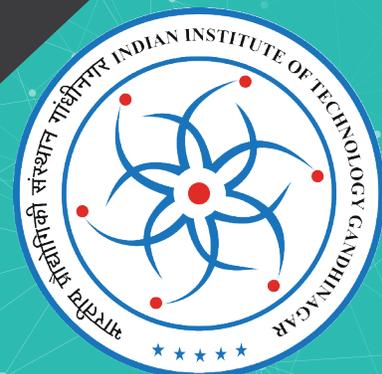


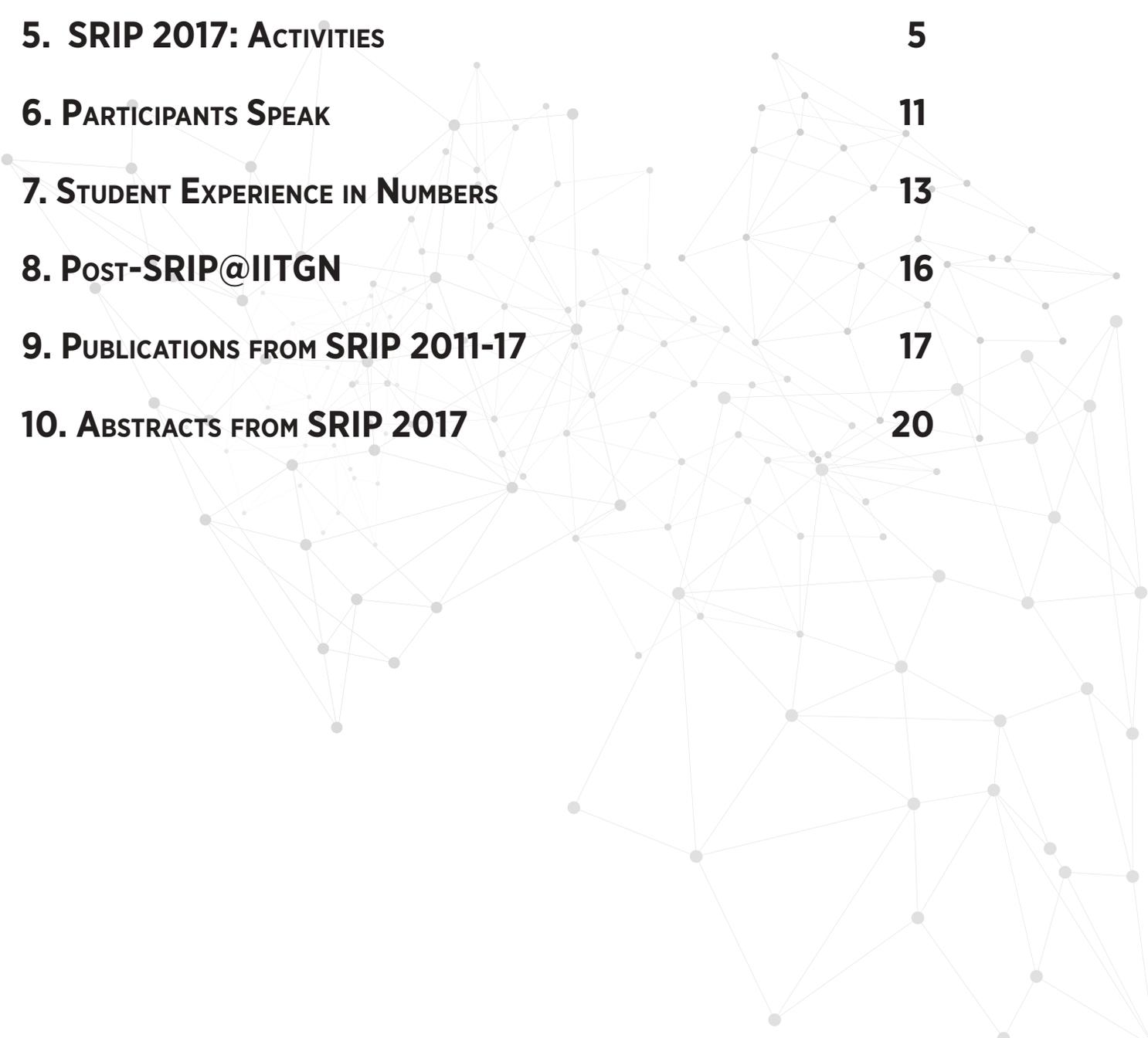
Indian Institute of Technology Gandhinagar

# Summer Research Internship Program 2017 Report



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## ACKNOWLEDGEMENTS

The organizers of Summer Research Internship Program (SRIP) 2017 thank IIT Gandhinagar for providing all necessary financial, personnel, and infrastructure support. Regular guidance of Director Professor Sudhir K. Jain is gratefully acknowledged. The support from the academic office under the leadership of Professor Amit Prashant is put on record. The organizers are thankful to the speakers of the SRIP Lecture Series: Professor K. Chelvakumar, Professor Svetlana Brzev, Mr. Manish Jain and Dr. Harish PM. Special thanks are due to Mr. N. Ravi for help in dealing with the data and postal communications. The team comprising Mr. Gaurav Shukla, Mr. Devarsh Barbhaya and Ms. Khushbu Shah photographed and/or videographed all events. These pictures are used in this report. The videos of the welcome session and the SRIP Lecture Series are available on the IIT Gandhinagar Youtube page. The support provided by the communication team led by Dr. Neeldhara Misra is appreciated. This document was given the final shape by Mr. Franklin Kristi. The organizers are grateful for the efforts. The support of Ms. Mouli Kethineedi in coordinating the preparation of the report is acknowledged. The organizers thank all participating faculty members and interns for the successful completion of the program. The student body of IIT Gandhinagar organized the sports and cultural events, which added color to the experience of the interns. Their efforts are deeply appreciated. The organizers are thankful for the help and support of all those who directly or indirectly contributed towards SRIP 2017.



## ORGANISING TEAM

Undergraduate Research Committee at IIT Gandhinagar coordinated and organized the SRIP 2017. Drs. Vineet Vashista, Manish Kumar, Manoj Gupta and Pedro Pombo were the members of the committee.

Dr. Vineet Vashista is an Assistant Professor in the Mechanical Engineering discipline. His research focuses on design and control of mechanical system, and robotics. Dr. Vashista completed his PhD from Columbia University in 2015 before joining IIT Gandhinagar.



Dr. Manish Kumar is an Assistant Professor in the Civil Engineering discipline. He completed his PhD from State University of New York at Buffalo in 2015. He works in the area of earthquake engineering and blast engineering.



Dr. Manoj Gupta is an Assistant Professor in Computer Science and Engineering discipline. He joined IIT Gandhinagar 2016. He was working with Xerox research before that. He is interested in algorithms and data structures.



Dr. Pedro Pombo is a Visiting Assistant Professor in Humanities. He completed his PhD in 2015 from University Institute of Lisbon. Anthropology is his primary area of interest.



## BACKGROUND

The Summer Research Internship Programme (SRIP) started as an initiative aimed at increasing the visibility of the Institute and presenting its attractive environment to a large audience. As part of SRIP during the summer months the Institute offers specific research projects for students from all over India to participate in. The Institute supports the students by providing a stipend and hostel accommodation. The programme was started in 2011 and was limited to the state of Gujarat in the first edition. The second edition of the programme in 2012 attracted nearly 700 applications from all over the country for 12 research projects. Thirty five students were selected from among the applicants and spent between two to three months at IIT Gandhinagar working on their research projects of interest. An online application system was used in the third edition of the programme in 2013 and an unprecedented number of nearly 5,000 applications were received for 35 research projects. Eventually 45 students were selected for these projects based on several parameters such as academic background, profile and area of research interest.

Students from prominent institutions across India have participated in SRIP since its inception. These include other IITs notably IIT Roorkee, Delhi, Kharagpur, Kanpur, Madras, BHU and Guwahati; NITs at Durgapur, Hamirpur, Warangal, Rourkela, Surat, Allahabad and Bhopal as well as other prominent colleges of engineering, sciences and humanities and social sciences. A notable feature of SRIP in keeping with the Institute ethos is of students participating in research projects from across different disciplines. While at IIT Gandhinagar, the SRIP participants are treated no differently than the regular students of the Institute and are engaged in all academic and extracurricular activities of their interest. The programme is expected to grow many fold in the coming years due to increase in faculty strength, publication of work originating from previous rounds of SRIP and wider knowledge of the programme and the Institute's strengths. In this regard, the programme is expected to be a crucial element in the Institute's efforts towards attracting strong researchers and scholars to its postgraduate programmes of study.

## SRIP 2017: STATISTICS

A total of 8,257 internship applications were received for 70 projects offered by 40 IIT Gandhinagar faculty members, making an average of 100+ applications for a project. A total of 122 students were selected for the program (success rate of 1.5%). The number of selected students was 30% higher compared to the SRIP of 2016. Out of 122 selected students, 40 students were from IIT Gandhinagar and remaining from colleges across India including IIT Roorkee, IIT (BHU), IIT Kharagpur, IIT Patna, IIT Bhubaneswar, IIT Guwahati, NIT Surat, NIT Durgapur, NIT Hamirpur, NIT Rourkela, NIT Warangal, NISER, BITS Pilani, IISER Kolkata, DA-IICT, Nirma University, LD College of Engineering, Presidency University, and JNU.



## SRIP 2017: ACTIVITIES

### Welcome Session

A welcome session was conducted in the 300-capacity auditorium at IIT Gandhinagar on the 18th of May 2017. Our Director Professor Sudhir K Jain and Dean of Academics Professor Amit Prashant addressed the students. Professor Jain spoke about the potential among the undergraduates for independent research, and how opportunities like SRIP help shape the future of the students citing real-life stories. The videos of the talks can be seen on the IIT Gandhinagar Youtube page.



### SRIP Lectures Series

Five lecture sessions were conducted as part of SRIP 2017. Professor K. Chelvakumar delivered the inaugural lecture on scientific research, life, and related issues. Professor Chelvakumar is a Visiting Professor in the Mechanical Engineering discipline at IIT Gandhinagar. The second talk by Professor Svetlana Brzev was on the confined masonry buildings in the IIT Gandhinagar campus. The scale of confined masonry construction at IIT Gandhinagar is the largest in India. Professor Brzev is a Visiting Professor in the Civil Engineering discipline at IIT Gandhinagar. The third talk was by Mr. Manish Jain on toys and the science behind them. He coordinates the Creative Learning Institute (CLI) at IIT Gandhinagar. The fourth session of the SRIP Lecture

series was conducted again by Mr. Manish Jain, wherein the students got the hands-on experience on making the toys. The fifth and final lecture was given by Dr. Harish PM on the features of the IIT Gandhinagar campus. The discussions went from the types of buildings to the chairs in the classrooms. The videos of the five sessions are posted on the IIT Gandhinagar Youtube page.



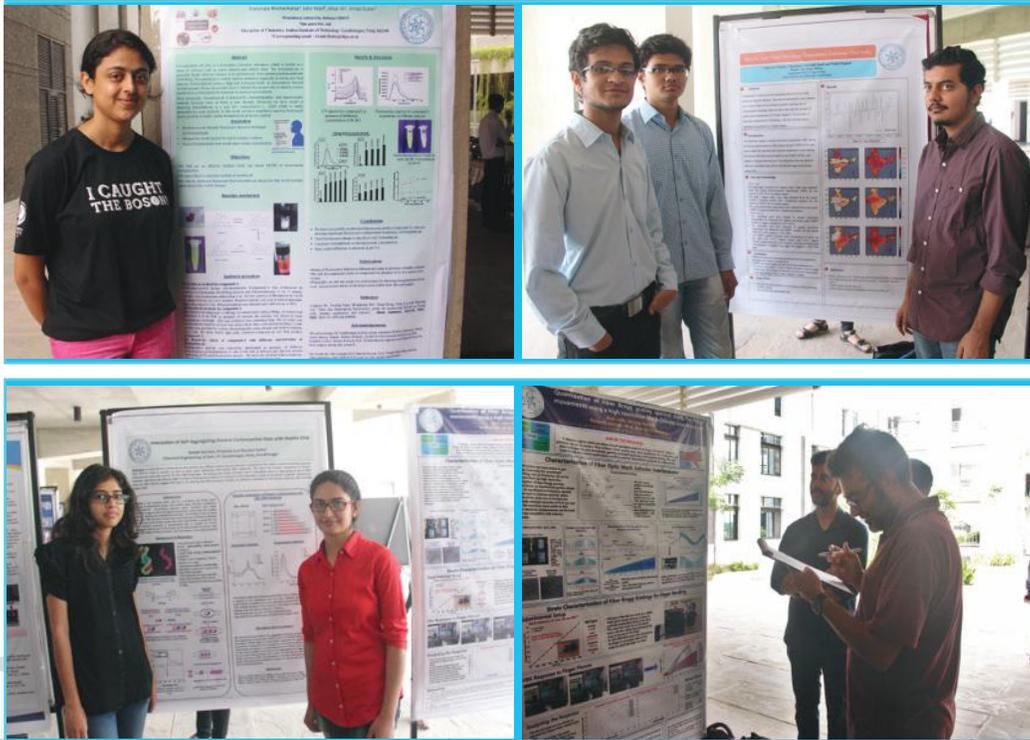


### Poster Session

A poster session was organized around the end of the SRIP. The students presented their work done during the summer. The posters were evaluated by a panel of judges comprising Drs. Chetan Pahlajani and Kabeer Jasuja. Five best posters were selected based on the recommendation of the panel.

1. “Floating Letters” by Abhavya and Abhinav
2. “Dense Crowd Profiling and Simulation Systems” by Ameya Daigavane and Shriya Kaneriya
3. “Synthesis of Fluorescent Probe for Monitoring Formaldehyde in the Industry” by Shatarupa Bhattacharya and Afsar Ali
4. “Transfer Learning by Fine Tuning with Data Augmentation” by Ayon Biswas
5. “Balance Impairment Measurement using Margin of Stability” by Gandhi Meet Bankim





### Solar Book Launch

A highlight of SRIP 2017 was the inauguration of a book entitled “Solar Power in India: Past, Present and 2022”. The book was edited by Professor K. Chelvakumar, and authored by Prathamesh Badve, Navjyot Panpalia, Parth Patel, Priyang Priyadarshi, Saksham Singhal, Puneet Swami, VVS Akhil and Dinusha Wichramaarachchi. The book is a primer to some important factors related to India’s solar energy goal. It is concluded that there is significant progress towards the goal while the lack of local production of cells and panels need to be addressed. The inauguration was preceded by a keynote lecture on solar power by Professor Juzer Vasi from IIT Bombay. The video of the event is posted on the IIT Gandhinagar Youtube page.





### **Research Proposal, Diary Writing and Bi-weekly Reports**

Every participant is required to submit a research proposal within a week of joining the program. Students are encouraged to maintain an online diary, namely, Tuesday-Friday (TF) Diary to keep track of their own progress. In addition, they also are encouraged to maintain a bi-weekly record online. At the end of the program every participant submits a report comprising the work done over the summer.

### **Viva-voce**

Each student gets to briefly interact one-on-one with a member of the Undergraduate Research Committee, which helps the committee understand and address concerns related to the stay of the students at the campus, availability of resources, or other factors that keep the student from realizing their best.

### **Games**

A carrom tournament was organised for the students and summer interns at IIT Gandhinagar. Students formed a team of two comprising one IITGN student and one external SRIP student. A total of 20 teams registered for the tournament. The team of Devanand (IIT Gandhinagar) and Angshuman (Indian Institute of Public Health Gandhinagar) won the tournament. A badminton tournament was also organized. A total of 16 teams registered. Sunny Bojja from IIT Gandhinagar was declared the winner.

## Cultural Events

A cultural night was organized in which the undergraduate students from the 2015 batch of IIT Gandhinagar delivered a band performance followed by a joint performance by the students of IIT Gandhinagar, IIT BHU, Vallabh Vidyanagar, and ICT Mumbai. Subsequently, a DJ night was organized where the SRIP interns danced to the tunes, and bonded among themselves and with the IIT Gandhinagar students.



## PARTICIPANTS SPEAK

*“Being a part of SRIP was a very new experience as compared to other internships. SRIP poster session was a great part as that gave us all chance to make poster and present our work. SRIP gave me a professional exposure, I also had the chance to work in a team and discuss ways to solve problems. I count this internship as one that gave me a lot of exposure while also making me more knowledgeable.”*

*--Aarju Goyal*

*“Working as a research intern under summer internship programme of IIT Gandhinagar has been a rich experience with lot of learning academically as well as otherwise. The work has taught me that persistence and determination is the key for getting through a research paper. You get stuck time and again at various point of time but your determination is what makes you successful. I am very thankful to my guide and the Institute for giving me such an opportunity and enriching experience.”*

*--Aditi Sharma*

*“Working on a research project was a different experience altogether, something I had not expected. So far having worked only on projects that were deemed necessary by the course, I had a feeling that research is all boring and I always wondered how can one develop an interest in this field. But over the due course of the internship I started enjoying the research, started having a sense of responsibility and ownership about the work. The best part is the feeling to know that you are doing something that can really bring some change (if not big). This was what kept me motivated and going through the texts and recalibrating the simulation models time and again.”*

*--Ankit Ghanghas*

*“I had a wonderful time at IIT Gandhinagar. The internship is instrumental in making me understand what research is all about. Every problem at first seemed a big barrier but just sticking with them made things better. SRIP lecture series was truly amazing. Thank you IIT Gandhinagar for this enriching experience.”*

*--Anunay Jain*

*“My work at IIT Gandhinagar was a very enjoyable experience for me. I learned a lot of values from this internship, both in life skills and academically. This was my first research experience, and I believe it was a good start as it opened options for me to pursue research for my future. Not only academically, I interacted with a lot of people here, made a lot of new friends and learned a lot of things. This internship was ultimately a very fruitful experience for me, and I hope to return here for the next SRIP too.”*

*--Hamdan Iftikhar*

*“My experience as an intern during SRIP 2017 at IITGN was phenomenal! The college is located in a peaceful village near the capital city of Gandhinagar and has a very scenic setting. More importantly, it was the people here who really helped me enjoy my internship. The internship was not only focused on technical knowledge but also focused on interpersonal skills. The facilities at IITGN are state of the art. With really spacious labs and a spread out academic area, the campus is highly conducive to research activities. Also, the faculty are extremely friendly and easily approachable. Moreover the students and other interns were extremely interesting to talk to, as well as really helpful. SRIP provided me with a great opportunity to not only work on a scientific project of my undertaking but also provided me with a platform to explore my horizons as well as network with likeminded individuals. For this, I will be forever indebted to this college and the coordinators who made it happen.”*

*--Jonti Talukdar*

*“It was a precious experience of mine being a part of SRIP-2017 at IIT Gandhinagar. After working almost for two months I can clearly say that this was my best experience of interaction with students of different institutions and discussing about their cultures. SRIP lecture series being another window for interacting with students and technocrats who devoted their lives to do their research works. Though these two months I learnt a lot not only about the projects but also social ethics and attitude towards work. From the lecture series, the workshop by Mr. Manish Jain was the best thing I have ever done. I also attended a short course in geosynthetics which was again a great opportunity to interact with the engineers and experts of civil engineering. Apart from all of these we tried out trips also which was also good experience. If I talk about my experience inside lab and project, it's been my first ever research experience so that makes it source of huge experience.”*

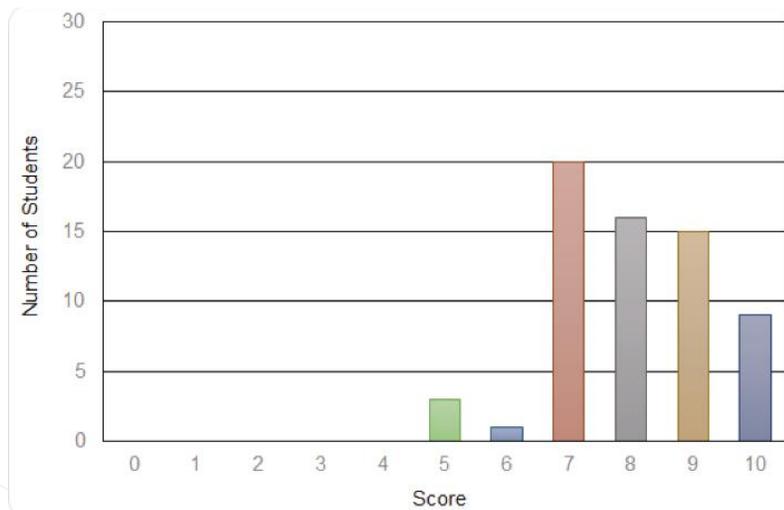
*--Mohit Singh*

*“Summer Research Internship Project 2017 was one of a kind experience, which enabled me to take a head start on my professional research career as an engineering student. Not only I was able to use the summer time with great productivity, but also helped me dig deeper into a topic of research interest. It is designed keeping in mind that a student learns to understand research protocols. The SRIP lecture series is another feature that adds to this program's value. I really appreciate the innovative idea of maintaining Tuesday-Friday diaries and biweekly report as one proceeds in the project which helped me evaluate myself while staying motivated for what's ahead. I would like to thank and congratulate SRIP-2017 for their success in organising in such an enriching program.”*

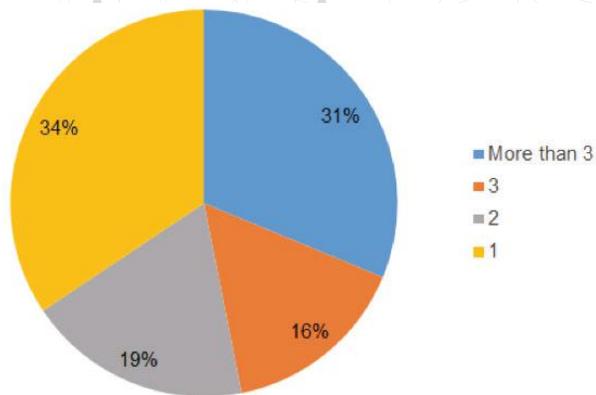
*--Samrath Kanthal*

## STUDENT EXPERIENCE IN NUMBERS

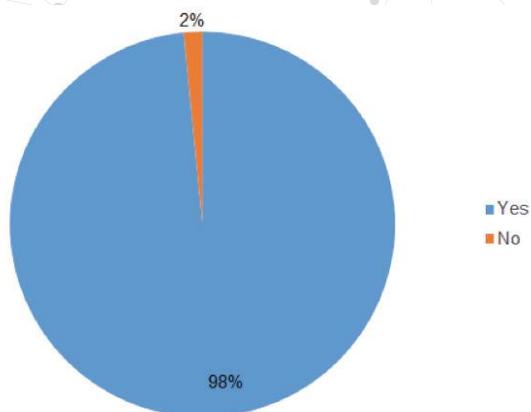
Was your research exciting? Rate on a scale of 0 to 10 (10 = very much so, 0 = not at all).



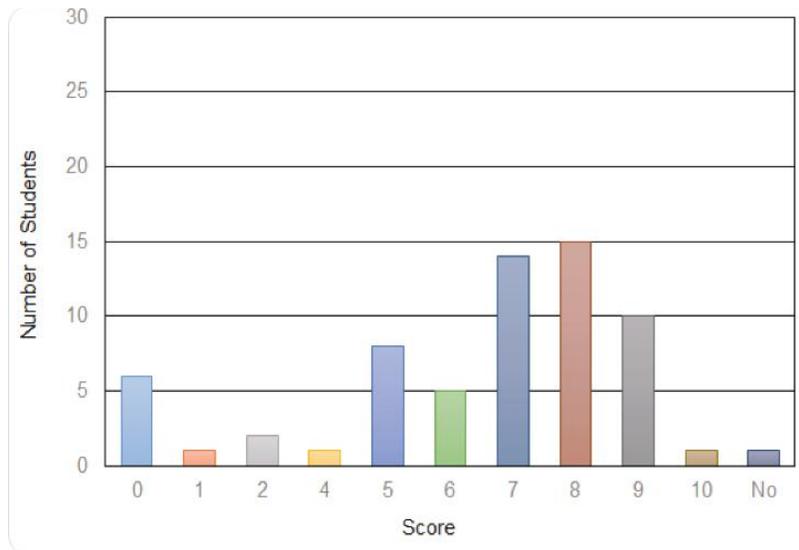
How many times did you meet your advisor every week on an average?



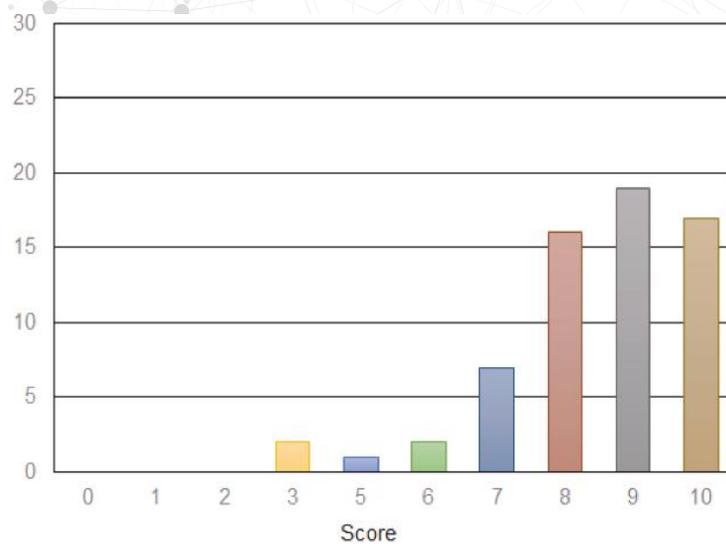
Did you receive sufficient guidance from your faculty advisor?



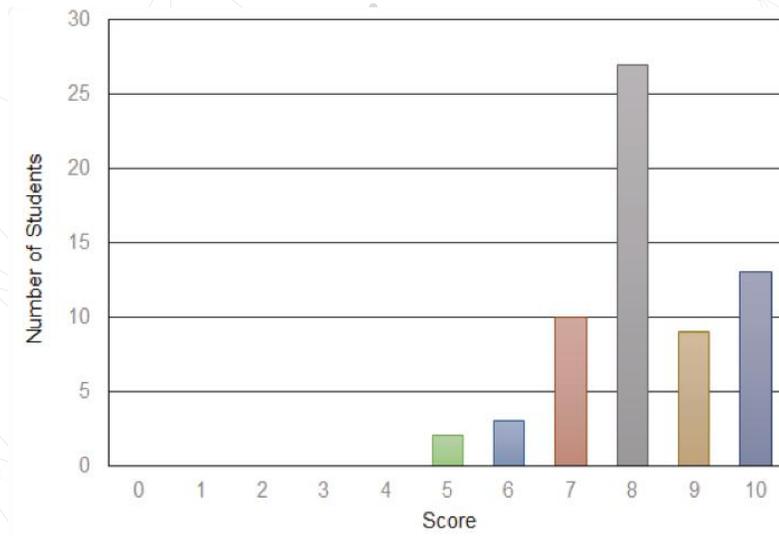
Did you participate in activities other than your project (e.g., SRIP lecture series, games, diaries). Rate on a scale of 0 to 10 (10 = most, 0 = none).



How was the infrastructure necessary for your functioning? Rate on a scale of 0 to 10 (10 = excellent, 0 = highly inadequate).



How was your overall experience? Rate on a scale of 0 to 10 (10 = excellent, 0 = very poor).



## POST-SRIP@IITGN

A significant number of SRIP participants are from IIT Gandhinagar itself. The Institute also sends a good number of students on an internship abroad during the summer. Undergraduate Research Conclave (UGRC) is organized in the beginning of the Fall semester, wherein the students who interned as a part of the SRIP or went to the academic and research institutions within or outside India present their work in the form of a poster. Select posters presented in the UGRC are considered for an award and/or recommended for a powerpoint presentation in front of the community. These posters are also put on display on the designated walls in the academic area. Following posters were recommended for an award in the UGRC 2017.

1. “Nonlinear Characterisation of Periodically Poled Lithium Niobite Waveguide” by Chinmay Shirpurkar
2. “Radiation Hardened Asynchronous Bundled Data Design” by Aparna Aketi

In addition, the posters by Geetanjali Panwar, Jaldhir Trivedi, M. Naveen, Nishant Patel, Tarun Sharma and Girishbhai Patel Parth were recommended for a powerpoint presentation in front of the community as a part of Undergraduate Research Seminar Series 2018.



## PUBLICATIONS FROM SRIP 2011-17

Year	Authors	Title	Journal/Conference/Publisher
2017	K. Chelvakumar (editor), P. Badve, N. Panpalia, P. Patel, P. Priyadarshi, S. Singal, P. Swami, VVS Akhil, D. Wichra- maarachchi	Solar power in India: past, present and 2022	Indian Institute of Technology Gandhinagar, Gandhinagar
2017	A. Dixit, K. Banerjee	New representations for $\sigma(q)$ via reciprocity theorems	Analytic Number Theory, Modular Forms and q-Hypergeometric Series, Springer Proceedings in Mathematics and Statistics
2017	V. Mavani, S. Raman, K. P. Miyapuram	Facial Expression Recognition Using Visual Saliency and Deep Learning	The IEEE International Conference on Computer Vision (ICCV)
2017	S. Dahale, A. Das, N. Pindoriya, S. Rajendran	An Overview of DC-DC Converter Topologies and Controls in DC Microgrid	2017 IEEE 7th International Conference on Power Systems (ICPS 2017), Pune, India.
2017	S. Ramakrishnan, S. Pachori, A. Gangopadhyay, S. Raman	Deep Generative Filter for Motion Deblurring	The IEEE International Conference on Computer Vision (ICCV)
2017	M. Verma, R. Ghosh, S. Raman	Saliency Driven Video Motion Magnification	The 6th National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG), IIT Mandi
2017	V. Patel, P. Shah, S. Raman	A Generative Adversarial Network for Tone mapping HDR images	The 6th National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG), IIT Mandi
2016	G. K. Singh, R. Chavan, V. V. Shah, A. P. Dahale, H. Madapusi	Backward-in-time input reconstruction	American Control Conference (ACC)
2016	B. Sonane, S. Ramakrishnan, S. Raman	Automatic Video Matting through Scribble Propagation	The 10th Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP), Indian Institute of Technology Guwahati
2016	H. K. Verma, A. Saikia, N. Khanna	A Hybrid Model for CFA Interpolation Detection	IEEE 3rd International Conference on Identity, Security and Behavior Analysis, IIIT Delhi
2016	H. Jain, J. Das, H. K.	An Enhanced Statistical Ap-	IEEE 3rd International Conference on
2015	S. K. Das, A. Bedar, A. Kannan, K. Jasuja	Aqueous dispersions of few-layer-thick chemically modified magnesium diboride nanosheets by ultrasonication assisted exfoliation	Scientific Reports (Nature)
2015	V. Karde, S. Panda, C. Ghoroi	Surface modification to improve powder bulk behavior under humid conditions	Powder Technology (Elsevier)

2015	D. Basu, S. Giri	Accidental eccentricity in multi-story buildings due to torsional ground motion	Bulletin of Earthquake Engineering (Springer)
2015	V. Gandhi, S. Heda, R. Anand, A. S. Zarin, A. Upadhyay, A. L. Chakraborty	Rapid detection of CO <sub>2</sub> using a Raspberry Pi-based field-deployable tunable diode laser spectroscopy system	International Conference on Microwave and Photonics ICMAP 2015
2015	U. Dwivedi, A. Dasgupta	Enabling Compliance of Environmental Conditions	International Conference on Information and Communication Technologies in Development (ICTD 2015)
2015	A. A. Kanoria, K. Panchal, R. Dongre, M. Damodaran	Computational Modelling of Aerodynamic Characteristics of Airships in Arbitrary Motion	AIAA Lighter-Than-Air Systems Conference at AIAA Aviation and Aeronautics Forum and Exposition (AVIATION 2015), Dallas, USA
2015	V. Palkar, G. Srivastava, O. Kuksenok, A. C. Balazs, P. Dayal	Using stability analyses to predict dynamic behaviour of self-oscillating polymer gels	American Physical Society March meeting, San Antonio, TX, USA
2015	M. Jalaj, M. Damodaran	Computational Modeling of Small Energy Harvester Subjected to Aeroelastic Instabilities	2nd Indian Conference on Applied Mechanics, IIT Delhi, India.
2015	M. Chawla, M. Mesa, K. P. Miyapuram	Graph Clustering for Large-Scale Text-Mining of Brain Imaging Studies	WCI 2015
2014	S. Pandey, R. Patidar, N. V. George	Design of a krill herd algorithm based adaptive channel equalizer	22nd IEEE International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS 2014), Malaysia
2014	T. Samanta, C. Wargo	Recasting "active aging" in India: Implications for theory and policy	Gerontological Society of America Annual Scientific Meeting, Washington DC
2014	R. Mallik, A. Gupta, A. Joshi, A. L. Chakraborty	Using tunable laser diodes to classify cold drinks brands and interrogate an FBG-based temperature sensor	12th International Conference on Fiber Optics and Photonics (Optical Society of America, 2014)
2014	P. Modi, R. Shah, V. Mishra	Projections of extreme precipitation events in India from regional and global climate models	American Geophysical Union (AGU) Fall Assembly 2014, San Francisco, USA
2014	G. Kanojia, S. R. Malireddi, S. C. Gullapally, S. Raman	Who Shot the Picture and When?	10th International Symposium on Visual Computing, Las Vegas, USA
2014	S. S. Pamulapati, S. Kirubakaran, V. Thiruvengatam	In Search Of Drugs For Helicobacter Pylori Infection	Research Scholars & Alumni Symposium 2014 (RSAS 2014), IIT Bombay
2014	S. Jolad, A. Roman, M. Shastry, M. Gadgil, A. Basu	A family bounded divergence measures based on Bhattacharyya coefficient	IEEE Transactions on signal processing
2014	A. Bapat, A. Ravi, S. Raman	An Iterative, Non-local Approach for Restoring Depth Maps in RGB-D Images	21st National Conference on Communications (NCC), IIT Bombay

2014	A. Chatterjee, V. Karde, S. Saroj, C. Ghoroi	Partial least squares analysis for property prediction of binary blends	CHEMCON 2014, Chandigarh, India.
2014	P. Gupta, N. V. George	An improved face recognition scheme using transform domain features	IEEE International Conference on Signal Processing & Integrated Networks (SPIN 2014), Noida, India.
2014	K. Sirisha, N. V. George	Improving convergence of nonlinear active noise control systems	2014 IEEE Students' Technology Symposium (TechSym 2014), IIT Kharagpur, India.
2013	N. V. George, G. Panda, V. Kumar	On the development of a partial update multichannel nonlinear active noise control system	7th International Conference on Signal Processing and Communication Systems (ICSPCS 2013), Gold Coast, Australia.
2013	G. K. Singh, V. V. Shah, H. J. P. Madapusi	Diagnosis of Parkinson's disease: A limit cycle approach	International Conference on Control Applications (CCA)



## ABSTRACTS FROM SRIP 2017

### 1. Python Tools

Aarju Goyal, Computer Science & Engineering, SVNIT Surat

Mentor: Nitin Khanna, Electrical Engineering



The surface of the moon is filled with Impact Craters, which are formed when different celestial bodies impact the surface. The force of these impact forms the craters which are mostly circular in shape. The Images are captured by the TMC (Terrain Mapping Camera) on board Chandrayan-1, where the Digital Elevation Model (DEM) images are generated using Nadir and Aft images while the Ortho-images are generated using Nadir Images. ArcGIS is a platform which offers location-based analysis and remote sensing; it has different topographies including that of the moon. ArcGIS offers Automation of the functions by using Python Plug-ins. The python plug-ins are developed using Anaconda. Impact Craters can be classified in many ways. Two of the main methods are Morphologically and Chronologically.

This project aimed to develop Python plug-ins for classifying the craters morphologically by feature extraction on Chandrayan-1 Images. The tools prepared in Python are used for automation in ArcGIS. The tools are used mainly to aid in finding an algorithm for crater classification. The Marking Circles tool marks the circles on the ArcGIS platform based on a DataFile which is provided. This DataFile can be any catalog and should contain the Latitude, Longitude and radius values. The profile classification tool is used mainly to generate profiles automatically of all the craters lying on a particular Image and extract features from the same. The profiles are generated in four directions so as to provide a better analysis. The Crater-Cropping tool is used so that the individual profiles of craters are available and different analysis can be done on them individually. Crater classification and feature extraction are done based on the elevation of the crater.

### 2. Purification of IMP domain from Inclusion Bodies

Aarti Singh, Biotechnology, School of Biotechnology, Gautam Buddha University

Mentor: Sivapriya Kirubakaran, Biological Engineering

IMPDH (inosine 5' monophosphate dehydrogenase) is the key enzyme for guanine bio nucleotide synthesis in *Helicobacter pylori* because *H.pylori* entirely depends on Pureine Salvage Pathway for its nucleotide synthesis. This bacterium is responsible for severe Gastric Cancer. The only way to inhibit cell proliferation is by arresting the nucleotide synthesis in *H.pylori*. This is the reason for targeting IMPDH gene. IMP domain is the part of catalytic domain in IMPDH. It has been shown in recent studies that CBS domain is not required for the activity of IMP domain. This IMP domain is present in inactive inside the inclusion bodies. The aim of this work is to isolate and purify IMP domain from inclusion bodies and reactivate those proteins again. IMP domain is incorporated into pET28a vector.

### 3. Floating Letter Display

Abhinav Narayan Harish, Electrical Engineering, IIT Gandhinagar

Abhavya Chandra, Chemical Engineering, IIT Gandhinagar

Mentor: Neeldhara Misra, Biological Engineering

Bireswar Das, Computer Science & Engineering



The project is a floating letter display that has the capability of displaying enriched digital content on a rotating physical medium. The output can be adjusted as per a text input by the user on the keyboard. Currently our project has the capability of displaying alphanumeric characters that are entered.

### 4. Effect of Oxidation on Magnetic Properties of GdFe<sub>2</sub> and YFe<sub>2</sub>

Abhiroop Mishra, Material Science and Engineering, IIT Gandhinagar

Ayush Gupta, Material Science and Engineering, IIT Gandhinagar

Mentor: Emila Panda, Material Science and Engineering



GdFe<sub>2</sub> and YFe<sub>2</sub> belong to a class of intermetallic compounds formed between crystalline rare-earth elements and 3-d transition elements. They have significant application in defense sector as they are widely used in the design and development of microwave components for communication and national defense applications. GdFe<sub>2</sub> is ferromagnetic with a Curie temperature of 790K while YFe<sub>2</sub> is ferrimagnetic with 545K Curie temperature. Thus GdFe<sub>2</sub> can be used in applications involving higher temperature since it retains its magnetic properties up to 790K whereas YFe<sub>2</sub> has its applications in a relatively lower temperature region. With time these compounds develop an oxide film on their surface which leads to degradation in their magnetic properties which is not desirable. Our aim is to study the micro structure of the oxide film overgrowth by X-ray diffraction so as to get an idea about loss of constituent(s) from bulk of the compound and hence relate it with the change in magnetic properties. To accomplish this, arc melted polycrystalline samples of GdFe<sub>2</sub> and YFe<sub>2</sub> were subjected to annealing under different conditions, primarily varying 2 parameters- temperature and pressure. Finally, micro structures of the oxide overgrowth under these conditions were investigated by Powder XRD and Grazing incidence XRD followed by measurement of magnetic properties to suggest the optimum working conditions for these compounds.

### 5. Methyl Lactate Synthesis using Batch Reactive Distillation Operational

#### Challenges and Strategy for Enhanced Performance

Aditi Sharma, Chemical Engineering, IIT Gandhinagar

Mentor: Nitin Padhiyar, Chemical Engineering



Esterification being a reversible reaction is mostly done through batch reactive distillation for better results. In batch reactive distillation, the distillation process sometimes separates the reactants depending on their boiling points. Thus it is a challenge to keep the reactants together. The cited paper suggests the use of semi batch reactive distillation instead of batch reactive distillation and shows the result for different cases. This report is the study of the cited paper and further work that we wanted to do with reference to the paper.

## 6. Dynamic and Fault Tolerant Algorithms for Graph Problems

Aditi Singh, Electrical Engineering, IIT Gandhinagar

Mentor: Manoj Gupta, Computer Science and Engineering

Given a graph  $G$  and a set  $S$  of source nodes where  $|S| = k$ , we want to process the graph such that the following queries can be answered efficiently: Query( $s; t; v$ ): Find the shortest distance between a source node  $s \in S$  and any other node  $t \in V$  avoiding the vertex  $v$ . When only one vertex is to be avoided in the query, it is termed as a single fault problem. For two cases, namely  $k = 1$  and  $k = n$ , this problem is solved. Our focus here is single fault problem in an undirected, unweighted graph with  $1 \leq k \leq n$ .



## 7. Image and Depth from a Conventional Camera with a Coded Aperture

Aditya Goel, Electrical Engineering, IIT Gandhinagar

Mentor: Shanmuganathan Raman, Electrical Engineering

A photograph is a 2D representation of 3D visual. A conventional camera has an aperture which can focus at multiple distances on adjusting it accordingly, but will focus only at a single plane on a particular adjustment. Hence it captures blurred versions of scene information away from the plane of focus. The research problem aims to design a coded aperture such that it is able to extract the depths of different objects and finally obtain an all-focused image.



## 8. Economic Analysis of Solar Power in India

VVS Akhil, Material Science and Engineering, IIT Gandhinagar

Mentor: K. Chelvakumar, Mechanical Engineering

The solar tariffs have been falling drastically from Rs 12.12 per unit in 2010 when JNN Solar Mission started to Rs 2.44 per unit in May, 2017. This price is less than the cost of electricity generation from coal by NTPC. This is a huge step towards solar sector achieving grid parity. These prices have been a subject to industry based factors as well as market based factors. This report analyses the trends and reason behind the fall of tariffs. As a part of this study, 4 calculators have been designed for easy understanding of government schemes and investment strategy for MW scale solar PV projects.



## 9. Extraction of Constituent Metals from Waste Printed Circuit Boards

Akshat Pachauri, Material Science and Engineering, IIT Gandhinagar

Mentor: Manas Paliwal, Department of Material Science and Engineering

Effective waste management is a challenge for the human civilization across the globe. While the system of 3 Rs (reduce, reuse and recycle) is applied for waste; reducing consumption and reusing end-of-life products is simply not possible in the context of electronic waste (e-waste). Due to a shortened life span, quick advances in technology and increasing consumption across the globe the production of e-waste has increased tremendously over the past decade. Recycling e-waste is essential because landfilling it is a threat to human health. The lead and mercury present in the e-waste can leach into the ground and contaminate groundwater. The central nervous system may be damaged for consumers of such water. But recycling e-waste is not just an idealistic undertaking for the better good of human health. Printed Circuit Boards (PCBs) present in e-waste are an urban ore of precious metals like gold, silver and palladium; whose extraction towards building an experimental extraction can give rise



to profitable business ventures. This project aims to devise a route for extraction of PMs and hazardous metals present in PCBs which can be sold back to PCB manufacturers in a cycle. The theoretical yields of metals extracted from this process are further calculated with an aim to calculate the overall capacity of a plant running on the devised process in the future.

### **15. Characterization of Fibre Optic Mach Zender Interformer using TDLS**

Ansh Joshi, Electrical Engineering, IIT Gandhinagar

Mentor: Arup Lal Chakraborty, Electrical Engineering



Fibre Bragg grating exhibit spectral shifts in response to strain and temperature changes and this allows us to employ them as sensors. To measure these spectral shifts we are using a frequency scale generated by an Unbalanced Mach Zehnder Interferometer(MZI). The Free Spectral Range (FSR) of the MZI is to be reduced to maximum extent possible so that the resolution of our measurements becomes competitive with other commercially available instruments. During our experiments we used two Distributed feedback (DFB) lasers at 1531.52nm and 1651.93nm. The interferometer was constructed using two 3dB optical couplers and patch cables of various lengths to introduce path difference. While characterizing the FSR of the MZI we observed that using temperature tuning gave precise values of FSR compared to current tuning as it can tune over a larger wavelength range and allows for averaging of laser non-linearities.

### **16. Finite Element Analysis of Reinforced Concrete Beams**

Anshul Yadav, Civil engineering, IIT Gandhinagar

Mentor: Gaurav Srivastav, Civil Engineering



Today, reinforced concrete is an integral part in the construction of any engineering structure. These structures depend mostly on beams and columns. Therefore, it is a safe practice to understand the response of these components under loading before we construct them. However, finding these results by experimental analysis is both expensive and time consuming. Recent developments in mathematics and computer technology have made it possible to have fast and accurate results of such problems using Finite Element Method. Finite element method is a numerical method which helps us in solving different types of equations which would otherwise be difficult to solve. There are many software available in the market that use FEM to solve these problems and give quick and accurate results. I used ANSYS 17.2 software to model and simulate different types of RC beams under different loads. I got the results for linear range of modulus of elasticity of concrete and compared them with the theoretical calculations.

### **17. Generation and analysis of Intensity-Duration-Frequency Relationships developed for India (25° spatial resolution) by using MSWEP and IMD precipitation data**

Anshuman Singh, Civil Engineering, IIT (BHU) Varanasi

Mentor: Vimal Mishra, Civil Engineering



We used MSWEP and India Meteorological Data (IMD) data to develop Intensity-Duration-Frequency (IDF) relationships for each grid of 25° spatial resolution lying inside India and the obtained relations from MSWEP are compared with IDF relations developed by using IMD dataset using the precipitation values for same duration (1979 to 2014). We also compared the annual mean values and 90 percentile values of the precipitation of the rainy days of both the datasets to get an idea about the distribution of

bias in mean values and extreme values of the MSWEP data. The development of IDF relations is done by using block maxima approach by fitting the maxima values in Generalized Extreme Value Distributions and by considering the extreme rainfall series as a stationary series. The IDF relations consist of the return levels (in mm/hour) corresponding to periods of 5 years, 10 years, 15 years, 20 years, 50 years, 100 years for durations of 3 hours, 6 hours, 9 hours, 12 hours, 24 hours and 48 hours in the case of the MSWEP data, as data was available with 3-hourly temporal resolution and for duration of 24 hours in the case of IMD data, as data were available with 24-hourly temporal resolution. For the same reason, the comparison between IDF relations for MSWEP and IMD data is done for 24 durations. From the results, it is observed that the stationary return levels estimated with MSWEP datasets are generally lower than those estimated with IMD datasets and the difference increases with increase in duration and return periods taken for comparison.

### **18. A Study on Fluid Structure Interaction Problems**

Anunay Jain, Civil Engineering, IIT (BHU) Varanasi

Mentor: Manish Kumar, Civil Engineering



Solids are surrounded by one or the other fluids. There is interaction involved at the interface of the solid and fluid domains. Hence, every problem essentially involves solid dynamics as well as fluid dynamics and is thus multiphysics in nature. In many cases the fluid velocity and pressure fields do not change significantly due to the solid displacement field and neglecting this interaction proves a good choice. One of the domains where this interaction becomes dominant is when thin elastic structures are surrounded by viscous fluid. And this forms the basis of the research work done as a part of this project.

Vibrations induced in simple elastic structures due to fluid pressure and viscous loading have been studied and simulated. The project required simulation of stress strain response in solid domain and velocity and pressure fields in fluid domain. The fluid domain was solved using a computational fluid dynamics (CFD) method and the structural domain using a computational solid mechanics (CSM) method. A partitioned approach was followed in which structure domain and fluid flows were solved separately using different solvers. Commercially available software package ANSYS was used to simulate both the domains – mechanical solver for CSM and fluent solver for CFD. Two-way coupling was essential for the simulations which involved simultaneous transfer of displacement and force data at the interface between the two solvers. Validation of the two solvers and coupling mechanism was done by solving simple structural and fluid dynamics problems using the two solvers and comparing the results obtained with some known results. The results of simulation show the dominance of different natural frequencies of the structure domain on the fluid induced vibrations in thin elastic plates.

### **19. Polycrystalline Microstructure in Non-Convex Domain Modeling**

Arjun Sanghvi, Mechanical Engineering, SVNIT Surat

Mentor: Ravi Sastri Ayyagari, Mechanical Engineering



This engineering project was intended on developing a suitable method for mapping non-convex polycrystalline microstructure. With use of different software and methods it has been made possible to map out simple geometries. However, there is no tool yet available to map out microstructures having non-convex geometries.

This report describes the development, implementation and explanation of a MATLAB program wherein suitable techniques have been used to map out non-convex microstructures. The code has been tested

sand analyzed for various convex and non-convex domains for 2-Dimension geometries which has been outlined in the report. The report also highlights how the code tackles different scenarios with examples. While we have been able to obtain satisfactory results for 2-Dimensional geometries further work is required for mapping out 3-Dimensional non-convex geometries.

## 20. Serpentine Motion

Arshdeep Singh Brar, Mechanical Engineering, IIT Gandhinagar

Mentor: Vineet Vashista, Mechanical Engineering



The aim of this work is to create a mobile robot which moves in a particular direction by repetitively changing its configuration. The idea is to use the inertial actuator to create such motion. This is an effort to imitate the serpentine motion of the snake. Currently the work has been done on only two modules but it will be extended to more number of modules and create a proper serpentine motion. This paper shows two different cases of simulation and reflects the effect of change in moment of inertia in the motion of the described robot.

## 21. SWOT Analysis of Indian Pharmaceutical Industry

Atmin Shah, Chemical Engineering, IIT Gandhinagar

Mentor: Chelvakumar, Mechanical Engineering



In the last ten years (2006-16) the compound annual growth rate (CAGR) of the Indian Pharma Industry (IPI) was more than 15%. IPI contributes 1.4% to the world pharma market in terms of value and 20% (3rd rank in the world) in terms of volume. It is the number one supplier of low-cost generic drugs in the world. Top 10 companies like Sun Pharma, Dr Reddy, Lupin, Cipla, Torrent Pharma etc. contributes to nearly one-third of the Indian Pharma market (IPM). Generic drug contributes more than 70% to the IPM whereas the contribution of the patented drug and 'over the counter' (OTC) medicines is less than 10% and nearly 20% respectively. Generic drugs are the growth engine of IPM. Past few years has been good for the IPM as many blockbuster drugs lost their patent protection term. The growth of revenue from the export has been excellent. It was around 19% per annum in the last ten years, contributing around 30-40% to the IPI. But now export has been facing challenges due to the pricing pressure, foreign policies and scrutiny by USFDA. The domestic market is also a mixed bag owing to Prime Minister Modi's vision of making drugs affordable for the Indian citizens. There is also pressure from the USA to change our patent norms as they are not in favour of US companies or of innovation. But, as the patent norms are in favour of the economic structure (around 18% of people leaving below poverty line) of India, it is difficult to change them. Yet given the importance of R&D (a key for success), IPI has slowly and gradually started investing more resources on R&D (innovation). The Indian government has also started the campaigns (like Pharma 2020) to foster the innovation.

## 22. 3-D swirling pendulum

Ayaz Lakhani, Mechanical Engineering, IIT Gandhinagar

Mentor: Harish P M, Mechanical Engineering



This study involves the brief analysis of a 3-d swirling pendulum. The 3-d swirling pendulum is a complex system that involves the dynamics of the lagrangian top and the 2-D pendulum. The analysis includes determining equations of motion, plotting graphs by varying length, mass etc. for various initial conditions. Verifying equations of motion and finally an overview of stability analysis. The swirling pendulum model can also be further extended to designing controllers. The swirling pendulum

model can also be further extended to designing controllers.

### 23. Transfer learning by fine tuning with data augmentation

Ayon Biswas, Electrical Engineering IIT Gandhinagar

Mentor: Ravi Hegde, Electrical Engineering

Training a deep CNN requires a huge amount of annotated training images which might be expensive and time consuming to produce. This requirement can be fulfilled by using pre-trained weights and training on synthetically rendered datasets. We additionally enrich the dataset by online and offline data augmentation techniques. We analyze the impact on mean average precision (mAP) by different combination of augmentation techniques. And hence must observe whether our model is able to successfully transfer knowledge learned from synthetic rendered images to natural images.



### 24. Computer Vision and Image Processing

Ayush Garg, Computer Science and Engineering, IIT Gandhinagar

Mentor: Shanmuganathan Raman, Electrical Engineering

Study of various techniques used in computer vision and image processing.



### 25. Scour around bridge pier

Bannelly Naresh, Civil Engineering, IIT Gandhinagar

Mentor: Pranab Mohapatra, Civil Engineering

Bridges are among the most prominent river structures that are being used and extensively studied. They are built upon piers which support them and carry the load. Scour is the process by which the river flow or flood water erodes the bed material around the pier decreasing the level of bed material around the pier thereby decreasing its stability. Scour is one of the major causes of bridge failure and 60% of all bridge failures occur due to scour and other hydraulic activity around the piers and abutments. Scour is of two types - clear water scour and live bed scour. In clear water scour the velocity of water is less than the minimum velocity required to erode the bed material (critical velocity) so the river flow approaching the pier has no sediments in it and the scour around pier happens due to obstruction and contraction of flow near the pier. While in live bed scour the velocity of flow is greater than critical velocity so the river flow already has some sediments dissolved in it which can be deposited in the scour hole so the in live bed scour the scour depth is fluctuating. In both the cases we are interested in finding the maximum scour depth as it will be the optimum condition in designing the structures. The estimation of scour depth is a very challenging task as it depends on various factors during the flood event. Also the lab experiments provide the approximate estimation of the field condition and presently we have to rely upon these approximations. Our primary aim is to find out the scour depth experimentally in a given condition and device methods to reduce the scour depth.



### 26. Interaction of Self-Aggregating Dimeric Carbocyanine Dyes with Duplex DNA

Deepti Gautam, Chemical Engineering, IIT Gandhinagar

Mentor: Bhaskar Datta, Chemical Engineering

A novel dimeric carbocyanine dye exhibits very different photo physical behavior compared to the widely studied monomeric cyanine dyes both by itself in solution as well as when upon interaction with duplex DNA molecules. We report the binding interactions of dimeric carbocyanine dyes with specific



AT-rich DNA molecules. The dimeric dye shows dramatic shift in absorption behavior depending on size of DNA duplexes (and the absorption maximum shifts from 647 to 590 nm). Spectroscopic studies of the short synthetic duplex with dye shows high cooperativity towards dimerization : binding of one dimer greatly facilitates binding of a second dimer. Moreover we observe slight increase in fluorescence which is in contrast to that observed in cases of monomeric cyanines. Experiments done for DNA helicity suggest that dye is not altering the DNA structure. Further, no helicity is rendered on the dimeric cyanines upon binding duplex DNA.

## **27. Sol-gel synthesis and characterization of La<sub>0.85</sub>Sr<sub>0.15</sub>CoO<sub>3</sub> nanoparticles and thin films**

Govind Kumar Sharma, M.Sc. Chemistry, IIT Gandhinagar

Mentor: Sudhanshu Sharma , Chemical Engineering



We synthesized nanoparticles and thin films of polycrystalline La<sub>0.85</sub>Sr<sub>0.15</sub>CoO<sub>3</sub> by sol-gel process. The properties of products were characterized by X-Ray Diffraction (XRD), Atomic Force Microscopy (AFM) and cyclic voltammetry (CV). The nanoparticles were obtained from the precursor sol of metal nitrates and citric acids. Then thin films were prepared by spin coating with precursor sol and ethylene glycol or polyethylene glycol on FTO (fluorine doped tin oxide) glass substrate, in which ethylene glycol and polyethylene glycol increases the viscosity of gel. The perovskite phase was obtained by calcining the precursor products at 650°C for 3 hours.

## **28. Visual detection of Pesticides and Herbicides**

Geetanjali Panwar, M.Sc. Chemistry, IIT Gandhinagar

Mentor: Bhaskar Dutta, Chemical Engineering



Here in this report we want to detect Pesticides by analyzing their chemical properties causes various functional groups. Parathion, which is pesticides to be detected here, contains a nitro group which can be reduced to -NH<sub>2</sub> group followed by formation of diazonium salt which can coupled with 2- naphthol to give reddish coloured product to be detected through UV-Visible spectroscopy. For, parathion, a red coloured dye is obtained and characterized.

## **29. Gravitational wave searches from compact binary coalescence**

Amritesh Kumar, Physical Sciences, National Institute of Science Education and Research Jatni

Mentor: Anand Sengupta, Physics

A century after Albert Einstein rewrote our understanding of space and time, physicists have confirmed one of the most important predictions of his general theory of relativity. In another galaxy, a billion or so light-years away, two black holes collided, shaking the fabric of space time. Here on Earth, two giant detectors quivered as gravitational waves washed over them. After decades trying to directly detect the waves, the recently upgraded Laser Interferometer Gravitational-Wave Observatory, now known as Advanced LIGO, appears to have succeeded, ushering in a new era of astronomy. Many methods are being used in detecting the GWs. Here some of the methods have been described such as match filtering, singular value decomposition (SVD) and their importance in the analysis of the GWs data

## **30. Change in Transfer of DNA**

Hamdan Iftikhar, Chemistry, IIT Kharagpur

Mentor: Sairam Swaroop Mallajosyula, Chemical Engineering



The problem statement of what I worked for the duration of two months during the SRIP - 2017 is how modifications in DNA can affect the charge transfer through DNA. This first brings up the question that

why is charge transfer through DNA important? After all, there are so many devices like metals and electrolytes that can do the same, and if we are looking for smaller size, then semiconductors can be used for this. The reason for this is the extremely small size of DNA and the relatively ease through which DNA can be obtained without consumption of any resources. Also, there are techniques like Polymerase Chain Reactions - PCR, which can amplify a single segment of DNA, across orders of magnitude to generate millions of copies of a DNA sequence in a relatively short amount of time. All this has led to the use of DNA in the design of Nanoelectronic sensors and devices. Now that we know the importance of DNA in charge transfer, the question came as to how can we optimize the process. This will require us to know about the mechanism through which charge is actually transferred through DNA, and what are the problems associated with it. The charge can be transferred through DNA through both mechanisms – hole-transfer and electron-transfer. Considering mainly the hole-transfer now, the two scientists who did pioneering work on DNA modification are Kiyohiko Kawai and Tetsuro Majima, and what they concluded was that a hole migrates through DNA through the HOMO of guanine bases. In other words, what actually facilitates the hole migration is the highest energy - highest occupied molecular orbital, and in the case of DNA, Guanine has the one with the highest energy among the four bases - Guanine, Cytosine, Adenine and Thymine.

My work included reading research papers by various authors who have already done these DNA modifications and compiling them onto a single report as to what modification brings what change in the rate of charge transfer, expressed in the terms of change brought in HOMO levels.

### **31. Friction stir welding of dissimilar alloys**

Harsh Khandelwal, Mechanical Engineering, Nirma University

Mentor: Amit Arora, Material Science and Engineering

FSW is a continuous process that involves plunging a portion of a specially shaped rotating tool between the butting faces of the joint. The influence of friction stir welding processing parameters on dissimilar joints conducted between aluminium alloy (AA6061-T6) and commercially pure copper (C11000) was studied. Welding was performed by varying tool shoulder diameter, and hardness measurement tests were performed. Also the variation of temperature and torque with time during welding operation were analysed. Results are generated on this basis and finally future scope of work is defined.



### **32. Circuits for near-threshold voltage computing**

Shah Harshil, Electrical Engineering, IIT Gandhinagar

Mentor : Joyce Meki, Electrical Engineering

As the era of diminishing Moore's law has started a need has arisen to find designs which are more energy efficient to meet the need to accommodate more transistor on a single chip. As a result, near-threshold voltage computing is studied and is researched upon. The existing models made are robust and noise tolerant for nominal voltage but they do not show same strength at low voltage and are more vulnerable to glitches. Various existing designs with minor modifications, like higher fan-in logic gates, can be used for low voltage operations. Whereas some elements like flip-flop can be operated at low voltage but show a considerable energy-delay tradeoff.



### **33. SEL (SINGLE EVENT LATCHUP) TOLERANT DEVICE**

Hasti Kasundra, Electronics and Communication Engineering, SVNIT Surat

Mentor: Joyce Meki, Electrical Engineering

Effects are being introduced, Sources of Radiation are being discussed and Single Event Latchup has been explained in detail. After detailed literature survey about various effects of radiation, simulations were done on Sentaurus TCAD regarding the SEL Tolerant device.



Radiation-induced errors are a major concern for modern digital circuits. Hence it becomes necessary to make the device tolerant to radiation. In this project effective Radiation Hardened by design structures are analyzed such as guard rings (GRs), in reducing the collected charge; Deep drain and Short Drain Devices. Effects of these Radiation-Hardened designs were observed by doing the current pulse analysis.

### 34. Synthesis of Unsymmetrically meso-Substituted Porphyrins

Himanshu, Chemistry, NIT Jalandhar

Mentor: Iti Gupta, Chemistry



Meso substituted fluorescent porphyrins molecule is synthesized for use in uv-vis, fluorescent tracking and Dye Sensitized Solar Cells, light sensitizer in photodynamic therapy. porphyrins has capability to act as dye for biological labelling. Presence of Naphthalene and carbazole to different positions enables it to get embedded in biological hydrophobic environment rendering biosensing applications. In this particular project we synthesised one fluorescent probe (Carbazol, Naphthalene) attached with Porphin moiety. Here we have done acid condensation of N-butylcarbazolealdehyde to make N-butylcarbazole dipyrromethane. This is followed by again acid condensation of above dipyrromethane with naphthalene aldehyde to get the targeted porphyrin molecules. Substitution of carbazole and naphthalene is done at meso position to make more conjugated system followed by metalation using heavy metal will enhance their applications in everyfield.

### 35. Executing Asimbench Benchmarks on Gem5 for PCM-LPDDR based main memories on hand-held devices

Indraneel Sarkar, Information Technology, National Institute of Technology, Durgapur

Mentor: Manu Awasthi, Computer Science and Engineering



Mobile devices like smartphones and tablets, dominate an important part in the worldwide market, where a wide variety of mobile applications like web browsers, social networks, email clients, audio and video players, document processing systems, and map programs are actively used by the consumers.

Performance and power limitations also vary widely across mobile platforms. Hence, there is a growing need for improving the ways at which memory can be made energy efficient with low performance and cost overheads.

Phase Change Memory (PCM) is an emerging technology that aims to be faster than flash and less expensive than DRAM. It is a type of non-volatile random access memory that exploits the unique behavior of chalcogenide glass. PCM is based on the repeated switching of a phase change material between the amorphous and the crystalline states associated with a large change in resistance. Information is stored in the phase of the material and is read by measuring the resistance of the PCM cell where the cell is programmed and read using electrical pulses. This mechanism could give enterprises and consumers faster access to data at lower cost, but there are certain challenges to overcome before that happens. Phase change memory (PCM) provides a non-volatile storage mechanism amenable to process scaling. During writes, an access transistor injects current into the storage material and thermally induces phase change, which is detected during reads. PCM, relying on analog current and thermal effects, does not require control over discrete electrons. As technologies scale and heating contact areas shrink, programming current scales linearly. As a scalable DRAM alternative, PCM could provide a clear roadmap for increasing main memory density and capacity.

The goal is to setup Moby(AsimBench)on gem5 for performing simulations to test the feasibility of the

idea that whether PCM-LPDDR hybrid memory can act as a better, cheaper and energy-efficient alternative to power handheld devices

### **36. Developing an application to manage Document Delivery Service**

Jagriti Bajpai, Information Technology, NIT Raipur

Mentor: T.S. Kumbar, Librarian, IIT Gandhinagar

IIT Gandhinagar has 1200 active users of the library services. As a part of this service, library is providing Document Delivery Service (DDS) to these users for the documents which are not available in the IITGN library. Usually, users request their document requirements through an email and then library staff processes these requirements. During the process, library staff populates the document (bibliographic) and users' details in such way that at the end of any year or during regular time sequence they are able to generate required reports, statistics and based on which they can take various decisions.

At present, library staff is managing this service using Excel and partly manual. To help manage this service more efficiently, the application software has been developed as part of my SRIP project. This application enables the library members to add inquiries, systematically manage inquiry data, documents, institution details, patrons (users), journal data, generating reports, searching and retrieving existing content, updating status and sending emails to the requested institutions and the patrons (users). This application has user management module in which three types of privilege categories are defined. This application is developed using HTML, CSS, Bootstrap framework, JavaScript, jQuery, PHP and MySQL.



### **37. Green office website**

Bhimavarapu Jayanth, Computer Science & Engineering, IIT Bhubaneswar

Mentor : Sriram Kanvah, Chemistry

The purpose of this internship is to develop a website to emphasize the green initiatives undertaken by IIT Gandhinagar. Along the way, learning new methods of waste disposal, energy generation from renewable sources which is the need of the hour. The Indian Institute of Technology Gandhinagar campus plays a large emphasis on the green initiatives from harnessing solar energy, recycling of water, generation of biogas, preserving biodiversity, and to reducing vehicular traffic within the campus



### **38. Characterization of edge emitting semiconductor lasers and external cavity quantum cascade laser for application in tunable diode laser absorption spectroscopy**

Jayesh J Nair, International School of Photonics, Cochin University of Science and Technology

Mentor: Arup Lal Chakraborty, Electrical Engineering

Tunable diode laser absorption spectroscopy (TDLAS) has emerged as a method-of-choice for trace gas detection. With the advent of tunable lasers, the practical application of TDLAS has been widened. Today TDLAS technology is employed for different environmental and industrial applications due to its advantages over other methods. Different semiconductor lasers are being employed to perform TDLAS in our lab. Characterization of these semiconductor lasers is important for understanding their behavior prior to applying them for gas sensing. In this work we have worked on DC and AC characterization of



1392nm Distributed Feedback (DFB) laser. Characterization of tuning coefficient of 1530nm DFB laser was also performed. The External Cavity Quantum Cascade Laser having a tuning range of 4247nm-4773nm was also characterized in this work. Basic understanding of all these lasers will be helpful in performing TDLAS more effectively.

### **39. Transfer Learning for Object Detection using Deep Convolutional Neural**

#### **Networks**

Jonti Talukdar, Electronics and Communication, Nirma University

Mentor: Dr.Ravi Hegde, Electrical Engineering



Modern day Computer Vision systems require a large amount of data to perform object detection and classification tasks. Since neural networks constitute a key element of these learning systems, it has become increasingly important to increase the dataset capacity to utilize these networks to their full potential. With the development of more complex and efficient computing resources, this data intensive task has been successfully parallelized to achieve very low training times. In such scenarios, the availability of a big enough dataset with both high diversity as well as generalization capability has become the key bottleneck to the training process. Annotation and retrieval of such a dataset manually is a very time consuming and tedious task. Hence generation of synthetic scenes rendered from 3D shape models offer a promising approach to transfer knowledge from synthetic to real domain. In this project, we aim to tackle this problem by generating synthetic scenes and analyzing their performance on real data, focusing on detection of packaged food products in refrigerator scenes. The synthetic images, generated using Blender-Python API, are clustered in scenes with different packing patterns, stacking, as well as a variety of configurations to cater to the diversity of real scenes. The performance of the synthetic dataset on real scenes is then evaluated using a number of state of the art convolutional neural networks (CNNs) as well as optimization performed to achieve high detection accuracy.

### **40. Person Re-identification in Dense Crowd**

Keya Desai, ICT(Information and Communication Technology, DAIICT, Gandhinagar

Mentor: Shanmuganathan Raman, Electrical Engineering



We have tried to address the problem of Person Re-identification in a dense crowd and also counting number of people in a dense crowd. It involves applying the concept of Machine Learning and Neural Networks. The objective is to develop an application that can identify people in a given video feed and give an alert if number of people in a frame exceeds a threshold. To develop such an application we have to use pedestrian detection problem along with Person Re-identification. The methods that are used in this include hierarchical Gaussian descriptor, Convolutional NeuralNetwork (CNN),HydraCNN, deep CNN (dCNN),Recurrent Neural Network(RNN),SIFT,density estimation;models such as ridge regression,SVM;interactive object counting. From all the methods available we looked at the merits and de-merits to identify the optimal model.

The dataset we will be using is Rath Yatra 2017, Ahmedabad city. The dataset thus includes video feed of crowded streets.

### 41. Synthesis of Cholesterol Conjugated Stilbenes

Komal Bajaj, Chemistry, IIT Gandhinagar

Mentor: Sriram Kanvah, Chemistry

A cholesterol conjugated nitrostilbene molecule is synthesised for use in fluorescent tracking and lipophilic receptor based imaging. Cholesterol has capability to bind the cell membrane. Presence of cholesterol to different fluorophores enables it to get embedded in biological hydrophobic environment rendering biosensing applications. In this particular project we synthesised one fluorescent probe (nitrostilbene) attached with cholesterol moiety. Here we have reduced acid to alcohol then substituted with bromide and attached to aldehyde for preparation of the fluorescent moiety. This particular moiety was then attached to cholesterol for future applications in biological system.



### 42. Study of ground penetrating radar technique and its application

Kulin Dave, Civil Engineering, Nirma University

Mentor: Amit Prashant, Civil Engineering

Ground penetrating radar (GPR) is a research tool that has many different applications to answer all sorts of questions ranging from concrete inspection, utility mapping, road inspection, archaeology, environmental assessment and many more. One such application is in the investigation of utility mapping present beneath a strata (for e.g. a road). GPR can be a much more cost effective and less invasive process than other traditional methods such as trenching and excavation. GPR uses electromagnetic frequencies ranging from 25- 2500 MHz that are sent from a transmitter into the ground and reflected back to a receiver unit to create a reflection profile showing the internal features of the imaged area. Results of GPR data are enhanced using some commercially available software packages (like RADAN 7) which must be interpreted accurately in order to assess any feature of study. Generally a four step process is followed while processing the data and then the interpretation is carried out. Ground composition, electromagnetic noise in the area, depth of a feature and resolution are some factors that determine the effectiveness of GPR profiling.

In this study an attempt is made to understand and have hands on experience on the equipments used in GPR, data collection methodology, post processing, interpretation and final marking on Auto-CAD drawings.



### 43. Design and Simulation of Jellyfish like Swimming Robot

Narkhede Kunal Sanjay, Mechanical Engineering, IIT Kharagpur

Mentor: Vineet Vashista, Mechanical Engineering

In this paper we present a robotic jellyfish that uses jet propulsion to propel itself in forward direction. This robot consists of a slider crank mechanism and, rocker mechanisms, a streamlined head, cavity shell and an elastic skin wrapped around the cavity. The rocker mechanisms are connected to the slider. These rockers create flapping motion which contracts and relaxes the cavity. During contraction phase an upward thrust is created which propels the robot in upward direction. Here a single motor is used to drive four rocker mechanisms. This robot is capable of diving and surfacing. Simulation was done to verify the designed motion mechanism.



#### 44. Source Printer Classification from Printed Documents using Font-size

##### Independent Geometric Distortion Signatures

Lalan kumar Mandal, Electrical Engineering, IIT Bhubaneswar

Mentor: Nitin Khnana, Electrical Engineering



This project proposes a set of features for characterizing character-level geometric distortions, referred as geometric distortion signatures and presents a novel system to use them for identification of the origin of a printed document. Detailed experiments performed on a set of seven printers demonstrate that for the five printers of different make and model, the proposed system achieves more than 94% accuracy for classifying individual rows/lines of a printed documents. For two printers of exact same make and model, corresponding average accuracy is 47% with almost all the misclassified rows being mapped to another printer of exact same make and model. As the proposed system is able to achieve high accuracy for classifying individual printed rows and most of the pages have around 40 rows, after taking majority voting on decisions for all the rows, the proposed system is expected to give 100% accuracy for classifying complete printed pages from printers of different make and model. We plan to extend this system on a larger database containing printed pages in different font shapes and sizes and different languages.

#### 45. Implementation of MD Analysis to analyze molecular dynamic simulations

Mandar Konde, Chemical Engineering, IIT Gandhinagar

Mentor: Sairam Mallajosyulla, Chemistry



(MD) simulation is the method of mimicking molecular systems through computer simulations. This method is used to study the time dependant behaviour of molecules. These simulations are generally used to study the fluctuations in the structures of proteins and nucleic acids under various conditions. Along with the structure, these simulations can provide information about the thermodynamics of the molecular system. There are various different simulation packages like CHARMM, GROMACS for performing these simulations. After the simulations are performed, the data generated has to be analyzed. Each method of simulation generates output files in different formats. Each method has its own method for analysis and the analysis of simulation results of one package by the analysis scripts of other simulation packages is not possible. MD Analysis provides a common platform for analysis of simulations results generated from different simulation packages. This goal of this project is to prepare script for analysis of data from molecular dynamic simulations, for future use without any requirement of the knowledge of scripting for the user.

#### 46. Transfer Learning Object Detectors from Synthetically Rendered Images

Manik Goyal, Computer Science and Engineering, IIT BHU

Mentor: Ravi S. Hegde, Electrical Engineering



Present Day Computer Vision and Artificial Intelligence tasks have improved quite folds mainly due to the advent of high computational Deep Neural Networks and High-Performance GPU's. Now the shift has occurred from manually extracting various features and applying different task-specific Machine Learning algorithms to using a more sophisticated computational method on a large bundle of similar data. The change though has made it possible to reach and out-perform (in some cases) human accuracy but has resulted constraining to specific domains mainly due to the basic requirement of large data for training, as annotation and retrieval of such large dataset manually for every new task is a tedious process. The emerging use of synthetically rendered data using 3D

models offers a promising solution for this problem. We demonstrate that with transfer learning an effective Object Detector can be learned solely from synthetically rendered data. We showcase this hypothesis by detection of packaged food products and bottles clustered in refrigerator scenes. Our Object Detector trained with 4000 synthetic images achieves mean average precision(mAP) 52.79% on a test set of 50 images. By combining a Semantic Segmentation model with Object Detector mAP further, improves to 55%. We analyse various dataset like how adding distractor objects affects learning, how spatial stacking changes the perception of the model. We also tried combining a semantic segmentation model with a simple foreground-background object detector to ignore specific distractor objects and understand how it improves precision. The use of synthetically rendered dataset is a novel approach as it reduces the constraint of collection and annotating large datasets and thus widens the horizons of Deep Learning applications.

#### **47. Data analysis of data from imu for human walking applications**

Mandlem Manikanta, Electrical Engineering, IIT Gandhinagar

Mentor: Vineet Vashista, Mechanical Engineering

Spatial gait characterization finds its importance in many rehabilitation therapies. This kind of system helps in assisting the exoskeleton to apply forces in specific direction during the therapy. This system also helps in programming robots using the data from human walking pattern.

- Foot mounted Inertial navigation system is one of the best methods to implement pedestrian tracking. This method helps in finding spatial gait parameters in an easy way just by mounting an IMU on the foot and processing the IMU data to get the desired parameters.

This project aims at real time special gait characterization using an Arduino which takes data from IMU MPU6050 which is mounted in the foot and analyses the data in real time to give desired spatial characteristics of human gait like distance covered, stride length, step length etc. This work is inspired from a Matlab code written by Poorna Talkad Sukumar and Carl Fischer to implement Pedestrian dead reckoning (PDR). This Matlab code can do post processing of the recorded data. This document shows how real time processing can be done, gives an overview of the way the PDR is used to calculate the spatial parameters, simple explanation of the ZUPT and Kalman filtering. The results and the limitations involved with this kind of implementation are further explained.

#### **48. Advanced optimization and control of household management in future smart gridsystems**

Manvi Katwal, Electrical Engineering , NIT Hamirpur

Mentor: Babji Srinivasan, Electrical Engineering

In order to improve collection and transmission efficiency of smart electricity information collection system with enormous number of data points, the theory of compressive sensing is applied. This model includes data compression method and reconstruction algorithm. Initially, we proved that the data satisfies the condition of sparsity, as for the process of compression, sparseness in data is necessary. For different types of signal, different types of sparsity measures were taken. Then, an improved iterative threshold algorithm was adopted to reconstruct the compressed data, and detailed processes for data reconstruction were proposed in succession. The compression and reconstruction were applied across space(using principle of correlation and clustering) and across time. Experimental results shows that data from different houses can be reconstructed accurately using the model of compressive sensing.



#### 49. Control Loop Performance Assessment (CLPA)

Mayuresh More, Chemical Engineering, IIT Gandhinagar

Mentor: Babji Srinivasan, Electrical Engineering



Control Loop Performance Assessment (CLPA) is a domain in the field of Control Systems that concerns with the quantification of the performance quality of a control loop. Control loops are integrated in industrial processes to reject disturbances. However, it is found that 60% of the control loops in industries are poorly tuned due to lack of convenient CLPA methods. The methods require the information of process delay and an exact model of the process. However, these are not easily available parameters. To tackle this issue there is another method developed which uses only routine process data. This method, using Hurst exponent, is very useful in this regard. However, this method has its own issues. The project concerns with tackling these.

#### 50. Balance impairment measurement using margin of stability

Gandhi Meet Bankim, Mechanical Engineering, IIT Gandhinagar

Mentor: Vineet Vashista, Mechanical Engineering



SRIP Project Balance Impairment Measurement using Margin of Stability serves as an initial phase of the project Sensorized Passive Prosthetic Limb. This SRIP Project involves studying the human gait which is the study of different patterns of human walking. For studying the human gait, we require to know the dynamics of human gait and hence the kinetics and kinematics of human gait. For studying the kinematics of human gait, Vicon Vero Motion Capture System and associated Software named Vicon Nexus was used in this project. Hence this project involved setting up of Vicon Vero Motion Capture Cameras, aiming the cameras and also calibrating them to generate a virtual workspace. After the workspace has been generated, next comes preparing the subject which involves taking different measurements of subject like weight, height, leg length and so on. Subject Preparation also involves placing Vicon Vero Motion Capture Markers on different joints of subjects body. After subject preparation, Static Trial is taken to verify that all the markers are recognized by the Vicon Nexus Software and to create a skeleton template which is unique for each subject. After Static Trial, Dynamic Trial is taken which is when the subject is walking on a treadmill. After recording the Dynamic Trial, the recorded data is processed and then that data is worked on using MATLAB and other softwares to get different human gait parameters. The data that is recorded in our project contains marker trajectories, velocities and accelerations. Using these data, different gait parameters were calculated. Once all the things were ready, the project involved taking data of an able-bodied person i.e. without any amputation walking normally and the same subjects human gait is recorded by introducing some constraint like no rotation of knee or ankle. When knee joint is restricted then it is similar to realizing a Transtibial Lower Limb Amputation or Below Knee Amputation. When both knee and ankle joint are constrained then it is similar to realizing a Transfemoral Amputation or Above Knee Amputation.

For our project we focused on restricting the ankle movement by making the subject wear an ankle brace and then recording the human gait using Motion Capture. Thereafter using both the data i.e. normal walking by an able-bodied subject and walking wearing an ankle brace of that same subject, project involved comparing the gait parameters and determining which parameter to be used to give feedback control loop from the prosthesis to the residual limb of the subject. The gait parameter that our project discusses is Margin of Stability. For Margin of Balance Impairment Measurement using MoS Stability, one need to understand the related parameters Base of Support and Extrapolated Center of Mass. Base of Support according to our project is the contact area of the feet with the ground at any instant of the gait cycle. Extrapolated Center of Mass is the projection of Body Center of Mass on the

ground in addition to Body Center of Mass velocity multiplied by a constant factor. Hence using Margin of Stability as a varying gait parameter in the next phase of our final project we intend to create a feedback control loop using the Margin of Stability.

### **51. Synthesis of Naphthalene containing fluorescent derivatives**

Mehga Bajaj, Chemistry, IIT Gandhinagar

Mentor: Sriram Kanvah, Chemistry

Water-soluble, near infrared emitting naphthalene-based fluorescent boronic acid fluorophores were synthesised. These types of fluorophores with boronic acid or hydroxyl molecules can be conjugated to biomolecules like glucose or protein. It is expected that introduction of biological moiety into organic fluorophores enhances biocompatibility along with decreased toxicity and improved stability inside the cells.



### **52. Simulation of optical absorption spectra of gold nanorods, Methods of synthesis of Pd Nanoparticles, FBG interrogation methods and noise filtering techniques**

Mohammed Zia J, School of Photonics, Cochin University of Science and Technology

Mentor : Arup Lal Chakraborty, Electrical Engineering

This report contains three independent works which are written in the form of chapters in this report. Chapter 1 discusses the simulation of optical absorption spectra of gold nanorods using Mie and Gans theory and the simulation is done in MATLAB program. Chapters 2 discusses various methods of synthesis of Pd Nanoparticles and discuss the importance of synthesis of Pd NPs. Chapter 3 discusses different methods of interrogation of FBG and also discuss various noise filtering techniques employed to remove noise produced during interrogation of FBG using MATLAB.



### **53. Proposing Seismic Design Chart for Displacement in Cantilever Retaining Wall**

Mohit Singh, Civil Engineering, IIT Patna

Mentor: Amit Prashant, Civil Engineering

The main aim of this project is to propose seismic design charts for designing cantilever retaining walls. Such charts were developed by Franklin and Chang for the design of gravity walls for expected displacement using Newmark Sliding block theory. Design codes for cantilever retaining walls suggest the use of design charts applicable for gravity retaining walls considering soil above heel to be part of wall. Case studies have witnessed the formation of v-shaped rupture planes in the backfill which has been incorporated by the double wedge model. A design chart has been accordingly proposed analysing double wedge model for 153 ground motion data. The design chart with mean, standard deviation and maximum envelope has been proposed which can be used depending upon the risk that can be allowed with respect to seismic sliding displacements and can be easily adopted by the engineers.



#### 54. Methanol Steam Reforming for Portable Fuel Cell Systems

M Naveen, Mechanical Engineering, IIT Gandhinagar

Mentor: Atul Bhargav, Mechanical Engineering



In the present trend of depleting non-renewable resources, we need to find an alternative solution. Hydrocarbon based fuel cell systems are an alternative source of energy in the upcoming future as they combine the high thermodynamic efficiency of fuel cells with the infrastructure efficiency of hydrocarbons while maintaining low emissions.

Steam reforming is a method for producing hydrogen which can be provided to a hydrogen fuel cell. This is achieved in a processing device called a 'reformer' which reacts steam at high temperature with a hydrocarbon. In reformers, catalysts are used to improve the process and to maximize the yield of hydrogen.

This project aims to build and operate an experimental test rig which can qualitatively and quantitatively evaluate commercially available catalysts. In our experiment, conversion yield of catalysts are evaluated as a function of Temperature, Reaction Ratios and Residence time (GHSV - Gas Hourly Space Velocity). This experimental data could be used to carry out the reforming process efficiently in a commercial scale. This study may also benefit relevant people working in the same field to enhance their research studies.

#### 55. Study the effect of reducibility or non-reducibility and OSC (oxygen storage capacity ) of the prepared materials

Naveen Tak, MSc Chemistry, IIT Gandhinagar

Mentor: Sudhanshu Sharma, Chemistry



Four metal oxides  $\text{CeO}_2$ ,  $\text{TiO}_2$ ,  $\text{ZrO}_2$ , and  $\text{Al}_2\text{O}_3$  were prepared using Solution combustion method. Surface modification was done using 1M  $\text{H}_2\text{SO}_4$  and 1M  $\text{HNO}_3$ . Fourier transform infrared spectroscopy (FTIR) clearly shows the differences between these two (pure metal oxide and acid treated metal oxide). 2% Ruthenium (Ru) supported (Ru on metal oxides) were synthesized using formaldehyde as a reducing agent. Detailed characterization using X-ray diffraction (XRD), Brunauer–Emmett–Teller (BET) surface area measurement and transmission electron microscopy (TEM) will be carried out of these supported materials. Results of these techniques will be helpful in order to study the effect of reducibility or non-reducibility and OSC (oxygen storage capacity) of the prepared materials.

#### 56. Purification And Crystallization Of IMPDH & CD151

Neha Dhaka, Biological Sciences, National Institute of Science Education and Research

Mentor: Vijay Thiruvengatam, Biological Engineering

IMPDH (inosine 5' monophosphate dehydrogenase) is one of the key enzymes required for the de novo purine nucleotide synthesis. IMPDH controls one of the checkpoints in cell cycle as well as synthesize the guanine nucleotides which are crucial for cell cycle proliferation. It is the only pathway for synthesis of guanine nucleotide in *H. pylori*. The bacteria is responsible for severe gastric cancer. One of the ways of inhibiting the cell proliferation is by inhibiting the activity of this enzyme. Our aim is to isolate and purify and crystallize this enzyme, in order to find its structure, which can be used for studying it and drug designing. CD151 belongs to a class of membrane proteins Tetraspanin present in multicellular eukaryotes. It has two extracellular and four transmembrane domains. The N and C terminal of the loop lie in intracellular region. Role of CD151 and other tetraspanins has been shown, to be related to many crucial metabolic activities. Tetraspanins are highly conserved between species, which makes it

interesting for studying.

### **57. Overgrowth of Gold Nanorods in Ascorbic Acid An Experimental and Theoretical Study**

Parsanta Yadav, M.Sc. Chemistry, IIT Gandhinagar

Mentor: Saumyakanti Khatua , Chemistry

To study the growth or overgrowth mechanism of gold nanorods in ascorbic acid with CTAB, CTAB+Sodium Salicylate

### **58. Graph based image segmentation**

Pansetty Karthik, Electrical Engineering, IIT Gandhinagar

Mentor: Shanmuganathan Raman, Electrical Engineering

Image segmentation is an important part of Image Analysis. It is of great practical importance and has been the interest of research for a long time. Image segmentation has been very useful in tasks such as Object detection and recognition, content based image retrieval, video surveillance, traffic control systems, medical imaging and many other tasks.

Classical Image Segmentation techniques are based on color and edge detection. This edge or boundary is generally found out by taking the gradient in the image. In this segmentation technique, we construct the superpixels of the image and then build a graph from these superpixels and give them edge weights by setting a specific threshold. To segment this image, we cluster the graph into two clusters. Different clusters form different regions of the image. So, this way we get the segmented image.

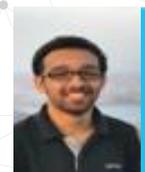


### **59. Solar Power In India: Past, Present and 2022 Off-Grid**

Parth Patel, Chemical Engineering, IIT Gandhinagar

Mentor: K. Chelvakumar, Mechanical Engineering

In a time where the use of non-renewable sources of energy is increasingly being questioned because of its adverse impact on the climate, the focus has hence shifted to renewable resources for a sustainable present and future. India ranks 8th in the world for solar potential measured throughout the year. With such abundance of this renewable energy, India has been pushing towards harnessing solar energy to achieve energy security for the country.



### **60. Person Re-Identification in dense crowd (Rath Yatra Dataset)**

Prakruti Joshi, Information and Communication Technology (ICT), DA-IICT

Mentor: Dr Shanmuganathan Raman, Electrical Engineering

We propose to develop a model for re-identification of a particular person in multi-camera system in dense crowds. We studied different machine learning techniques, neural network algorithms and image processing techniques and worked on problems like object detection, object counting in dense images, descriptor properties and integrated all these problems to solve the person re-identification problem. Due to problems like occlusion, perspective, clutter and few pixels per person, intensive appearance changes due to certain factors, counting and re-identification in densely crowded images is difficult. We have looked into descriptions, benefits, demerits and codes of certain techniques such as feature descriptors such as SIFT, Gaussian, HOG, Deformable Parts



such as ridge regression, SVM; Fourier transform for crowd analysis; interactive counting, Hierarchical Gaussian Descriptors for person re-ID, pedestrian detection problem, deep Convolutional Neural Networks(dCNN) using cosine distance etc. Till now we were working on existing data-sets. Now we will work on the Rath-Yatra 2017, Ahmedabad city data-set. We will apply the studied feature descriptors and learning methods and thus provide a person re-identification and crowd management model for security purposes in large crowds or public gatherings.

### 61. Metropolis Monte Carlo Simulation of the 2-D Ising Model

Prateek Verma, Chemical Engineering, IIT Gandhinagar

Mentor: Kaustubh Rane, Chemical Engineering

The 2-Dimensional Ising model is a model which represent interacting spins, whose properties are of importance. The model is particularly difficult to solve methodically and thus it requires us to make approximations and perform computational experiments. For the sake of efficiency, a modified Monte Carlo algorithm, known as Metropolis Algorithm is used. By the help of the programing interface MATLAB, the algorithm was implemented and used to measure several thermodynamic variables over the range of temperatures.



### 62. Manufacturing Landscape of Solar in India

Prathmesh Badve, Mechanical Engineering, IIT Gandhinagar

Mentor: Chelva Kumar, Mechanical Engineering

Government of India has set an ambitious goal of deploying 100 GW of grid connected solar power projects by 2022 under its National Solar Mission (NSM). This report extracts and summarizes salient facts from India's past and present solar energy activities.

The study spans from device technologies and production capabilities through modes of deployment. Present cell technologies and India's position are outlined. Design of a solar panel production plant is explained in detail. Major elements of plant design are identified and quantified. Problems faced by Indian manufacturers and customers are highlighted.



### 63. Deep Generative Models for Collaborative Filtering

Prince Roy, Mathematics and Statistics, IISER Kolkata

Mentor: Dinesh Garg, Computer Science and Engineering

In this project, our goal is to explore the use of non-linear models for col-laborative altering problems in general and two-sided ratings in particular. In recent times, it was shown that Restricted Boltzaman Machines (RBM) can be a good candidate choice when it comes to working with a non-linear model for collaborative altering problems. While the current-state-of-the-art explores the use of RBM for one sided ratings systems (Hinton, 2007) a popular class of collaborative \_ltering problems, we wish to extend the same framework to the case of two-sided rating problems. The motivation behind this work stem from several recent applications in the arena of sharing economy including ride sharing (Uber, Ola), apartment sharing (AirBNB), etc. Most of these sharing economy applications have a provision where both consumers as well as service providers both can rate each other and therefore, inferring the true quality of each agent in such a system becomes quite an important and challenging problem. In addition, we also want to explore another types of deep generative models namely, Generalised Adversial Network (GAN) for both one sided and two sided rating problems. GAN have gained phenomenal popularity in recent times due to their ability to produce new samples that



kind of networks could be useful for collaborative altering problems because we can use it to augment the training data-sets and also infer the ratings of users. Our hope is that at the end of this project, we should be able to develop a mathematical model for this problem as well as advance the state-of-the-art in this area.

#### **64. Solar Power in India: Past, Present and 2022 – India’s International Relations**

Priyang Priyadrashi, Material Science and Engineering, IIT Gandhinagar

Mentor: Kasivisvanathan Chelvakumar, Mechanical Engineering



This chapter deals with India’s recent history of developing solar cells and modules and thereby producing power. Facts that India possessed and the facts due to which India started its solar power production has been clearly mentioned in the chapter. International relations and mismatching between the policies may lead to proper shaping of the framework and better outcomes of the regarded work. Here India, provides numerous incentives for producing solar cell manufacturing industries in India, but it is being resulting into a turn out and the incentives are failing. One is able to get profits because of the incentives and sooner or later the prices are going to increase. Hence, these incentives are just the chance given to Indian manufacturers to enhance the technology of solar cell manufacturing and commercializing or lowering down to one’s economical feasibility will only lead to grid parity. Comparison between the development of solar technology and solar power production has been described in the chapter and depending on it, few best ways to reach marvelous goal of conserving solar energy has been written for the fortune of Indian Solar Industry.

#### **65. Interaction of Self-Aggregating Dimeric Carbocyanine Dyes with Duplex DNA**

Priyanka, Chemical Engineering, IIT Gandhinagar

Mentor: Bhaskar Datta, Chemistry



Cyanine dyes are used extensively as photosensitizers for color photography. Photo physical behavior of a novel dimeric carbocyanine dye is very different compared to the widely studied monomeric cyanine dyes by itself in solution as well as when upon interaction with duplex DNA molecules. We report the binding interactions of dimeric carbocyanine dyes with specific ATrich DNA molecules.

Cyanine dyes have high extinction co-efficient and high sensitivity for fluorescence. So, fluorescence measurements of cyanine dyes are very efficient for examination of biological material. Because of this property, the direct investigation of disease on a molecular level can be easily done. The dimeric dye shows dramatic shift in absorption behavior depending on size of DNA duplexes. Moreover we observe light increase in fluorescence which is in contrast to that observed in cases of monomeric cyanines. Experiments done for DNA helicity suggest that dye is not altering the DNA structure. Further, no helicity is rendered on the dimeric cyanines upon binding duplex DNA.

#### **66. Solar Power in India: Past, Present and 2022**

Puneet Swami, Civil Engineering, IIT Gandhinagar

Mentor: K. Chelvakumar, Mechanical Engineering

No abstract submitted!



## 67. Tone Mapping Operators

Purvik Shah, Vaibhav Patel, ICT, DA-IICT

Mentor: Shanmuganathan Raman, Electrical Engineering

Nowadays, some smartphones can generate HDR images with advance cameras. However, to observe the vastness in these images, an HDR display is needed. In the case of lack of such a display, different Tone mapping operators (TMO) are used instead. It converts HDR images to LDR images, which can be used to display on LDR images. There has been a lot of research in the direction of finding an optimal TMO. We'll be exploring the possibility of using a generative model to Tone map such images.



## 68. A Study of efficient algorithms for hard combinatorial optimization problems

Raj Rajvir, Computer Engineering, L. D. College of Engineering

Mentor: Neeldhara Misra, Computer Science and Engineering

The following components summarize the work done during my SRIP project:

1. Understanding tools for establishing the computational hardness of decision and optimization problems, and attempting hardness proofs for certain combinatorial games. This was done by following the course on Fun with Hardness Proofs<sup>1</sup> and working on the assignments. The problem that we attempting showing hardness for, but without success so far, was called Noodles<sup>2</sup>, which s out into a flow-type problem.
2. Reading about reconfiguration problems, especially for the Steiner Tree problem on special classes of graphs (in particular, interval graphs and split graphs). Here, the goal is to “gradually modify” one given solution to another given solution, or demonstrate that such a sequence of modifications is impossible.
3. Reading about the colorful components problem, where the goal is to remove a collection of edges from an undirected vertex-colored graph such that in the resulting graph all the connected components have no repeated colors.
4. Learning commonly used graph algorithms and fundamental results in graph theory by attending the ACM-India Summer School on Graph Theory and Graph Algorithms for the last three weeks of my stay. ACM-India Summer School on Graph Theory and Graph Algorithms for the last three weeks of my stay.



## 69. Modeling of Paper Pulp Drying Process

Rajat Ranjan, Mechanical Engineering, IIT Gandhinagar

Mentor: Atul Bhargav, Mechanical Engineering

Mod -roofs are composites made up of dry cardboard shreds , starch and natural fibers(followed by a an epoxy coating on the surface boundaries). These are proposed as a replacement to conventional kaccha house roof structures so as to provide effective protection . The industries currently involved in the production of these mod-roofs use air-convection based dryers as a drying technology for moisture removal. A set of challenges are faced by them including:

- ineffective core moisture removal
- long drying time
- the air convection based dryer takes up few mod-roofs at a time , thus leading to a low batch production rate.



Various other drying technologies have also been tested, but they come up with new challenges including high cost and uncontrolled heating.

Industries require a methodology that could provide optimum core moisture removal without causing unnecessary harm to the surface. Current research work aims to closely study the process of (mod-roof) drying through analyzing parameters like core moisture(or water) removal rate and rate of increment in surface temperature. The primary work involved simulation of the drying methodology through COMSOL 5.2a MULTIPHYSICS ( finite element method based simulation software). The software breaks down the domain into finite number of elements and calculates the required quantities at the node points of each element through direct or iterative solving approaches. Simulation process involved: Modeling of multiphase flow(air + water + vapor) inside a porous domain(mod-roof) , simulating evaporation of water within the pores , modeling of heating methodology(like convection or microwave heating) Goal of research : Simulate various industrial drying methodologies and analyze results by performing parametric comparison based on moisture removal rate, net drying time, increment in surface temperature etc.

## 70. Synthesis and characterization of pyrrole based compound

Rajvir Singh, Chemistry, IIT Gandhinagar

Mentor:Iti Gupta, Chemistry

Synthesis of two different type of dipyrromethane (DPM) has been performed. The procedure involves the reaction of an aldehyde with pyrrole in the presence of Trifluoroacetic acid (TFA). Further, these dipyrromethane was reacted with Bromo-Polyethylene glycol (Bromo- Peg); which results in the formation of Peg-DPM (Pegylated Dipyrromethane). Spectroscopic technique i.e. NMR, IR, Mass spectroscopy were used for the confirmation of product formation



## 71. Asymmetric $\alpha$ -alkylation of dienals

Rakesh Yadav, MSc. Chemistry, IIT Gandhinagar

Mentor: Chandrakumar Appayee, Chemistry

Making c-c bond is very important and fascinating area in organic synthesis. This can be one by organo catalyst as well as metal catalyst. But due to environmental hazards of metal, organocatalyst catalyst is getting popular. Asymmetric alkylation of dienals is a novel methodology. We have optimized reaction condition for asymmetric alkylation with different combination of acids, solvents and catalyst.



## 72. Saliency Driven Video Motion Magnification

Ramyani Ghosh, Computer Science and Engineering, PES University

Mentor: Shanmuganathan Raman, Electrical Engineering

Our surroundings under go very subtle changes that we can't detect with the naked eye. Motion magnification is an application which works towards amplifying the minor motion and colour changes in the video and making them visible to the naked eye. Previous motion magnification techniques amplify all motions present in the video which may result in a noisy amplified video because of large background motions. Our goal is to avoid this by applying the magnification only to the region of interest (ROI).The object of interest is detected using the concepts of saliency, scribbles, and image matting.



### 73. Non-linear analysis of geomorphic data

Reeta Murmu, Integrated Science, ISERC Shantiniketan

Mentor: Vikrant Jain, Earth Sciences

research both in modelling and in experimenting characterising geosystems over wide

range of scale. Bamsley, described a method for generation of fractal dimension with fractal interpolation using IFS method. Mareschal used an algorithm given by Bamsley for interpolating a fractal line between selected data points and this algorithm has been used to reconstruct synthetic profiles from a few given set. The main objective was to apply the IFS algorithm to topological profiles and try to estimate their fractal dimension.



### 74. Development of Oxygen Reduction Copper Based Catalyst by Synthesis of Redox Active Ligands

Shreya Sen, Msc. Chemistry, BIT Mesra Ranchi

Mentor: Arnab Dutta, Chemistry

Synthesis of inexpensive oxygen reduction reaction (ORR) catalyst with high catalytic activity and substantial stability are of huge importance for worldwide for efficient renewable energy usage. Pt and Pd-based materials are currently used as ORR catalysts but the high cost as well as huge energy loss during catalysis has inspired the scientific community to search for a better alternative. Naturally occurring enzyme multi-copper oxidase can be such an option, however its activity at narrow chemical space (pH 4-8) is not favourable for practical usage in proton exchange membrane fuel cell (PEMFC). Here in this work, we have incorporated enzyme-inspired amino acid based OCS to copper containing synthetic Schiff base complexes containing a redox non-innocent ligand. The formation of complex was determined from its UV-Vis Spectroscopy.



### 75. Interference in Skill Learning

Reshma Babu, Cognitive Science, IIT Gandhinagar

Mentor: Pratik Mutha, Biological Engineering

From the extensive adaptation and sequential learning literature, it is evident that interference plays a huge role during memory consolidation. There is a lack of literature when it comes to skill learning especially regarding consolidation. This exploratory project looks at whether skill learning follows the other paradigms with respect to the interference. Using skill tasks that would require different control policies to learn, interference was tested. Using the initial data, the preliminary analysis proves that in contrast to the other paradigms there is minimal interference observed when skill learning is involved. Further statistical analysis to test for significance and more extensive data collection is required to corroborate this finding.



### 76. Modeling of the Combustion of Solid Propellants

Rishabh Bhattacharya, Mechanical Engineering, IIT Gandhinagar

Mentor: Dilip Sundaram, Mechanical Engineering

The goal of this research is to conduct a comprehensive review of various high-energy materials and develop a combustion model for a chosen high energy material which can be used as an ingredient in propellants and explosives.



### **77. Analog Performance Comparisons of III-V and strained-Si in Double Gate FETs at Ultra-short Gate Length (12nm)**



Rohan Sengupta, Electronics and Communication Engineering, NIT Allahabad

Mentor: Nihar Mohapatra, Electrical Engineering

Nanoscale double gate n-MOSFETs with silicon and III-V (GaAs and InAs) channels are studied using numerical simulations. The device structures are simulated using the program NanoMOS, which uses the NEGF technique for treating the ballistic electron transport in the channel. Due to density of states bottleneck, III-V devices offer no performance advantage over silicon devices in the ballistic regime for digital logic applications. Here we compare the analog performance of silicon and III-V devices and the results indicate that the latter device gives significant advantage over the former in terms of intrinsic gain.

### **78. Stabilization of slopes using geosynthetics**



Rohit Gaur, Civil Engineering, IIT Roorkee

Mentor: Amit Prashant, Civil Engineering

The aim of this project is to propose a suitable design solution for stabilizing slopes using geosynthetics. Usually, engineers stabilize the slopes by providing retaining walls, soil nailing and other conventional techniques. Currently, a new technology has been adopted which makes use of geosynthetics type of material which have proved to be cost effective compared to the conventional methodologies. In this project, the emphasis was to understand the methods of stabilizing the slopes using geosynthetics. Accordingly, the mechanisms have been explored due to which such structures are susceptible to failure. In this direction, MSEW and GEO5 have been explored in detail and used to solve general slope stability problem. This work was further explored to solve a real-life problem at Gosikhurd Left Bank Canal near Nagpur, Maharashtra where in the canal embankment have undergone huge sliding displacements under the influence of swelling pressure of the embankment soil. A suitable cost-effective design solution has been proposed in which gabion mattress has been provided as lining and basal reinforcement.

### **79. Ising model-based toolkit to validate Monte Carlo Simulations**



Koripalli Rohith, Chemical Engineering, IIT Gandhinagar

Mentor: Kaustaub Rane, Chemical Engineering

Ising model consists of lattice with spins which can take only two values and these spins are able to interact with their nearest neighbours in an applied magnetic field. The Ising model can be in various required dimensions. This model is well studied and their standard results can be available in literature with which one will be able to validate Monte Carlo Simulations. The process is a code will be written in Fortran to simulate an Ising 2d model by using Monte Carlo Simulations. The obtained graphs will be compared to the standard available graphs and some probability functions in the algorithm will be replaced with some other suitable functions. Later the Fortran code will be parallelized on a Raspberry pi cluster to overcome some computational issues. My Fortran code is expected to calculate the macroscopic properties(average values) of Ising model by Monte Carlo simulations. Due to some debugging errors, my code is not able to calculate some of the goals in the project.

## 80. Mapping and Morphological Analysis of Lunar Craters

Roushan Kumar, Computer Science, IIITM Kerala

Mentor: Vikrant Jain, Earth Science



The moon does not have any atmosphere and its surface is covered by the craters and debris. These craters are the main source of data to characterise and study the surface of the moon. So to understand the characteristics and chronology, detail study of crater ( i.e. large as well as small one) is necessary. For this purpose mapping and spatial statistics of crater is needed which can be achieved by the software known as ArcGIS .Using ArcGIS, some of the topographic attributes is obtained e.g. elevation profile, slope, depth, aspect, hillshade,depth- diameter ratio of craters,which can be used to analyse characteristics of the crater and the impact of the various features or attributes on the crater age and destruction.Crater slope can be used to identify the stage of crater which is categorize in three stage i.e. a) young(high slope,depth ), b) adult(medium slope and less depth) and c) old(less slope and less depth) . The last stage of crater is considered as destroyed because of very less slope  $<10^\circ$  and depth $<50$  m.Slope plays a major role in the deformation of the crater as depth starts decreasing after some time period.Depth diameter ratio is used for the morphological classification of the craters

## 81. Development of cloud application for Intel Edison

Rutu A Patel, Electrical Engineering, Birla Vishwakarma Mahavidyalaya

Mentor: Arup Lal Chakraborty Electrical Engineering



Internet of Things (IoT) is the technology being used to interconnect various devices and collect and share data. IoT can be deployed for remotely accessing devices such as as temperature sensors in high temperature reactors. In the project work done during the internship, I present a method to interface temperature sensor LM35 with Intel Edison Board which is a dedicated controller and preferred choice for developing IoT based embedded system projects. The prototype developed, senses the temperature of the surrounding, and sends the data to AWS IoT platform for storage and processing. The system also contains a buzzer to signal when the temperature raises beyond the set value. This report also describes the various steps required to configure and use the Intel Edison development board which will serve to be a good starting point for students interested in exploring the Intel Edison board. Besides the developed system will prove to be useful for the various projects ongoing in the Photonic Sensors Lab. This system can be integrated with the gas sensing equipment that is being planned to be flown on a drone for measuring gas concentration levels at locations. The gathered data can be viewed on computer or mobile application in real time.

## 82. Methanol powered PEMFC system configuration evaluation

S.Santhosh, Mechanical Engineering, IIT Gandhinagar

Mentor: Atul Bhargav, Mechanical Engineering



PEMFC (Polymer Electrolyte Membrane Fuel Cell) converts chemical energy to useful electrical energy whose primary motive is same as that of a combustible engine; but the sole difference lies between the by-product of the energy harvesting process and cost factor. The running cost of a PEMFC system can be reduced by integrating FPS (Fuel Processing System) with PEMFC, where we process methanol to get hydrogen thus reducing the transportation and storage cost of the fuel. Further, the extra capital cost of FPS could be compensated by making the system self reliant with proper water and thermal management transforming the system that can produce both high grade heat and electricity; hence a CHP system. As first step a thermodynamic model had been designed using Aspen Plus software of both PrOx and methanation configuration incorporated with the V-I

curve (characteristic V-I curve generated using MATLAB to characterise the behaviour of fuel cell model with pre specified factors and parameters) and thermally balanced the simulation by varying  $\phi$  anode or by MeOH adjustment to burner. Part load studies had been conducted and results have been produced. Dependency of stack performance on various parameters like temperature, anode gas composition, anode and cathode stoichiometry had been studied.

### 83. Short Asymmetric Synthesis of Paraconic Acids

Sachin Giri, MSc. Chemistry, IIT Gandhinagar

Mentor: Chandrakumar Appayee, Chemistry

A short and convergent route for the asymmetric synthesis of paraconic acids has been developed. Asymmetric reduction was designed as a key step in this synthetic route using organocatalysis.



### 84. Synthesis of naphthalene derived porphyrins

Sachin Dev, MSc Chemistry, IIT Gandhinagar

Mentor: Iti Gupta, Chemistry

Synthesis of naphthalene derived A2B2 and A3B porphyrins have been done by acid condensation method. By doing substitution either at meso or beta position unstable behaviour of porphyrin can be stabilized.  $\pi$  conjugation of this phenothiazine which is highly electron rich can be increased by attachment of a naphthalene aldehyde moiety and then absorption will be more in comparison to normal porphyrin. These have make a highly conjugated system giving exposure to many applications and these porphyrins can act as good energy storage systems, as a sensitizer in Dye Sensitized Solar Cells. As well as in the field of biological sciences, these are playing as dye for biological labelling, light sensitizer in photodynamic therapy, for cell imaging. Synthesis of these porphyrins starts with synthesis of starting material Dipyromethane of N- Butyl phenothiazine and its acid condensation with naphthalene aldehyde to get the desired porphyrin and are purified with the column chromatography.



### 85. Human Dynamic Modeling

Saeed Aamer, Mechanical Engineering, Indian Institute of Technology Gandhinagar

Mentor: Vineet Vashista, Mechanical Engineering

A critical aspect of the development of prosthesis is the designing of a simple and effective human dynamic model which would enable simulation of human gait while altering parameters like mass and length of limbs as well as locking of joints. The process by which this is done is described in this report. Various existing dynamic models were studied to understand the human gait. A proposed single leg model is discussed, with a brief explanation of the inverse dynamics necessary along with measurement and application of motion capture data in analyzing the model. Such a model can be expanded to a more wholesome two leg model in the future.



### 86. Quadcopter Dynamics and Control

Sagar Gupta, Electrical Engineering, Indian Institute of Technology Gandhinagar

Mentor: Dr Vineet Vashista, Mechanical Engineering

Quadrotors are becoming very popular in the DIY zone but still the controlling aspects of the same still



remain bit tough to master for everyone. Research is going on to help device controllers that can either automatically locate their trajectories for specific goals or maybe even teach the pilot how to control the rotorcraft as he/she continues to use it. For being able to do some research on these lines my first goal was to understand the working of quadrotors by making one and also learn about how the conventional ones are controlled through the flight controllers so that then we have a clear idea regarding what all kinds of tweaks can be easily performed on the rotorcrafts for experimentation

### **87. Solar Power in India (Past, Present and 2022)**

Saksham Singal, Mechanical Engineering, IIT Gandhinagar

Mentor: K Chelvakumar, Mechanical Engineering

Jawaharlal Nehru National Solar Mission (JNNSM) has advocated a target of 100 GW of solar power by 2022. India's current solar capacity is a mere 12.29 GW of which 5.62 GW was added just last year. Meeting this gigantic target of 100 GW necessitates a continuous, abundant and affordable supply of solar equipment such as solar panel, inverter, junction box etc. The JNNSM target envisages a pronounced opportunity for indigenous solar equipment manufacturers by ensuring a constant demand for the next 5 years at least. This report deals with the subtleties pertaining to solar equipment manufacturing industry of India, knowledge of which is essential to capitalize on the newly opened frontiers.



### **88. Object Detection using Deep Convolutional Neural Networks Trained on Synthetic Data**

Sanchit Gupta, Computer Science, BITS, Hyderabad Campus

Mentor: Ravi Hegde, Electrical Engineering

Object detection forms one of the key elements of computer vision systems and their applications. And since the last few years, convolutional neural networks have become ubiquitous in the fields of image and video recognition, owing to their successful applications in analyzing visual imagery. Almost all modern day, state-of-the-art object detection models rely on convolutional neural networks (CNNs) to obtain exceptional results. But in spite of their remarkable performance, the convolutional neural networks suffer from a major drawback, the amount of training data they require. To yield acceptable results, a convolutional neural network requires a sizable and diverse amount of training data. Unfortunately, data collection and annotation is a time consuming and expensive task. One way to address this problem is to automate the whole process of data collection, thereby eliminating the time expending manual labor work. This project aims to show that a CNN trained on artificially generated data is able to perform satisfactorily on never seen real world data. To ensure greater scalability of this idea, the CNN's object detection potential was tested on food items packed in a refrigerator. This kind of scenario not only allowed for a greater variety of data with numerous parameters to tweak, but also proved to be a fine judge of the generalizing capability of our implemented CNN. All synthetic training images were rendered using Blender-API, and subsequently fed to a suitable CNN designed for object detection and classification. In the hopes of getting more insight into the functioning of the transfer learning pipeline, multiple state-of-the-art CNN's were tested and pitched against each other in terms of their object detection accuracy. In our findings, Faster R-CNN proved to be an excellent bound box predictor, with both, better visualizations and a higher mAP (mean average precision) of 57.85, when compared with other networks (or CNNs) on a single class object detection task.



### 89. Three Level Security for Non-Volatile Main Memory

Sanjith Athlur, Computer Science and Engineering, PES University, Bengaluru

Mentor: Manu Awasthi, Computer Science and Engineering



With increasing demands of larger capacity of main memory and due to poor potential of semiconductor technology scaling below 22nm, non-volatile memories are being proposed as alternatives to the current DRAM technology. Though advantageous in numerous ways, limited write endurance and data remanence as a threat to confidentiality pose serious downsides. It has been proposed to tackle the data remanence problem by encrypting the data in memory but it incurs heavy performance and power overhead apart from needing additional structures in hardware and increasing the number of writes. As the main memory capacity increases, these overheads are going to shoot up and the traditional mechanisms proposed to encrypt the entire memory will be very expensive. In order to mitigate these overheads, we propose a three level security mechanism by trading off security by different extents possible. The three levels from the least secure to the most being (1) page table encryption, (2) entropy based selective encryption and (3) complete encryption. Any one of the appropriate level can be chosen by the user based on the sensitivity of the data that needs to be protected and the level of security that is needed.

### 90. Preparation of Ruthenium-polypyridyl photosensitizer system for solar driven hydrogen production

Sarla yadav, Msc Chemistry, IIT Gandhinagar

Mentor: Prof Arnab Dutta, Chemistry



Hydrogen as source of energy is now the demand of hour. Nature has its own ways of producing hydrogen such hydrogenase enzymes which is known as efficient to produce hydrogen. Ruthenium polypyridyl complex has been used as photosensitizer to harvest solar energy. Here we want to synthesise ruthenium polypyridyl-cobalt complexes in which cobalt will be coordinated to moiety having functional groups with proton availability, which will be readily available for synchronous proton donor, and hence eases hydrogen production. Mentor: Prof Arnab Dutta, Chemical Engineering

### 91. Scour Around Bridge Pier

Sarthak Mittal, Civil Engineering, IIT Gandhinagar

Mentor: Pranab Mohapatra, Civil Engineering



In this research project we are focused on the topic 'Scour around bridge pier'.

Here we are intended to find out the basic terminology and theory related to scour and its process, how does the change in various parameters affect the scour depth, how do we measure the scour depth and formulate it, and lastly how can we reduce the scour depth for the safety of bridge pier. For this we have performed an experiment to see how closely our result resembles that of theory proposed by various scientists and we want to calculate the error in our measurement. Further we need to propose our method of reducing the scour depth.

## 92. Estimation of proprioceptive states on simultaneous learning of two different perturbations



Seemadri Subhadarshini, Biotechnology and Medical Engineering, NIT Rourkela

Mentor: Pratik Mutha, Biological Engineering

In our day to day lives, we often come across constant environmental changes and our brain is characterized by its ability to adapt to these perturbations. This ability to adapt can be tested by introducing known perturbations in the movement time, movement sequence or a combination of both. Motor learning, in particular motor adaptation, is driven by information from multiple senses. For example, when arm control is faulty, vision, touch, and proprioception can all report on the arm's movements and help guide the adjustments necessary for correcting motor error. In recent years we have learned a lot about how the brain integrates information from multiple senses for the purpose of perception. Goal-directed reaches are rapidly adapted after reaching with misaligned visual feedback of the hand. It has been suggested that reaching with misaligned visual feedback of the hand also results in proprioceptive recalibration. Proprioceptive recalibration is realigning proprioceptive estimates of hand position to match visual estimates. Here, we wish to find whether learning two opposing visuomotor perturbations will recalibrate the proprioceptive estimates separately for each perturbation or there will be no change in the estimates.

## 93. Detection of formaldehyde



Shatarupa Bhattacharya, Life Sciences, Presidency University

Mentor: Arnab Dutta, Chemistry

Formaldehyde (HCHO) is a flammable colourless substance, which is soluble in a range of solvents such as water, ethanol and diethyl ether. The formaldehyde is generally found either in solution or in polymerized form named paraformaldehyde [(HCHO)<sub>n</sub>]. Formaldehyde is widely used in industries especially in textile and food industry. Formaldehyde poses a high risk to human health on consumption beyond limited amount. Hence the primary motive behind this project was to identify a more usable form of formaldehyde detection in practical environment.

Most commonly formaldehyde is detected by chromatographic and spectroscopic methods however none of them is user friendly. Moreover we have aimed at detecting formaldehyde at a very low concentration (~ 1mM) which is rarely detectable by usual methods. In this work, we have modified a reported fluorescent dye to develop a readily usable formaldehyde detection method.

## 94. Effective techniques for slope stabilization of Expansive Clayey Soils



Shirali Prajapati, Civil Engineering, IIT Bhubaneswar

Mentor: Amit Prashant, Civil Engineering

The aim of this study is to provide efficient and effective design solution for the stabilization of slopes with expansive soils. It has been extracted from many case studies that this soil has been problematic for many structures owing to its swelling shrinkage behavior. Literature has witnessed the failure of many embankments due to swelling of such soils in presence of water which was not dissipated due to poor drainage. In this study, the behavior of such embankments was studied and accordingly geosynthetic material has been provided for its stabilization proper drainage has been ensured. Geo5 and ReSlope has been explored to perform analysis of such slopes. Different design solutions were analyzed to solve a real-life project of canal embankment at Nagpur site. The merits and demerits of these solutions were looked upon in detail. Finally, a suitable and cost-effective

and flexible gabion mattress has been provided as canal lining. Also geocomposite has been suggested in the solution to be provided as drainage media.

### 95. FBG spectral shifts on a glove

Shivang Agarwal, Electrical Engineering, IIT, Gandhinagar

Mentor: Arup Lal Chakraborty, Electrical Engineering



The aim of the project was to work towards the making a glove that would monitor finger movements by sticking Fiber Bragg Gratings (FBGs) on the glove for rehabilitation and entertainment purposes, and thus quantizing its spectral shifts based on different positions of the fingers. FBGs are periodic variations of the modulation index in a short segment of an optical fiber . As light propagates through this modulated structure, Bragg diffraction causes a band of wavelength to be selectively reflected. The peak wavelength of this band is called the 'Bragg wavelength'. Its value depends upon grating period, i.e. the periodic modulation of its refractive index, which can be influenced by changes in temperature and applied strain on the grating. The FBGs were stuck on a finger of a 3D-printed hand in a particular way so as to effectively monitor the effect of strain generated in the fiber on bending the finger. As strain was generated, the FBG spectrum would shift and accordingly its peak wavelength would change. Accordingly, these wavelength shifts were monitored with respect to the angle of bend of a finger. The shifts were monitored using a Mach Zehnder interferometer. The acetylene line at 1530.371 nm was used as an absolute wavelength marker. The interferometer output has distinct peaks equidistant in the frequency domain, which were used to quantify the wavelength shifts of the FBG spectrum. It was observed that for the given experimental setup, each bend of 5 degrees was distinguishable in terms of corresponding wavelength shifts. A characteristic non-linearity was observed when the readings were plotted. The next step would be to perform the same experiments on human hands.

### 96. Insight into energetics of carbohydrate-protein interaction: A DFT study

Shivansh Kaushik, Msc. Chemistry, IIT Gandhinagar

Mentor: Sairam S. Mallajosyala, Chemistry



The aim of the project was to work towards the making a glove that would monitor finger movements by sticking Fiber Bragg Gratings (FBGs) on the glove for rehabilitation and entertainment purposes, and thus quantizing its spectral shifts based on different positions of the fingers. FBGs are periodic variations of the modulation index in a short segment of an optical fiber . As light propagates through this modulated structure, Bragg diffraction causes a band of wavelength to be selectively reflected. The peak wavelength of this band is called the 'Bragg wavelength'. Its value depends upon grating period, i.e. the periodic modulation of its refractive index, which can be influenced by changes in temperature and applied strain on the grating. The FBGs were stuck on a finger of a 3D-printed hand in a particular way so as to effectively monitor the effect of strain generated in the fiber on bending the finger. As strain was generated, the FBG spectrum would shift and accordingly its peak wavelength would change. Accordingly, these wavelength shifts were monitored with respect to the angle of bend of a finger. The shifts were monitored using a Mach Zehnder interferometer. The acetylene line at 1530.371 nm was used as an absolute wavelength marker. The interferometer output has distinct peaks equidistant in the frequency domain, which were used to quantify the wavelength shifts of the FBG spectrum. It was observed that for the given experimental setup, each bend of 5 degrees was distinguishable in terms of corresponding wavelength shifts. A characteristic non-linearity was observed when the readings were plotted. The next step would be to perform the same experiments on human hands.

## 97. Understanding the protein-surface interactions through Molecular Simulations

Shreya Mathur, Industrial Chemistry, IIT Varanasi

Mentor: Mithun Radhakrishna, Chemical Engineering



Recent advances in computer software lead to developments in the successful molecular simulations of protein structural dynamics and these molecular simulations yields results that increasingly agree with experimental observations. Here, we study the effect of temperature and surface hydrophobicity on protein (in the framework of a hydrophobic-polar H-P lattice model ) and its energy. Proteins perform a vast array of functions including catalyzing .So their property can be enhanced when they are mobilized on the surface. For the study of protein adsorption on flat surfaces, two impenetrable surfaces were modeled in the xy plane, one placed at  $z = 0$  and the other placed at  $z = z_{max} = 43$ , with periodic boundary conditions imposed in the x and y directions. The surface at  $z=0$  is hydrophobic and now the interactions at different relative temperature and with different hydrophobicity were recorded which show us that with increasing surface hydrophobicity both internal energy of protein and surface energy increases.

## 98. 3D PAINTING - A Software To Paint In A 3D Virtual Environment

Soham Kulkarni, Computer Science and Engineering, IIT Bhubaneswar

Mentor: Uttama Lahiri, Electrical Engineering



The issues with the upper limb movement of a stroke patient or an elderly person, related to abduction and adduction skills are very critical for performing Activities of Daily Living (ADL). The conventional rehabilitation often has a rigid design and the repetitive exercises also turn out to be monotonous for the patients undergoing rehabilitation. The use of technology assisted can be potent to address such issue. For example, Virtual Reality (VR) can provide flexibility to the designer to design and develop various rehabilitation exercise platforms aimed to scaffold skills related to ADL activities, which often turn out to be motivating for the participants.

## 99. Source Printer Identification using CNN

Vivek Goyal, Computer science, Vellore Institute of Technology

Mentor: Nitin Khanna, Electrical Engineering

Today, with the advancement in the technology, the identity documents or any original document can be scanned and easily modified and misused. This forgery can even lead to some criminal act. It is important to devise a method that can authenticate a document for its source. Existing work focuses on this issue and presents a method that can detect the original source of a document by characterizing the features that are obtained from the content of the document. The method proposed in this work focuses on this issue and presents a method that can detect the original source of a document by characterizing the features that are obtained from the content of the document. The method proposed in this work focuses on increasing the efficiency of the method earlier presented by Ferreira et. al. The previous method uses Convolution neural network to extract features from the character images extracted from a page. These features are fed into SVM Classifier to characterize the pages for their source printer. The images used as input in the previous work are of fixed size. The proposed work also uses Convolution Neural Network for feature extraction and SVM classifier for classification, but additionally, the proposed method is capable of taking input images of variable sizes. The Spatial Pyramid Pooling is used to enable input from the variable sized images. Enabling variable sizes in input prevents the deletion of any features from the image and hence improves the characterization. An increase in accuracy is observed from the results as compared to previous work keeping the dataset and training parameters as same as previous work.

### 100. A study of some quadrics

Sudip Pandit, Mathematics, IIT Gandhinagar

Mentor: Indranath Sengupta, Mathematics

Let  $K$  be a field and  $X, Y$  denote matrices such that, the entries of  $X$  are either indeterminates over  $K$  or 0 and the entries of  $Y$  are indeterminates over  $K$  which are different from those appearing in  $X$ . We consider ideals of the form  $I_1(XY)$ , which is the ideal generated by the  $1 \times 1$  minors of the matrix  $XY$ . We have tried to compute a Gröbner basis for the ideal  $I_1(XY)$ , where  $X$  is an alternating matrix. We have also tried to understand whether the quotient ring  $K[X; Y] = I_1(XY)$  admits some ASL structure or not.

### 101. Stabilization of slopes using Geo-synthetics and chemical treatment

Sumit Kumar Nandan, Civil Engineering, IIT Patna

Mentor: Amit Prashant, Civil Engineering



The main objectives of this study are investigation of potential failure mechanisms, determination of the slope sensitivity to different triggering mechanisms, designing of optimal slopes with regard to safety, reliability and economics and designing possible remedial measures. In this study, ReSSA (3.0) (Unreinforced and reinforced slope stability analysis) has been explored in detail to analyze and design slopes under general conditions. A real case study on canal embankment of expansive soil has been studied wherein the canal embankment has undergone significant sliding displacements due to huge swelling pressures. Different existing solutions involving chemical and mechanical stabilization have been explored in detail to solve this problem. All suggested designs have been analyzed by the software and factor of safety parameters with respect to overturning, sliding, bearing capacity and global stability have been verified. A suitable solution has been proposed wherein 20% fly ash material has been suggested to be mixed with expansive soil. This has ensured significant reduction in the swelling pressure getting exerted on the canal bank.

### 102. Rapid Design of Wide-Area Heterogeneous Electromagnetic Metasurfaces beyond the Unit-Cell Approximation

Surabhi Girish Purohit, Electronics Engineering, Birla Vishwakarma Mahavidyalaya Engineering College

Mentor: Ravi S. Hegde, Electrical Engineering



We propose a novel numerical approach for the optimal design of wide-area heterogeneous Electromagnetic Meta surfaces beyond the conventionally used unit-cell approximation. The proposed method exploits the combination of Rigorous Coupled Wave Analysis (RCWA) and global optimization techniques (two evolutionary algorithms namely the Genetic Algorithm (GA) and a modified form of the Artificial Bee Colony (ABC with memetic search phase method) are considered). As a specific example, we consider the design of beam deflectors using all-dielectric nanoantennae for operation in the visible wavelength region; beam deflectors can serve as building blocks for other more complicated devices like metalenses. Compared to previous reports using local optimization approaches our approach improves device efficiency; transmission efficiency is especially improved for wide deflection angle beam deflectors. The ABC method with memetic search phase is also an improvement over the more commonly used GA as it reaches similar efficiency levels with upto 35% reduction in computation time. The method described here is of interest for the rapid design of a wide variety of electromagnetic metasurfaces irrespective of their operational wavelength.

### 103. To synthesis and optimization of highly Pi-conjugated thiol fluorophores

Surya Pratap Singh, M.Sc Chemistry, IIT Gandhinagar

Mentor: Dr.Sriram Kanvah, Chemistry



A thiol containing fluorophores having stilbene linkage exhibiting interesting property when bind with gold and silver (coinage metals). Thiol fluorophores are highly conjugated molecules having intense fluorescent colour and fluorescence properties. Thiol fluorophores can be use as a organic additive in preparation of gold nanorods. They can change the size and shape of the nanorods . The LSPR( Longitudinal surface plasmon Resonance) and TSPR (Transverse Surface Plasmon Resonance) can also be change by this molecule.

Thiol fluorophores can be used in biological properties because sulfur has great tendency to make sulfur-sulfur linkage. In biological compounds which contain sulfur, these fluorophores can bind with sulfur containing biological molecules and we can detect these type of linkage because thiol fluorophores gives intense fluorescent colour.

### 104. Ecotourism in Gujarat

Swara Joshi, Humanities & Social Sciences, IIT, Gandhinagar

Mentor: Ambika Aiyadurai ,Social Sciences



Ecotourism is based on the idea that the conservation of nature should be practiced along with well-being of local communities and sustainable development. It tries to achieve the dual goals of preserving environment and also taking care of the needs of the local communities. The larger goal is to engage the local communities in ecotourism projects by providing them livelihoods, increasing their skills, as well as to develop in practices that are compatible with the local culture, architecture and that are eco-friendly.

In this Summer Internship, I assessed the role of the local communities involved in ecotourism projects in the state of Gujarat. Gujarat is increasing becoming a key player in shaping ecotourism in India. It has successfully implemented ecotourism projects in various parts of the state but the role played by the rural communities in these projects is yet to be examined in detail. The aim of this research project is to assess the role of local communities and to gain a sociological understanding of ecotourism in Gujarat. The study presents an overview of three models in Gujarat: Ganeshpura farm (SEWA, Mehsana), Gir forest (Saurashtra) and Kutch desert (Northwest Gujarat). During the study, field visit was made to a ecotourism site managed by Self Employed Women's Association (SEWA) at Ganeshpura. This is an example of community-driven ecotourism site where the decision is taken by the local village women and the profit is shared by the group. This is a farm-based ecotourism centre where the emphasis is on green livelihood initiatives and tourists get an experience of local village life. Compared to a mega-touristic enterprise such as the Gir or Kutch where the focus is on the charismatic species such as Asiatic Lions or the mystic landscape of the Kutch, Ganeshpura operates at a small scale and at a nascent stage where it is wholly managed by rural women. This internship is part of the large project which will continue in the future where empirical data will be collected through an extended field trip.

### 105. Interaction of biologically relevant G-quadruplex DNA with novel dye

Swarnalata Parua, M.Sc Biotechnology, Hemchandracharya North Gujarat University

Mentor: Dr Bhaskar Datta, Chemistry



G-Quadruplexes play a vital role in biological systems, such as telomere maintenance, replication, transcription and translational processes. These structures are highly dynamic and the variations in the stability and (or) conformation of these structures are linked to lethal diseases like cancer and several neurodegenerative diseases. Cyanine dyes are bright fluorescent molecules and are among the well-known class of synthetic molecules for nucleic acid detection. In this work we have studied the binding mechanism of a dimeric cyanine dye in identifying shuttle variation in G-quadruplex structures formed by C-Kit, C-Myc, K-RAS and human telomere oligonucleotide sequence. Bis-DISC4 +2, show 2.2, 3.5, 5.6 fold fluorescence enhancement in presence of human telomere compared to C-Myc, KRAS, C-Kit. This work presents an interesting result of a GQ ligand.

### 106. Seismic Analysis of Suspended Ceiling System

Tarun Sharma, Civil Engineering, IIT Gandhinagar

Mentor: Manish Kumar, Civil Engineering



Past studies on seismic events, followed by experiments and analytical studies have improved the design and performance of the buildings, dams, bridges etc. However, the lack of consideration for protection of nonstructural components in the buildings has brought poor performance in the past earthquakes. Nonstructural elements sum up to 70% of the overall building cost, especially in the cases of hospitals, hotels and commercial buildings (C. V. R. Murty et al., NICEE 2013). Failure of these elements may resist the functionality of the building and may also be life-threatening to humans.

Damages and failure of suspended acoustic ceilings have been widely reported in the past seismic events due to poor design and experimental studies. In this study, an analytical model of a system with one acoustic tile, T-shaped runner grid and hanger wires (model 1) and suspended ceiling of area 144 ft<sup>2</sup> (model 2) were developed based on the industry standards using a mechanical simulation software, ANSYS 17.2 (SAS IP, Inc.). Fifteen sets of ground motion with different intensities each of peak ground acceleration (PGA) 0.3g, 0.8g, 1.3g, 1.8g, and 2.3g were applied in the three mutually perpendicular directions to model 1 for seismic analysis. The result was obtained in the form of probability curve for total failure (total collapse of the ceiling, vertical uplift higher than 38mm for model 1) as a function of the PGA. Vertical uplift of the tile was found to be increasing with PGA but varying with intensities at same PGA. The probability equals one was found above 2.3g PGA for the failure of model 1.

Detailed modelling and other failure parameters such as displacement of T-runner, friction, etc. need to be incorporated in the model, to obtain more significant results. This study considers unbraced system, analysis of the braced system should be performed in the further study.

### 107. Design of Cable Driven Locomotive Mechanism for a Mobile Robot

Tushar Pareek, Mechanical Engineering, IIT Gandhinagar

Mentor: Vineet Vashista, Mechanical Engineering



The focus of this project is designing an innovative locomotive mechanism for a mobile robot with the use of cables. Initially literature survey has been done on specific robotics research papers. Then different permutations and combinations with varying number of cables have been considered with 1, 2, 3 and 4 degree of freedom mechanisms considering it as a multi linked structure. Pertaining to each case, statements comprising of similarities, comparisons and other factors are mentioned

alongside the figures. Then, use and effects of passive springs are considered and mathematical analysis is briefly explained regarding specific cases to explain the idea of Quantification of Workspace. This work tries to implement the fundamental of cable driven robotics to design an improved locomotive mechanism for a mobile robot.

### **108. Self Oscillating Polymeric Gels**

Vinay Karwa, Polymer Engineering, Institute of Chemical Technology, Mumbai.

Mentor: Pratyush Dayal, Chemical Engineering

The BZ Gels is one of the most recent research topics that is being studied only in five countries of the world. My motivation besides studying it was BZ Gels like Heart Beats, Muscle Tissues, Glycolytic Oscillators, Neural Oscillators. The main objective was to model the BZ Gels and determine the limit point cycle where the stable and unstable limit cycles will collide. My approach is to understand the mechanisms and the models of the BZ reaction, understand the BZ reaction in polymeric gels and model the above knowledge. The main aim besides developing them was to design materials that can sustain large amount of interconversion of energy. They can convert mechanical energy to chemical energy and vice versa. Their main applications are biomimetic actuators, soft robots, cilia, flagella. After solving the differential equations of Orgenato Model using C++ it was found that results through C++ converged with those through matlab. And for plotting the Limit point cycle, to verify its nature and its intersection with hopf bifurcation curve, epsO values are found out( where the stable and unstable limit cycle collide) for a specific range. It concluded that even above hopf bifurcation curve( plotted using epsH values) there exists points where limit cycles collide i.e. oscillations do exist. And also , the three variable orgenator model was simulated and understood.

### **109. An intersection between Cognitive and Computer Vision**

Viraj Mavani, Electronics and Communication, L. D. College of Engineering

Mentor: Shanmuganathan Raman, Electrical Engineering

Emotion recognition tasks require background of both cognitive and computer vision and can be put to use in various different systems. Facial Expressions consist of Action Units (AU's) which can be used to recognize emotions. Emotion Recognition is also important in various Human Computer Interaction applications. For this, I developed an algorithm to morph different faces to create expressions of varying intensities and I also trained a conventional Convolutional Neural Network named AlexNet to classify 8 different emotions viz. angry, contemptuous, disgusted, fearful, happy, sad, surprised and neutral. Image Saliency is a concept which states that there is an intensity map of any respective image which showcases the areas where any general human being would look at. This problem from cognitive science has been tackled by computer vision researchers by using eye-tracking data collected from gaze tracking modules. Merging the saliency maps and portrait face images, we intended to train the CNN architecture in such a way that it learns how humans interpret emotions by looking at facial expressions.



### **110. Microstructure Development in Mg-Al alloys during Homogenization**

Yash Shukla, Metallurgical Engineering, IIT (BHU), Varanasi

Mentor: Manas Paliwal, Material Science and Engineering

Thermodynamic and kinetic knowledge is indispensable to understand the microstructural development of alloys. The development of solidification, diffusion and precipitation



simulation models for Mg and Al alloys have been used to predict the evolution of as cast and homogenized microstructure. The new alloy development requires the tailoring of the homogenization and final aging treatment conditions for better combination of mechanical properties. In certain heat treatments, the homogenization or redistribution of solutes, dissolution of secondary phases and precipitation of new phases can occur concurrently.

In the present study, we intend to study the microstructure development in Mg-9 wt. pct. Al alloy during homogenization and dissolution processes. Concurrently, homogenization experiments will be performed for Mg-9 wt. % Al followed by microstructure characterization using SEM and EPMA. The experimental data will be used to validate the results from the one-dimension homogenization model based on diffusion simulation and fine tune the model if required.





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