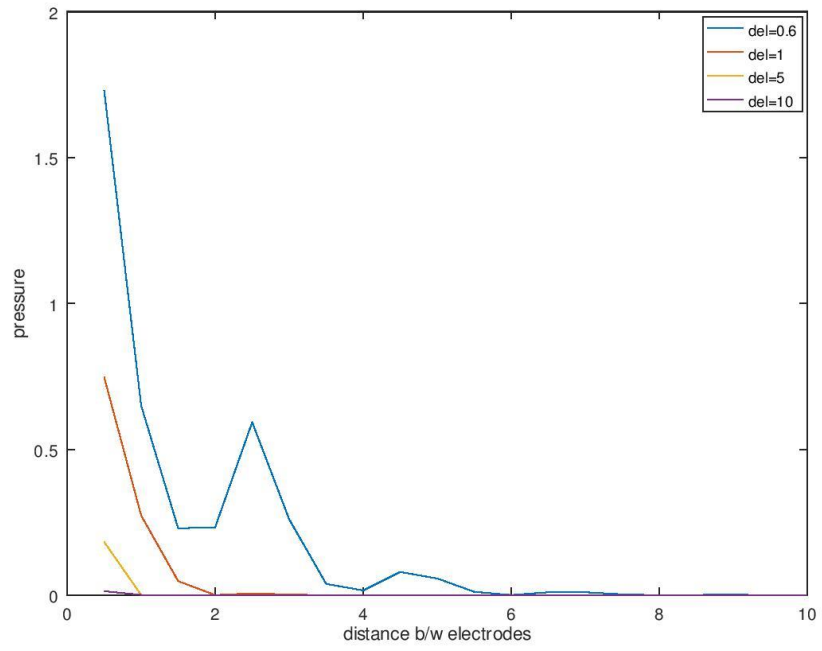
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The rediscovery of Room Temperature Ionic Solvents as designer solvents promised a revolution in Synthetic Chemistry. RTILs hold promise as solvent free electrolytes for super capacitors, solar cells, batteries and electro actuators. First of all it is crucial to understand the electrical double layer concepts. It uses a Landau-Ginzburg type continuum theory of solvent free ionic liquids and use it to predict the structure of electrical double layer. Flows are described in correlated electrolytes and ionic liquids with only one new parameter , an electrostatic correlation length. This model captures over screening from short range correlations dominant at small voltages which are neglected in previous EDL theories. In this research I modified the normal Poisson equation to fourth order Poisson - Boltzmann equation which then was solved for small potential on colloidal surface (assumed as charged plate) in high concentrated electrolyte

solution. Mathematical modeling of the model is done to find the force between charged plates. This model (Bazant's model) used a non- local kernel $K(r,r')$ which decayed over length scale l_c . The solutions obtained were then plotted on Matlab to give variation of potential versus distance between the plates and pressure versus correlation length. The plots obtained are shown as below:





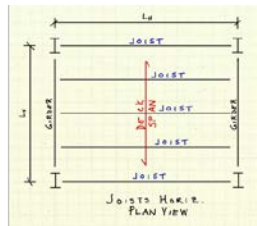
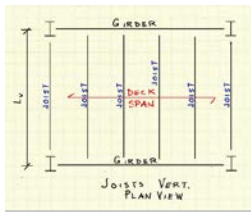
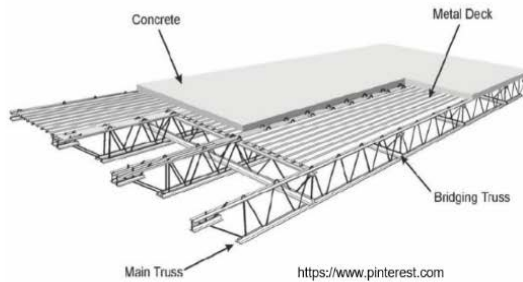
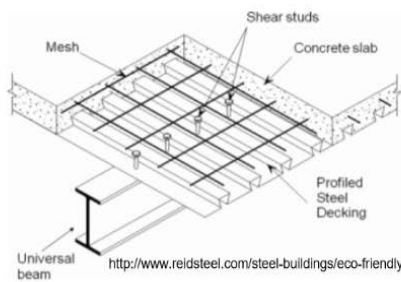
ECONOMICAL FLOOR FRAMING

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In planning, designing and constructing a project, cost of construction has always been a prime concern for civil engineers and contractors. This is true today more than ever due to rampant urbanization. Therefore the objective is to study the parameters, that are either individually or jointly affecting the cost of any construction project. In simple words, our team was looking for factors that drove

the cost for construction of a steel framed floor. This helps create a tool for engineers and builders to make economic decisions while planning a construction project.

Following the instruction of my advisor I started with an interior bay bounded by all direction and it was earlier assumed that the cost of the whole floor is the summation of those of each bay.

For a typical interior bay, a slab with *non-composite deck* was selected with undraped reinforcement. The beams are supposed to be simply supported. Load distribution was taken care by the tributary area assumptions. A single aspect ratio i.e. a particular dimension of the bay was observed. Several plots were generated with help of spreadsheets corresponding to a bay area. The process was expanded for numerous other aspect ratios, each of which creates a possibility for a different spacing of the joists or wide flanged beams. Three dimensional plots were generated with the help of MATLAB and interpretations were made from it, where all the data could compacted in a single graph. Interpretations were made from the graphs produced. We also had aims of producing surface plots considering 3-4 factors that drive the cost of construction of floor. We did the same process for different orientation of the beams and joists in the bay and found some useful plots shown below. After all this work, we were asked to give a poster presentation on our work.

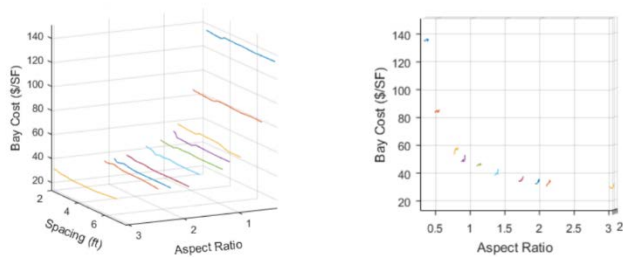
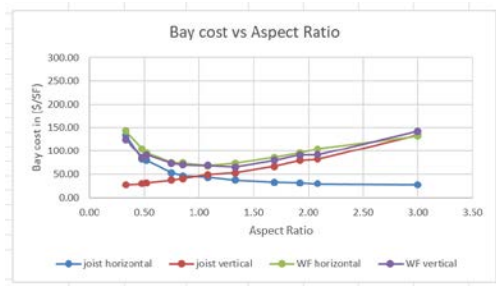


Fig 3. Bay cost vs aspect ratio and spacing

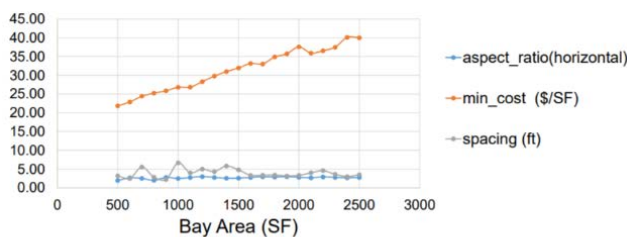


Fig 5. Effect of increasing the bay area

We deeply acknowledge with gratitude, the contribution of **BITMAA-NA** and **BIT Mesra** for partly sponsoring our Immersive Summer Research Experience (2018) at Illinois Institute of Technology, Chicago.

Room Reconstruction using LIDAR and Three Wheel Omni Drive

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ABSTRACT:

This project presents the design, validation and implementation of a three-wheeled holonomic motion system of a mobile robot designed to operate in homes or indoor spaces. The project analyses the kinematics of the motion system and validate the estimation of the trajectory comparing the displacement estimated with the internal odometry of the motors through encoders and the displacement estimated with a SLAM procedure based on LIDAR information.

The major components required in this project are:

Hardware:

1. Three-Wheel Omni Drive
2. YD LIDAR F4 PRO
3. Raspberry Pi 3
4. Arduino Atmega 2560
5. Adafruit L293D Motor Shield V 2.3
6. 12V DC Motors
7. AB Type Magnetic Encoders
8. Li-Po Battery 12V
9. Power Bank 5V
10. Power Distribution Board

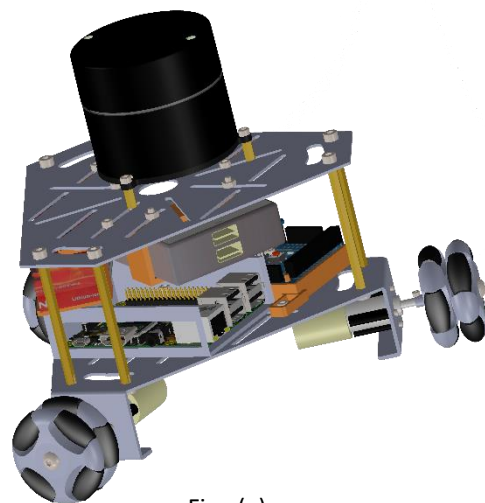


Fig : (a)

Software:

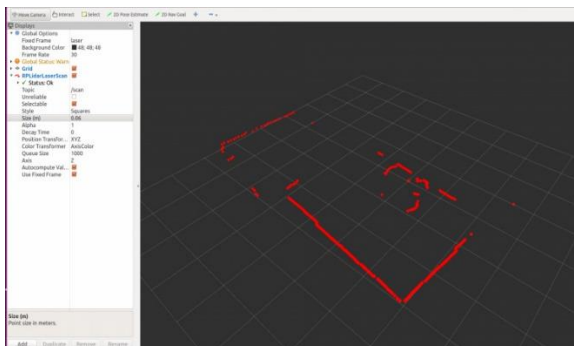
1. ROS- Kinetic (Robot Operating System) on Ubuntu Mate
2. Rosserial Arduino IDE
3. Solidworks 2017

The majority of work was done on ROS- Kinetic Operating system which is a set of software libraries and tools that help us build robot applications from drivers to state-of-the-art algorithms and with powerful developer tools. ROS- Kinetic is a version of ROS.

For reconstruction purpose a LIDAR sensor was used which is a laser scanner and uses the process of Light Detection and Ranging (LIDAR) by measuring distance to a target by illuminating the target with pulsed laser light and measuring the reflected pulses with a sensor. Differences in laser return times and wavelengths can then be used to make digital 2D or 3D representations of the target.

METHODS:

The robot along with the fixtures required for components were designed in Solidworks 2017(CAD Software) and the robot was initially controlled using keyboard to generate a map of the surrounding. For precise movement of the robot encoder data was utilized and for mapping the surrounding the LIDAR data was assembled and converted to a point cloud form using certain packages in ROS. We tried to implement SLAM (Simultaneous Localization and Mapping) algorithms in our robot through navigation stack in ROS which contains a package called gmapping which uses the odometry data, LIDAR data, robot's current and desired location to give velocity commands to the robot to move autonomously and produce a map of the environment while avoiding any obstacles encountered along the way. The results were visualized on a visualization software in ROS called Rviz.



CONCLUSION:

Such types of robots have varied applications in numerous fields such as domestic, military or industrial depending upon the type of usage. Self-driving cars also utilize similar techniques for navigation. The project enabled us to utilize ROS platform for developing our robot and make it mobile using Arduino and Raspberry Pi.

PHYSICAL LAYER AND ACCESS TECHNOLOGIES FOR 5G AND FUTURE GENERATIONS WIRELESS NETWORKS

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In our research project, we as a group studied the major physical layer technologies which form the base for 5G networks. These physical layer technologies were subdivided into three major technologies (Non-Orthogonal Multiple Access Technology, Polar Code and Filtered-OFDM and massive-MIMO technology) among the three members of our group by our mentor.

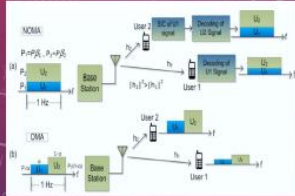
Non-Orthogonal Multiple Access Technology is discussed among the New Radio (NR), which is a study item focussing on the design of next generation air interface. It is an upcoming multiple access technology specially designed for supporting 5G and future wireless communication scenarios which has improved features over traditionally used multiple access technologies in terms of better spectral efficiency, ability to accommodate larger number of users etc by virtue of its unique property of non-orthogonal resource allocation. NOMA can accommodate much more users via nonorthogonal resource allocation by allowing controllable interferences. Massive MIMO systems have shown potential to become a candidate for the next generation wireless technologies including 5G

communication technology. Massive MIMO can be understood as an arrangement of MIMO systems having large quantity of antennas at base station and at terminals and these large number of antennas at base station work for fewer antennas at the terminals making use of same time and frequency resources. The growing number of served users and the increasing demand for large amounts of data opened the doors for this technology. The scaling of MIMO technology to large scale is to increase the capacity by 10 times so as to have the capability of supporting the future generations wireless networks. Polar codes, presented by Arıkan, are a class of error-correcting codes that are proven to achieve channel capacity for long block codes. They have been designated for the next generation of wireless communication standards. The 5G standardization process is putting its main focus on improved error-correction performance, lower power consumption, lower latency and higher throughput. For example, machine-to-machine communications in 5G require massive connectivity among a huge number of devices, on a scale much higher than the most bandwidth-demanding applications in 3G and 4G, with a limited power budget. Therefore, consistent and efficient encoding and decoding methods need to be constructed.

We studied various research papers and also performed simulations on MATLAB and Simulink platform for understanding the key features, advantages and various research trends related with this technology. The important facts were then presented in form of poster and a detailed report for final submission in the Armour R&D Expo. Apart from this, our research group also got an opportunity to work on a research problem related to future generations wireless communication assigned by our mentor regarding an efficient constellation scheme for transmission of symbols from large number of users with optimized average energy and maximised distance between adjacent symbols. We presented a mathematical formulation for this problem and a developed a MATLAB code for testing the constellation characteristics based on the various input symbols from different users and then observed and compared the different constellation shapes and presented the findings to our mentor.

INTRODUCTION

The continuously increasing demand of internet and huge number of users is posing a challenge for 5G wireless communications. The conventional orthogonal multiple access technologies i.e. Frequency Division Multiple Access (FDMA) for 1G, time Division Multiple Access (TDMA) for 2G, Code Division Multiple Access (CDMA) for 3G and Orthogonal Frequency Division Multiplexing (OFDM) for 4G can't accommodate such large number of users here, different users are allocated orthogonal resources in either the time, frequency, or code domain in order to avoid interference.



The Non-Orthogonal Multiple Access (NOMA) schemes have attracted lots of attention recently as they can accommodate much more users via non-orthogonal resource allocation. Rather than utilising orthogonal signals to differentiate between signals at the receiving end, the NOMA technique utilizes the superposition coding principle to multiplex multiple users onto the same time and frequency resources while ensuring controlled symbol collisions. In this manner, NOMA increases the number of connections at an additional cost of increased complexity of receiver for separating the signals. Thus they are promising techniques to improve spectral efficiency and support massive connectivity.

ADVANTAGES AND CHALLENGES

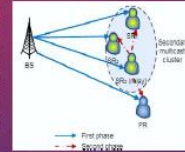
Benefits of NOMA over OMA

- Better Spectral Efficiency
- Better Cell Edge
- Throughput
- Massive Connectivity
- Low transmission latency
- Relaxed Channel Feedback

Challenges in NOMA

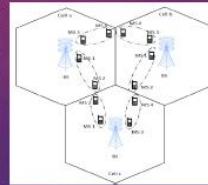
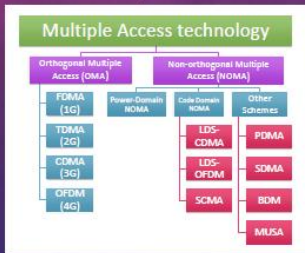
- Dynamic User Pairing
- Resource Allocation
- Complexity
- Receiver Complexity
- Error Propagation
- Signalling Overhead
- Effect of Interference and Distortion

Cooperative NOMA (C-NOMA): It, relies on several relay nodes to help source in forwarding information to the respective destinations. In Cooperative NOMA, users having better channel conditions act as a relay in assisting the users with poor channel conditions. Some techniques such as Bluetooth and UWB schemes is used for delivering signals from users with better signal condition to users with poor channel condition at the cost of additional time slots.



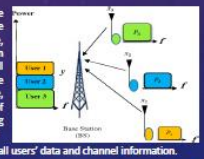
CLASSIFICATION

Multiple access schemes allow users to share the given spectrum in most effective manner. The classification of these schemes are based on the fact whether the resources are being allotted orthogonally or non-orthogonally to these users and the further subdivision of these schemes are done based on the fact that the resource being allotted is code domain, frequency domain or time domain in case of orthogonal access and power and code domain in case of non-orthogonal access.



Network NOMA: Generally, the cell-edge users face great interference from the neighbouring cell users. In the given figure, strong interference is expected between users 1 and 3, which degrades the overall performance of NOMA. Therefore, to resolve this problem of inter-cell interference, Network NOMA utilizes joint precoding of the users' signals across the neighbouring cells. The optimal pre-coders are difficult to design since each base station should know all users' data and channel information.

NOMA with MIMO: The MIMO technology is being used in 5G for increased capacity. MIMO-NOMA can be extended to MIMO and performs better than MIMO-OMA in terms of the sum channel capacity. The MIMO-NOMA system improves the sum capacity by allowing two users to share a single beamforming vector. To ensure the mitigation of problem of the inter-beam interference and the intra-beam interference, the power allocation is done on the basis of correlation among the users and channel gain difference.



BIBLIOGRAPHY

- [1] L. Dai, B. Wang, Z. Ding, Z. Wang, S. Chen and L. Hanzo, "Survey of Non-Orthogonal Multiple Access for 5G," in *IEEE Communications Surveys & Tutorials* 2015.
- [2] L. Dai, B. Wang, Y. Yuan, S. Han, C. L. I and Z. Wang, "Non-orthogonal multiple access for 5G: solutions, challenges, opportunities, and future research trends," in *IEEE Communications Magazine*, vol. 53, no. 9, pp. 74-83, September 2015.
- [3] S. M. R. Islam, N. Avizohar, O. A. Dobre and K. S. Kwak, "Joint-Power-Domain Non-Orthogonal Multiple Access (NOMA) in 5G Systems: Potentials and Challenges," in *IEEE Communications Surveys & Tutorials*, vol. 19, no. 2, pp. 721-742, Secondquarter 2017.

ACKNOWLEDGEMENT

We would like to acknowledge Birla Institute of Technology, Mesra, BIT Mesra Alumni Association North America and Illinois Institute of Technology, Chicago for sponsoring this Research Immersion Program. We would also like to thank our professor Dr. Atkin for providing his valuable guidance.

INTRODUCTION

The coming age of wireless technology has brought with itself a burden of excess demand from the ever-increasing users for cellular mobile internet and multimedia services. The growing number of served users and the increasing demand for large amounts of data opened the doors for Multiple Input Multiple Output (MIMO) technology.



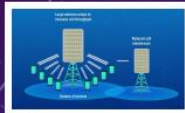
Massive MIMO can be understood as an arrangement of MIMO systems having large quantity of antennas at base station and at terminals and these large number of antennas at base station work for fewer antennas at the terminals making use of same time and frequency resources. The performance of these m-MIMO systems has shown significant improvement in bandwidth efficiency along with reduction in transmitted power, thus leading to spectral efficiency.



ADVANTAGES AND CHALLENGES

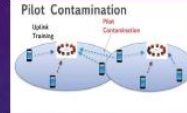
Benefits of m-MIMO systems

- Enhanced Transmission Reliability
- Enhanced spectral efficiency
- Enhanced energy efficiency
- Enhanced system security
- Applicability for mm-wave bands



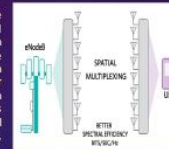
Implementation Challenges in m-MIMO technology

- Pilot Overhead in Channel Estimation
- Channel Feedback Problem
- Hardware Impairments



MAJOR TECHNOLOGIES

Spatial Multiplexing: Massive MIMO systems use the spatial modulation technology which involves incorporating the spatial dimensions as an additional dimension for transmitting information in these communication systems so as to reduce the required amount of transmitted power, and most importantly increase the number of channels that a base station can serve without allocation of more frequency channels.



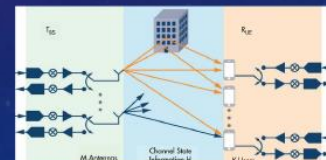
Time Division Duplexing: The time division duplexing technology is popularly adopted in communication systems because of its several attractive features including accommodating various patterns of uplink and downlink traffic in cellular networks. The TDD schemes are commonly categorized as static and dynamic TDD.

Space Time Coded Systems: Space Time Codes are used in wireless communication to transmit multiple copies of a data stream across a number of antennas and to exploit the various received versions of the data to improve the reliability of data transfer.

BEAMFORMING TECHNIQUES

Beamforming can be analyzed by arranging the signal elements in an organized array to produce the desired radiated beam patterns by processing the signals in the direction of the desired terminals and cancelling beams of interfering signals. This can be accomplished by using Finite Impulse Response (FIR) Filter.

CLASSIFICATION OF BEAMFORMING




BIBLIOGRAPHY

- [1] K. Zheng, L. Zhao, J. Mei, B. Shao, W. Xiang and L. Hanzo, "Survey of Large-Scale MIMO Systems," in *IEEE Communications Surveys & Tutorials*, vol. 17, no. 3, pp. 1738-1760, third quarter 2015.
- [2] Y. Huang, B. Jalaian, S. Russell and H. Samani, "Reaping the Benefits of Dynamic TDD in Massive MIMO," in *IEEE Systems Journal*.
- [3] Ali, E., Ismail, M., Nordin, R., "Beamforming techniques for massive MIMO systems in 5G: overview, classification, and trends for future research," *Frontiers in Technol Electronic Eng* (2017) 18: 753.

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Armour College of Engineering
ILLINOIS INSTITUTE OF TECHNOLOGY

POLAR CODES AND FILTERED OFDM

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Department of Electrical and Computer Engineering (ENGR 498-13)



Professor: Guillermo Atkin

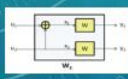
INTRODUCTION

The growing demand for better data transmission and the planning towards the evolution of 5G has increased the interest in finding ways to improve the throughput and reliability of data transmission. Channel coding plays an important role in improving these.


Polar codes, introduced by Arkin, represent an emerging class of channel coding technique with the power to approach the capacity of a discrete memoryless channel. They have been designated for the next generation of wireless communication standards.

Encoding: The basic idea of polar coding is to create a coding system where one can access each channel individually and send data only through the reliable ones. It is based on **channel polarization**, which is splitted into two phases:

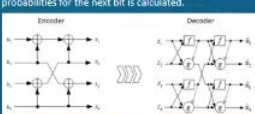
- Channel Combining:** It combines two copies of channel, respectively until N channels are combined.



- Channel splitting:** It splits the combined channel back into N channels, but with changed reliability.



Decoding: In this process, one bit is decided before the probabilities for the next bit is calculated.



ADVANTAGES

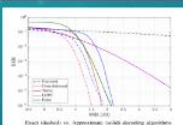
- Simple encoding and decoding
- Lower computational complexity
- Similar error correcting capability compared to that of LDPC and turbo codes
- Performs well for long data blocks
- Universal and versatile

CHALLENGES

- Data Dependencies
- Complex hardware design
- Poor performance for short blocks
- Inflexible and limitations due to serial structure
- Backwards compatibility

PERFORMANCE

When we transmit BPSK over the AWGN channel, the convolutional codes, turbo codes and the polar codes with half code rate, the following BER vs SNR graph is obtained. The error correction capability is similar for LDPC and polar codes, but both perform poor in comparison to turbo codes.



APPLICATIONS

- 60GHz Millimetre Wave
- Optical Access Networks
- Physical layer security
- Enhanced Mobile broadband
- Ultra-reliable low latency Communication (URLLC)
- Massive Machine type communication (mMTC)

FUTURE SCOPE

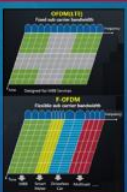
- Reducing the calculation operations or increasing the parallelism of the decoder so as to decrease the decoding latency, or to increase the throughput.
- Polar coded modulation i.e. jointly describe polar code and modulation.
- Hybrid automatic repeat request (HARQ) for link adaptation.

COMPARISON WITH OTHER CODES

	POLAR CODE	TURBO CODE	LDPC CODE
ENCODING	Structure: Recursive Convolutional Encoder	Structure: Convolutional Encoder	Structure: Sparse Matrix
DECODING	Structure: SC, SCL, SSCL, *SSCL	Structure: BP	Structure: BP
COMPLEXITY	Low	High	High
PERFORMANCE	Throughput: > 100 Gbps	> 20 Gbps	> 20 Gbps
LATENCY	0.05 μ s	0.25 μ s	0.05 μ s
ADAPTABILITY	Flexible	Flexible	Flexible

FILTERED OFDM

F-OFDM is a spectrally localized waveform in which different sub-band filters are used to create OFDM subcarrier groupings with different inter-subcarrier spacing, OFDM symbol durations and guard bands. This significantly lower the out-of-band emission (OOBE) that can mitigate interference in asynchronous access. Filtered-OFDM is currently in its nascent stage. It requires prototyping and field testing.



Need for F-OFDM:

- Personalized services to different needs and channel characteristics
- Reduced out-of-band emission (OOBE)
- Flexibility, spectrum efficient and MIMO-friendly
- Low power consumption
- Supports asynchronous transmission
- Supports multiple waveforms

BIBLIOGRAPHY

[1] Arkin, "Channel Polarizations: A Method for Constructing Capacity-Achieving Codes for Symmetric Binary-Input Memoryless Channels," in IEEE Transactions on Information Theory, vol.55, no.7, pp.3091-3093, July 2009.

[2] K. Niu, K. Chen, J. Lin and Q. T. Zhang, "Polar codes: Primary concepts and practical decoding algorithms," in IEEE Communications Magazine, vol. 52, no. 7, pp. 192-203, July 2014.

[3] Zhang, M., Jia, J., Chen, J. Ma and J. Qiu, "Filtered-OFDM - Enabler for Flexible Waveform in the 5th Generation Cellular Networks," 2015 IEEE Global Communications Conference (GLOBECOM), San Diego, CA, 2015, pp. 1-6.

ACKNOWLEDGEMENT

We would like to acknowledge Birla Institute of Technology, Mesra, BIT Mesra Alumni Association North America and Illinois Institute of Technology, Chicago for sponsoring this Research Immersion Program. We would also like to thank our professor Dr. Atkin for providing his valuable guidance.



Using ANSYS for Civil Engineering Purposes

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Department of Civil & Environmental Engineering

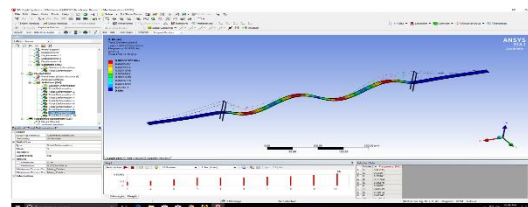
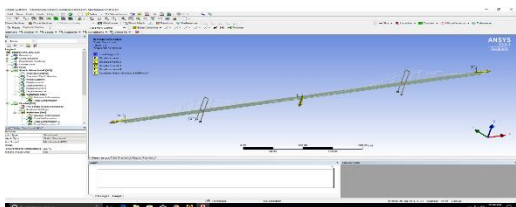
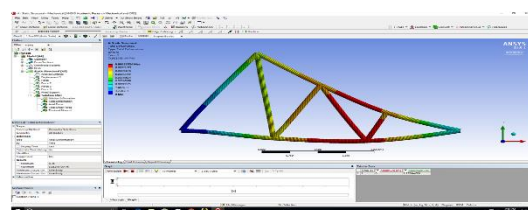
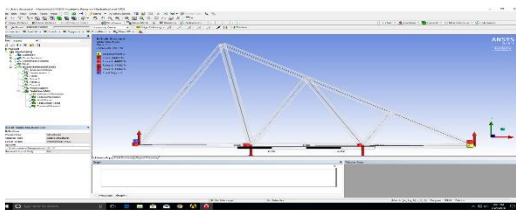
Project Guide: **Prof. James Thomson (Ph.D)**

Carnegie Mellon University, Pittsburgh, PA.

ANSYS, Inc. is an American public company based in Canonsburg, Pennsylvania. It develops and markets engineering simulation software. ANSYS software is used to design products and semiconductors, as well as to create simulations that test a product's durability, temperature distribution, fluid movements, and electromagnetic properties. ANSYS develops and markets finite element analysis software used to simulate engineering problems. The software creates simulated computer models of structures, electronics, or machine components to simulate strength, toughness, elasticity, temperature distribution, electromagnetism, fluid flow, and other attributes. ANSYS is used to determine how a product will function with different specifications, without building test products or conducting crash tests. For example, ANSYS software may simulate how a bridge will hold up after years of traffic, how to best process salmon in a cannery to reduce waste, or how to design a slide that uses less material without sacrificing safety.

Most ANSYS simulations are performed using the ANSYS Workbench software, which is one of the company's main products. Typically ANSYS users break down larger structures into small components that are each modeled and tested individually. A user may start by defining the dimensions of an object, and then adding weight, pressure, temperature and other physical properties. Finally, the ANSYS software simulates and analyzes movement, fatigue, fractures, fluid flow, temperature distribution, electromagnetic efficiency and other effects over time. ANSYS also develops software for data management and backup, academic research and teaching. ANSYS software is sold on an annual subscription basis.

My Project Goals at the Carnegie Mellon University included, learning how to use ANSYS Mechanical interface and Workbench to solve static and dynamic structural problems and to write a handbook to help students use ANSYS. I ran multiple simulations on bridges, trusses, frames, beams and spring mass systems to explore and analyze the software. I and my teammate were able to determine and report a few bugs in the software to the ANSYS team which we were informed would be corrected in the 19.2 version of the software. Some screenshots from my analysis are depicted below:

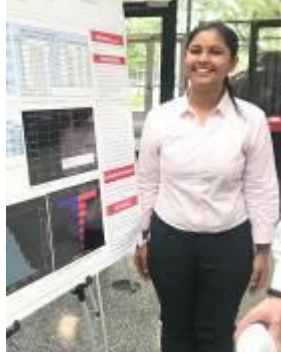


Stochastic Modeling of Risk and Uncertainty in Project Management

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ABSTRACT

Business executives often face the challenge of deciding what projects to invest in. They need to know which projects will maximize the chances of success. Many projects fail because the project cost estimates do not consider the risk and uncertainty (threats and opportunity). The estimates are often too optimistic and unrealistic.

HawkEye is a simulation software that was developed by Project Management Hawks (PMHawks). While the team PMHawks-2016 built HawkEye 1.0 that calculated Project Cost, NPV estimation and Portfolio Optimization, PMHawks-2017 added functionalities like Project Schedule, NPV and Decision Trees in HawkEye 2.0.

Our team Project Management Hawks-2018 (PMHawks-2018) is a group of four enthusiastic students. We have developed a modeling application HawkEye 3.0 to solve the above stated problems for our immersive summer research experience. While the previous versions of HawkEye worked in collaboration with MS Project and Visual Basic, HawkEye 3.0 has altogether scrapped the need of these two softwares by creating a model based on the programming language Python.

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METHODS

HawkEye 1.0 developed a Monte Carlo engine and used Latin Hypercube sampling method to calculate the calculate Project Cost, NPV estimation and Portfolio Optimization. While HawkEye 2.0 worked in tandem with MS Project to calculate the Project Schedule and NPV.

HawkEye 3.0 has completely eliminated the use of MS Project and Visual Basic which has increased the usability of the software.

The user can calculate Project Cost, Schedule, and NPV as well as optimize Portfolios independently.

All the results are displayed in the form of interactive graphs and charts. The user can also get “tornado charts” to see the effect of the tasks on the complete project.

The user has the independence to use the software in Windows, Mac and Linux. The platform independence has further simplified the usage.

PMHawks-2018 has also implemented “Portfolio Optimization” which gives the user the best portfolio mix. In the previous versions only the deterministic method was used to select the portfolio whereas HawkEye 3.0 can calculate it stochastically.

It can also find total critical path time and the slack for the non- critical tasks. We have also included “Probabilistic branching”. The critical path can be calculated with risk as well as without risk in Project Schedule.

CONCLUSIONS

- With the help of HawkEye Model we can generate more conservative project cost and schedule estimates. HawkEye 3.0 model will give the user better insights into project cost and schedule. Ultimately all of this will lead to more successful projects.
- The speed has improved significantly from the previous models, the performance has improved while HawkEye 3.0 can now perform more number of simulations.
- HawkEye 3.0 calculates the critical path and the float for each individual task for the Schedule that was not possible in the previous versions.
- When one accounts for the risk and uncertainty to do probabilistic analysis for NPV, the estimates are going to be more conservative and realistic. That would help one take more effective decisions. Thus, executives can have a better insight into the profitability and success of a project.
- When the NPV is positive, HawkEye 3.0 gives a percentage chance of the project being successful whereas the deterministic method does not give us this information.
- HawkEye 3.0 identifies the portfolio that has projects based on the highest NPVS vs the projects based on the highest BCRs. HawkEye 3.0 shows that selecting portfolios based on highest BCRs is a better method.

HawkEye 3.0 is a more robust, powerful and faster modelling software for stochastic modelling of Project Cost, Project Schedule, NPV and Portfolio Optimization.

