



INDIAN INSTITUTE OF TECHNOLOGY, KANPUR
CENTRE FOR CONTINUING EDUCATION
SURGE Program



SURGE 2020 Annual Report



Students-Undergraduate Research and Graduate Excellence

Message from Head, Centre for Continuing Education

Dear SURGE Friends,

Congratulations to all the 2020 SURGE fellows and their mentors on another successful summer!

The success of the program has been possible due to hard work of SURGE fellows, enthusiastic and dedicated faculty mentors, excellent support provided by staff members, and financial support by our illustrious alumni.

A record number of approximate 1000 applications were received from different colleges and 69 excellent students from different institutions and from IITK were joined the SURGE programme in online mode.

I would like to congratulate all the members of SURGE family who made this summer so successful. Thanks to the SURGE Core Committee, for their invaluable leadership. Thanks to the all mentors who took time out of their busy summers to direct the boundless energy of SURGEians down the most illuminating path.

Finally, thanks to all of the friends and alumni whose donations help make SURGE financially possible. I applaud all of your tremendous generosity and look forward to your continued support.

Helping support the next generation of innovators is truly an investment in the future!

Thank you!

Rajesh M. Hegde

Head, Centre for Continuing Education

SURGE Program – An Overview

IIT Kanpur launched an 8-week SURGE (Students-Undergraduate Research and Graduate Excellence) program in the summer of 2006. Under this program, a small number of selected undergraduate students from top engineering colleges from all over India are given an opportunity to explore research and to experience the academic atmosphere of IIT Kanpur. Students in second and third year of their academic program are selected from a large pool of applicants. The students get selected on the basis of their academic record, their research proposal & their technical achievements.

Under the SURGE program, students undertake short duration, but focused on research project and push their intellectual abilities beyond those driven by the classroom.

This year due to COVID pandemic guidelines, students were unable to come at IIT Kanpur campus, so to make summer internship feasible surge program was converted into online mode. The Institute has recommended MookIT as favourable online platforms for creating e-resource for Lecture notes. Weekly work reviews by the professors through meetings was done. The interns were asked to keep their work updated on MOOKIT platform. The SURGE participants were required to give a mid-term report after six weeks, to a review committee consisting of a group of academic staff members. At the end of the program all the SURGE students were asked to make a short video and explain about all the work carried out at IITK which was then evaluated by faculty members.

This year (in 2020), One SAARC student (from Nepal) was selected under SURGE program

Few selected students are given stipend, all students are given a commendation certificate and those who produce exceptional quality research are given an award in addition to the certificate.

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Funding SURGE

The Dean of Resources and Alumni Office raises funds to support SURGE students from a variety of sources including gifts from individuals, foundations, and corporations. SURGE depends upon the generosity of its many friends for annual gifts or for contributions to the SURGE endowment to build a robust financial base. We thank the donors who have supported SURGE 2020 and beyond! Endowments help to ensure the future of the SURGE program and provide students with unparalleled research opportunities.

Special Thanks to: Batch 1977 and 1980, Shri N R Narayana Murthy

Project Funded

This year 15 students received stipend from institute projects (The suggested stipend for 8 weeks' duration is between Rs. 8000 to Rs. 12500).

Self-Funded

This year 54 students were selected in SURGE Program under the self-funded category.

Opportunities still available for new endowments

Individuals or batches may support in several ways to establish endowments—they may be paid in full at creation, given in instalments over a period. The contributors can be proud of the investment they have made in the future of bright and talented students, and the donors gain the personal satisfaction from playing an important part in the formation of young people, many of whom will make significant contributions to the nation and the world.

Participants of SURGE 2020 from IITK

S.N.	Name	Mentor	Project Title
1	Abhishek bansal	Dr. Vipul Arora	Deep Learning for P300 based character recognition
2	Akansh Agrawal	Dr. B. Bhattacharya	Modelling of MEMS based Microfluidic Device for the segregation of CTCs and WBCs
3	Akshan Agrawal	Dr. B. Bhattacharya	Modelling and Designing of MEMS based Microfluidic Segregation System for Circulating Tumour Cells from Leukocytes in the Whole Blood
4	Anshika Chaudhary	Dr. Anandh Subramaniam	Finite Element Studies on Semi Coherent to Semi Semi Coherent Transition of Precipitates in Crystalline Materials
5	Anshul Agrawal	Dr. Vipul Arora	Detecting auditory attention to instruments in polyphonic music by deep learning on EEG signals
6	Anshuman Das	Dr. Tanmoy Mukhopadhyay	Morphing Aerofoil and Optimal Shape Prediction for Various Flight Conditions
7	Aryan Sinha	Dr. Tanmoy Mukhopadhyay	Design and Analysis of Kirigami based auxetic cellular metamaterial
8	Ayushi Goyal	Dr. Vishal Agarwal	DFT study of effect of ZrOx on CO2 Hydrogenation to Methanol
9	Gopal Bhaskar	Dr. Shikhar Krishn Jha	Image processing using machine learning for boundary identification.
10	Ravi Prakash Tripathi	Dr. Lalit Saraswat	Selves Within The Self

11	Sampada Sinha	Dr. Siddhartha Panda	Detection of Heavy Metals.
12	Sanket Garg	Dr. Nitin Gupta	Neuronal Tracing
13	Shivi Gupta	Dr. Shilpi Gupta	Simulating photonic devices and integrated circuits using finite-difference time-domain method
14	Smriti Chhattani	Dr. Pranamesh Chakraborty	Visualizing LSTM networks for Traffic state prediction
15	Soham Ghosal	Dr. Anurag Tripathi	Granular Flow In COMSOL

Participants of SURGE 2020 at IITK from Other Universities

S.N.	Name	Institute Name	Mentor	Project Title
1	Abinandhan M	NIT, Tiruchirappalli	Dr. Rakesh Kumar	A study on the effects of bulk viscosity on compressible flows
2	Achal Vinod	Shiv Nadar University	Dr. Joydeep Chakraborty	Reading Course on Quantum Mechanics
3	Additi Pandey	Jesus And Mary College, University Of Delhi	Dr. DLVK Prasad	Exponential, logistic and power law growth pattern of CoVID 19
4	Aditya Dhankhar	Thapar Institute Of Engineering And Technology	Dr. Ramkumar J	Study on Green Energy and Manufacturing applications
5	Akshay Rajesh Deodhar	College Of Engineering, Pune	Dr. Swarnendu Biswas	Unsupervised Clustering for SpMV Format Selection
6	Ananya Mohapatra	NISER	Dr. Mahendra Kumar Verma	Exploration of Energy Transfers in KdV Equation
7	Aniket Raj	MMMUT	Dr. Anoop Singh	A Study on Household Energy Consumption Pattern using Smart Meter Data Analysis
8	Anish Singh	RTU	Dr. Rakesh Kumar	Numerical study of the interaction of a supersonic jet with a corrugated wall
9	Ankur Mallick	IEST, Shibpur	Dr. A. K. Singh	Capturing the effect of strain rate on the evolution of microstructure and texture in metallic materials using Visco Plastic Fast Fourier Transform based crystal plasticity simulations
10	Anshumali jaiswal	MANIT, Bhopal	Dr. Anubha Goel	Examination of variation in incense composition and analysis of chemical characterization of emissions from incense burning

11	Anubhav Joshi	RTU	Dr. Rakesh Kumar	Bulk viscosity estimation
12	Arpan Sow	Jadavpur University	Dr. Ashoke De	Droplet Heating and Evaporation
13	Ayush Raj	NIT, Tiruchirappalli	Dr. Ramkumar J	Modeling and simulation of magnetic abrasive finishing (MAF) process
14	Damanpreet Singh Monga	Panjab University	Dr. Akash Anand	Fourier extensions and accurate approximation of functions by trigonometric polynomials
15	Debanjana Chakraborty	SRMIST	Dr. Anubha Goel	Review of indoor air purification techniques to remove prominent pollutants in indoor microenvironments
16	Deeksha M Hegde	NIT, Surathkal, Karnataka	Dr. DLVK Prasad	Structure and multiscale modeling of SARS CoV 2 spike glycoprotein, potential epitopes and drug binding sites
17	Diganta Ghorai	National Institute Of Fashion Technology	Dr. Ritwij Bhowmik	Visual Experience Using Moving Images
18	Divyanshi Dixit	NIT Warangal	Dr. DLVK Prasad	Semiempirical quantum chemical calculations to understand the electronic structure of H ₂ O and H ₂ O ⁺ from the view point of hydrogen bonding and electron lone pairs.
19	Irin Talukdar	Jadavpur University	Dr. A. K. Singh	Study of multi-component alloys using classical molecular dynamics simulations
20	Ishan Tiwari	RTU	Dr. Rakesh Kumar	Bulk viscosity effects and estimation
21	Jigar Hitendrakumar Panchal	Silver Oak College Of Engineering And Technology, Ahmadabad	Dr. Tanmoy Mukhopadhyay	Analysis over zigzag airfoil for morphing structure

22	Kodukula Vaishnavi	Saint Francis Degree College For Women	Dr. DLVK Prasad	Hydrogen atom in higher dimensional euclidean space
23	Kunal Ghosh	IEST, Shibpur	Dr. Rakesh Kumar	Study of flow of supersonic jet over a corrugated wall using computational fluid dynamics
24	Mahaan Mitra	Bengal College Of Engineering And Technoogy	Dr. Venkatesh K S	Tracking Multiple Objects from Different Camera Views
25	Mahesh Subhash Gupta	NIT Rourkela	Dr. Anoop Singh	Low Cost Indoor Occupancy and Climate Monitoring System For Energy Conservation
26	Manas Maurya	Manipal Institute Of Technology	Dr. Vipul Arora	Question Answering Demo
27	Manaswita Shekhar Singh	Malaviya National Institute Of Technology	Dr. A. K. Singh	Building a computational utility for macro scale deformation of steel
28	Megha L	Karunya Institute Of Technology And Sciences, Coimbatore	Dr. S K Mishra	HPMA-hydrogel encapsulated SS-31 for treatment of chemotherapy induced cachexia
29	Nalin Singh	College Of Engineering Pune	Dr. A. K. Singh	Phase field modelling for solid-solid phase transformation
30	Pragya Gupta	Vellore Institute Of Technology, Vellore	Dr. S K Mishra	Melanoma: A Search of Molecular Probe for Early Detection
31	Priyatosh Sahoo	NIT, Rourkela	Dr. A. K. Singh	Macroseggregation in binary alloys
32	Rajdeep Sardar	Jadavpur University	Dr. Abhijit Kushari	Numerical investigation of Compressible flow characteristics in a Core and By-pass Nozzle of Titan Engine
33	Rajneesh Pandey	Maulana Azad National Institute Of Technology	Dr. K. Balani	Finite Element Analysis of Shear Stress Distribution in SS 304 and Ti6Al4V substrates during reciprocation

34	Riddhideep Biswas	Jadavpur University	Dr. Kamal K Kar	CFD Analysis of Spray Painting Process by Electrostatic Rotary Bell Sprayers
35	Ritam Paul	IEST, Shibpur.	Dr. Tanmoy Mukhopadhyay	Stochastic Uncertainty Quantification of Material Properties (Elastic and Shear Modulus) and Poisson Ratio for Two-Dimensional Multiplanar Hexagonal Nano Materials.
36	Satyam Agrawalla	NIT Rourkela	Dr. Kamal K Kar	To study the working of current collector and find out the most efficient current collector for a 100 Farad Supercapacitor
37	Shipali	IEST, Shibpur	Dr. Abhijit Kushari	Numerical investigation of flow through Bypass and Core nozzles of a turbofan engine
38	Shree Patnaik	National Institute Of Science And Technology	Dr. Kamal K Kar	Designing of a separator layer for 100uF supercapacitor
39	Shubham Raj	NIT Rourkela	Dr. Anoop Singh	Automatic Data collection from Power supply and Demand graph using python and online web plot digitiser
40	Shubhrangshu Biswas	Indian Institute Of Science Education And Research Kolkata	Dr. Anjan K. Gupta	Conductivity for Different Structures in Carbon Micro-tubules: Tight Binding Model Explanation
41	Siddhant Nayak	NIT, Rourkela	Dr. Anubha Goel	Data analysis on levels of various ambient air pollutants during the Diwali week of 2019 in Kanpur.
42	Sita choudhary	MNIT, Jaipur	Dr. N. P. Gurao	Understanding the effect of grain size and strain path on the evolution of intragranular misorientation in copper using viscoplastic fast Fourier transform based crystal plasticity simulations
43	Smita	IIIT, Bhubaneswar	Dr. Anoop Singh	Data analysis of tariff regulations of large hydro power generation plants.

44	Soumalya Ghosh	Jadavpur University	Dr. A. K. Singh	Macrosegregation in Binary Alloys
45	Soumya Mitra	Jadavpur University	Dr. A. K. Singh	Phase field modelling and simulation of microstructure evolution based on classical and non-classical diffusion equations using finite difference and spectral techniques
46	Soumyadeep Ghosh	IEST Shibpur	Dr. Arun K Saha	The flow characteristics of wall jet at low Reynolds number
47	Srinithi S	Madras Institute Of Technology	Dr. Abhijit Kushari	Performance analysis and fan design for conversion of a turbojet engine into a turbofan engine
48	Sucharita Pal	NIT Durgapur	Dr. Harshwardhan H. Katkar	Modelling of Covid-19 kinetics
49	Swetha G	A C College Of Technology, Anna University	Dr. A. K. Singh	Phase field modelling and simulation based concepts on diffusion equations
50	Unnathi.C	NIT, Andhra Pradesh	Dr. Anoop Singh	Device implementation of Low-Cost Indoor Occupancy and Climate Monitoring System
51	Utsav Sharma	Karunya Institute of Technology and Science Coimbatore, Tamil Nadu	Dr. Ramkumar J	Exploring Research Opportunities in Modern Manufacturing: Rapid Prototyping and Magnetic Abrasive Machining
52	Yamini Singh	Manipal Institute Of Technology	Dr. Venkatesh K S	3D Effect in a Video chat
53	Yash Pradhan	NIT Raipur	Dr. Anoop Singh	Analysis of policy and meter data for tariff recommendations
54	Yatharth Bhargava	IIIT Bhubaneswar	Dr. Debadatta Mishra	Processor Optimization For NVMe SSD using Kvell

Abstracts: SURGE 2020 Research Projects done at IIT Kanpur

Deep Learning for P300 based character recognition

Abhishek Bansal, Mentor: Dr. Vipul Arora

The dataset is taken from BCI competition 3 dataset 2 named P300 speller paradigm recorded with BCI 2000 system. The novelty in our approach is that the data sets will be split in several partitions and a classifier will be trained on each of this partition. The outputs of all classifiers will finally be summed up to get a final decision. The raw data is filtered with an 8-order bandpass C.

A study on the effects of bulk viscosity on compressible flows

Abinandhan M, Mentor: Dr. Rakesh Kumar

Historically Stokes assumed the bulk viscosity to be identically zero for all fluids. However, Stokes himself did not take this hypothesis as always true. He mentioned that in commonly encountered flows, if analysis with and without considering bulk viscosity produces same results, then it would be because of small value of divergence of velocity, rather than bulk viscosity being zero.

Reading Course on Quantum Mechanics

Achal Vinod, Mentor: Dr. Joydeep Chakraborty

Quantum Mechanics has played a fundamental role in shaping the modern society that we all form a part of and it's always fascinating to see how did these ideas eventually came into play. This project evolved in form of a reading course on quantum mechanics. It focuses on the history of quantum mechanics and how it took the form in which it is most popular today. We start by studying Planck's postulate and Einstein's perspective on the emerging ideas of quantization. We then study how various experiments such as, Photoelectric effect, Compton scattering, Bremsstrahlung process, Rayleigh scattering, pair production and annihilation which weren't explicable using theories of classical electromagnetism, ultimately lead to a worldwide acceptance of the idea of photons. Then we study the "quantum revolution" where De-Broglie played a fundamental role in establishing the wave-particle duality.

Exponential, logistic and power law growth pattern of CoVID 19

Additi Pandey, Mentor: Dr. DLVK Prasad

Several papers have been published to model the spread of COVID 19 epidemic. In this project work, we have analysed exponential, logistic and power law growth pattern of CoVID 19 in Germany. We collected the data for the infection count in Germany and constructed the three models to compare their plots with the actual data plot. The exponential model indicated an ever increasing infection count.

Study on Green Energy and Manufacturing applications

Aditya Dhankhar, Mentor: Dr. Ramkumar J

SURGE program period was divided into smaller sub-projects to understand the literature review process, product design for rural agro-needs, and advanced modeling of tribological behavior.

1. A comprehensive literature review was conducted on the various new and innovative applications of solar energy technologies.
2. A cold press hydraulic oil expeller machine for rural applications was model.

Modelling of MEMS based Microfluidic Device for the segregation of CTCs and WBCs

Akansh Agrawal, Mentor: Dr. B. Bhattacharya

Our project is aimed at segregation of CTCs from WBCs using antibody independent methods, helping in the detection of tumour in the body. The processes like Pinched Flow Fractionation, Dean Flow Fractionation, Piezoelectric Actuation are involved for this purpose. The simulations are carried out using ANSYS software to visualise the separation resolution. Also, the effects of bluff objects in pin.

Modelling and Designing of MEMS based Microfluidic Segregation System for Circulating Tumour Cells from Leukocytes in the Whole Blood

Akshan Agrawal, Mentor: Dr. B. Bhattacharya

Circulating Tumour Cell is essential biomarker in detecting numerous solid cancers, especially Prostate Cancer. Our project aim to design a microfluidic device capable of high resolution separation of CTCs from Leukocytes. On the basis of stiffness property of cells, the Piezoelectric effect can be used to see the pronounced effect in their separation. The enhancement in segregation can be achieve.

Unsupervised Clustering for SpMV Format Selection

Akshay Rajesh Deodhar, Mentor: Dr. Swarnendu Biswas

Sparse Matrix Vector Multiplication (SpMV) is a BLAS kernel which is frequently used in several scientific applications, and proves to be a bottleneck. Several Sparse Matrix storage formats like Ellpack, Compressed Sparse Row, Hybrid, Coordinate have been developed, each having a different SpMV kernels. The execution time for the SpMV operation for a sparse matrix depends on the format used, and different formats are optimal for different matrices. Used clustering for assigning optimal formats to sparse matrices in an SpMV runtime, to minimize the number of matrices which have to be benchmarked for training the model.

Exploration of Energy Transfers in KdV Equation

Ananya Mohapatra, Mentor: Dr. Mahendra Kumar Verma

This project details a numerical study of the equation to extract exact solutions outlining the existence of solitary wave like solutions- **Solitons**. I am working towards energy transfers and flux employed in KdV Equation, a nonlinear equation that solves exactly with the help of Inverse scattering techniques. I use Initial functions to solve this equation and study the combinations that produce a particular type of solution known as solitons.

A Study on Household Energy Consumption Pattern using Smart Meter Data Analysis

Aniket Raj, Mentor: Dr. Anoop Singh

Analysing the energy consumption behaviour of a household using smart meter data and cluster analysis. Insights include weekly-analysis, identifying day-wise peaks, valleys, and their corresponding time of occurrences to know the time that is mostly harnessed for peak usages.

Numerical study of the interaction of a supersonic jet with a corrugated wall

Anish Singh, Mentor: Dr. Rakesh Kumar

The present work contributes on numerical analysis of interaction of a supersonic jet with an adjacent wall having corrugated asperities on it and oriented in the direction parallel to the jet.

- CFD simulation of supersonic jet over the flat and corrugated wall.
- Simulation of the supersonic jet at Mach 1.5 at NPR 2.7,4 and 8.
- Comparison of shock patterns on the corrugated wall with that of the flat wall.
- Comparison of numerically obtained results with that of experimentally obtained results.

Capturing the effect of strain rate on the evolution of microstructure and texture in metallic materials using Visco Plastic Fast Fourier Transform based crystal plasticity simulations

Ankur Mallick, Mentor: Dr. A. K. Singh

Determine the regions of maximum stress at the microstructural level and provide microstructural design strategies to mitigate the initiation of failure. This is done by first doing high strain rate deformation and analyzing its effects through Visco Plastic Fast Fourier Transform based crystal plasticity simulations.

Finite Element Studies on Semi Coherent to Semi Semi Coherent Transition of Precipitates in Crystalline Materials

Anshika Chaudhary, Mentor: Dr. Anandh Subramaniam

Study of the stability of prismatic dislocation loops in precipitates in the proximity of free surfaces will give an insight of microstructural sensitivity properties in materials. Finite Element Method has been used to study the stress field and energetics of precipitate with dislocation loop near free surface by feeding stress free Eshel by strains.

Detecting auditory attention to instruments in polyphonic music by deep learning on EEG signals

Anshul Agrawal, Mentor: Dr. Vipul Arora

This is a proof of concept that attention paid to a particular instrument in polyphonic music can be inferred from ongoing EEG, a finding that is potentially relevant for both brain-computer interface and music research.

Examination of variation in incense composition and analysis of chemical characterization of emissions from incense burning

Anshumali jaiswal, Mentor: Dr. Anubha Goel

Analysis of various components of emissions from incenses responsible for indoor pollution as Indoor air quality greatly affects wellbeing, individuals pass up a major opportunity the bigger picture, the air where they invest a large portion of their energy. People as a rule spend around 80% of their lifetime by being engaged with indoor exercises.

Morphing Aerofoil and Optimal Shape Prediction for Various Flight Conditions
Anshuman Das, Mentor: Dr. Tanmoy Mukhopadhyay

An adaptive aerodynamic surface able to morph to its optimum shape based on the mission requirements would drastically improve the effectiveness of a vehicle in its missions. This work attempts onboard detection and management without any human input by use of Machine Learning Methods.

Bulk viscosity estimation

Anubhav Joshi, Mentor: Dr. Rakesh Kumar

The ANSYS Fluent model for a C-D nozzle case and the compare its value with and without bulk viscosity and then compare their results to see the effects of it with the help of UDF, then using it for the shocks and high-speed dynamics. In case of incompressible flow, it is not needed as the equation does not have it, also in case of monoatomic gases its value is zero at the low density. But knowledge of the volume viscosity is important for understanding a variety of fluid phenomena, including sound attenuation in polyatomic gases (e.g. Stokes's law), propagation of shock waves, and dynamics of liquids containing gas bubbles.

Droplet Heating and Evaporation

Arpan Sow, Mentor: Dr. Ashoke De

Droplet heating and evaporation is a phenomenon which has become an indispensable part of industry and technology such as evaporative cooling, fuel combustion, spray drying and it is also important to cloud physics, pre-mixing of air-fuel, pollution control, nanofabrication etc. Evaporation is an unsteady problem, associated with both mass and heat transportation.

Design and Analysis of Kirigami based auxetic cellular metamaterial

Aryan Sinha, Mentor: Dr. Tanmoy Mukhopadhyay

Study includes hands on paper model development through Kirigami. Kinematic analysis of spherical linkages was performed to investigate mechanical properties of the structure as a function of microstructure geometry. Tessellations were developed on CAD software and FEM simulations were performed.

Modeling and simulation of magnetic abrasive finishing (MAF) process

Ayush Raj, Mentor: Dr. Ramkumar J

A theoretical model for material removal and surface roughness is developed accounting for micro cutting by considering a uniform surface profile without statistical distribution. Surface roughness is calculated for various speed of tool and strength of magnetic poles. Effects of various input parameters are analyzed.

DFT study of effect of ZrOx on CO2 Hydrogenation to Methanol

Ayushi Goyal, Mentor: Dr. Vishal Agarwal

The objective is to find the role of zirconium and its oxide in the hydrogenation of carbon dioxide. We will observe the rate of this reaction by taking ZrOx on the surface of Copper. We will also try different combinations of catalyst for this reaction. This research will help in understanding the science behind the catalytic process and

learning the effect of different catalyst on the reaction and the broader impact will be to find the better catalyst to use for industrial purpose to reduce the carbon dioxide emission and in return production of Methanol at faster rate.

Fourier extensions and accurate approximation of functions by trigonometric polynomials

Damanpreet Singh Monga, Mentor: Dr. Akash Anand

My project explores high-order approximation of functions with trigonometric polynomials. We initially used two-point Hermite interpolating polynomial to extend the given function to a larger domain and then approximate it with a trigonometric polynomial. Later we changed the two-point polynomial to three-point polynomial and piece-wise two-point polynomial and analysed their relative performance.

Review of indoor air purification techniques to remove prominent pollutants in indoor microenvironments

Debanjana Chakraborty, Mentor: Dr. Anubha Goel

The primary aim of the project is to examine the techniques that have been researched and available in the global market for purification of indoor air for the commonly found pollutants such as CO₂, NO₂, Particulate Matter, Volatile Organic Compound and Ozone and focus on highlighting the gaps and drawbacks/limitations of the techniques which could be focussed in future studies.

Structure and multiscale modeling of SARS CoV 2 spike glycoprotein, potential epitopes and drug binding site

Deeksha M Hegde, Mentor: Dr. DLVK Prasad

We study the structural biology of the spike glycoprotein of SARS CoV 2, the virus causing COVID 19, to find potential epitopes that can be modelled as drug targets. We perform multiscale simulations at chosen sites to analyse drug binding.

Visual Experience Using Moving Images

Diganta Ghorai, Mentor: Dr. Ritwij Bhowmik

With the growing years, our surroundings and experiences regarding the standard norms of the society makes our belief system rigid irrespective of its authenticity. My project is aimed at representing one of those aspects with respect to the ongoing crisis all around the world apart from the pandemic. A short animation film representing a vision, with carefully countering the emotional aspects.

Semiempirical quantum chemical calculations to understand the electronic structure of H₂O and H₂O⁺ from the view point of hydrogen bonding and electron lone pairs.

Divyanshi Dixit, Mentor: Dr. DLVK Prasad

In this project, we deal with the electronic structure of H₂O and H₂O⁺ in gas phase using semi empirical quantum chemical calculations. An attempt is made to investigate the controversy over the electron lone-pair and its connections to build the hydrogen - bond networks.

Image processing using machine learning for boundary identification

Gopal Bhaskar, Mentor: Dr. Shikhar Krishn Jha

This project aims to identify the grain boundaries in a micrograph of the ferrite phase of steel and refine them in order to obtain an image that consists of only grain boundaries by removing the background noise and scratches present in the micrograph initially. The project also aims to analyze the obtained grain boundary images on various parameters, including AGI (Average Grain Intercept), aspect ratio, average grain area and grain boundary length.

Study of multi-component alloys using classical molecular dynamics simulations,

Irin Talukdar, Mentor: Dr. A. K. Singh

The project deals with study of high entropy alloys, made of at least 5 different elements, using classical molecular dynamics simulations. This is done with the help of LAMMPS and OVITO softwares. The phenomenon of lattice distortion in HEAs is caused by the difference in atomic sizes of the various elements that constitute the multi-component alloys.

Estimation of bulk viscosity on flow physics using ANSYS FLUENT

Ishan Tiwari, Mentor: Dr. Rakesh Kumar

There are two ways to describe fluid flows first one is Lagrangian description and the other one is Eulerian description. In the Lagrangian description of fluid flow, individual fluid particles are marked and their positions, velocities, etc are described as a function of time. The physical laws, such as Newton's laws and conservation of mass and energy, apply directly to each particle.

In the Eulerian description of fluid flow, individual fluid particles are not identified. Instead, a control volume is defined. Control volume is a volume in space of special interest for particular analysis. The surface of the control volume is referred as a control surface and is a closed surface. The surface is defined with relative to a coordinate system that may be fixed, moving or rotating.

Analysis over zigzag airfoil for morphing structure

Jigar Hitendrakumar Panchal, Mentor: Dr. Tanmoy Mukhopadhyay

Main objective is to quantify how different patterns (zigzag type and smooth) of airfoil surface influence the aerodynamic performance of the airfoil at different angle of attack. If the chord length of airfoil is L , then we took the n number of segments with each of length L/n . We divided the airfoil surface into L/n number of equilateral triangles.

Hydrogen atom in higher dimensional euclidean space

Kodukula Vaishnavi, Mentor: Dr. DLVK Prasad

The unified theory of everything, the string theory and the M theory are possible only if there exist more than the (three + one) known space-time dimensions. The existence of extra dimensions can be indirectly proved by showing that the hydrogen atom can exist in a higher dimensional space. Trying to prove the existence of extra-dimensions by considering hydrogen atom in higher dimensions is the main objective of this project.

Study of flow of supersonic jet over a corrugated wall using computational fluid dynamics

Kunal Ghosh, Mentor: Dr. Rakesh Kumar

The present study is devoted to the study of interaction of a supersonic jet with a nearby corrugated wall using computational fluid dynamics (CFD). The results obtained in these CFD simulations will be compared with that of the experiments.

Tracking Multiple Objects from Different Camera Views

Mahaan Mitra, Mentor: Dr. Venkatesh K S

The aim of the project is to create a computer vision system to track objects as seen from different camera views. We would further like to explore the behaviour of the tracked object in physical space. We are using various conventional computer vision as well as machine learning techniques to develop an efficient algorithm to achieve our objective.

Low Cost Indoor Occupancy and Climate Monitoring System for Energy Conservation

Mahesh Subhash Gupta, Mentor: Dr. Anoop Singh

The main objective is to accurately detect the status (ON/OFF) of the air conditioning system at any location and control it remotely from the dashboard. Current sense module is used to detect the ON/OFF status and presently current is being captured and the module is being integrated with the existing network for further processing. High power relay modules interfaced with current sense modules and existing servers will be further used to control the air-conditioner from the dashboard itself, Thereby making the process of monitoring and controlling fully automatic without involvement of any human intervention.

Question Answering Demo

Manas Maurya, Mentor: Dr. Vipul Arora

The purpose of this project is to extract correct answers for questions asked about the tourist places in Delhi using the Question Answering technique. The demo for the project has been made in two ways. The first approach was to completely code the different parts of the factoid question answering block which include Document Retrieval, Document Ranking, Sentence Filtering and Sentence Scoring & Output. The Second approach is what the final project is based on and uses the concept of Bi-Directional Attention Flow presented in the 2016 ICLR paper, Bi-directional Attention Flow for Machine Comprehension.

Building A Computational Utility For Macro Scale Deformation Of Steel

Manaswita Shekhar Singh, Mentor: Dr. A. K. Singh

In this project the open source tool Code Aster is used for macro scale stimulation of hot rolling of steel. Parameters like output temperature, stress strain distribution will be used for calculating the stored energy used for determining the nucleation strategy of ferrite.

HPMA-hydrogel encapsulated SS-31 for treatment of chemotherapy induced cachexia

Megha L, Mentor: Dr. S K Mishra

We are proposing a novel therapeutic approach for targeted delivery of SS-31 antioxidant at the cachexia site (which has high level of cathepsin B enzyme), to reduce the ROS level, thereby help prevent muscle degradation. We hypothesize that Cathepsin B specific tetrapeptide (GFLG), when incorporated within HPMA polymer-based hydrogel as crosslinks, encapsulating the antioxidant SS-31, can facilitate controlled release of the drug at the muscle wastage site, thereby preventing the development of chemotherapy induced cachexia.

Phase field modelling for solid-solid phase transformation

Nalin Singh, Mentor: Dr. A. K. Singh

In this project work, our main objective is to model the solid-solid phase transformations using phase field methods. I have to write C source code for Spinodal decomposition, Order-disorder transformation, and precipitate growth.

Melanoma: A Search of Molecular Probe for Early Detection

Pragya Gupta, Mentor: Dr. S K Mishra

The project is an effort to study the existing methods to identify melanoma and the possible biomarker for its early detection. Malignant melanoma (MM) is a deadly cancer marked by a highly violent biological behaviour in human beings. Natural and artificial Ultraviolet (UV) radiation (sunlight, tanning beds, UV lasers, UV LEDs) has been one of the principal factors responsible for skin cancer. There is a significant need to recognize, classify and evaluate useful biomarkers, biomarker trends or surrogate markers in order to not only strengthen early detection of melanoma but also for differential diagnosis, staging, prognosis, preference of therapy and monitoring the efficacy of therapy. It has been reported that there could be a potential interesting link between the lactate dehydrogenase (LDH) levels in saliva and other bodily fluids. The increased level of LDH in saliva is reported to be one of the biomarkers which shoots up during the development of oral squamous cell carcinoma (OSCC). This project discusses the available details on molecular changes associated with malignant melanoma, diagnostic biomarkers to identify the melanomas and the role of LDH in saliva as a possible biomarker for the detection of oral diseases and to establish the potential association between rates of LDH in saliva and the differentiation of tumors.

Macroseggregation in binary alloys

Priyatosh Sahoo, Mentor: Dr. A. K. Singh

Our project focuses on simulating the alloy composition variation which is caused by macroseggregation during solidification of cast metal. We are simulating solidification behaviour of Pb-18%Sn alloy in OpenFOAM by using the SMACS benchmark solidification solver. The simulation result shows the variation of alloy composition. We also changed the different boundary conditions to simulate actual operating conditions during solidification. From the results, once we get the composition variation, we can plan on the processing of the cast metal to minimise the effects of macroseggregation.

Numerical investigation of Compressible flow characteristics in a Core and By-pass Nozzle of Titan Engine

Rajdeep Sardar, Mentor: Dr. Abhijit Kushari

In this comprehensive work, numerical simulation is performed for a standard geometry of core and by-pass nozzle of titan engine at specified pressure boundary condition and natural phenomenon of compressible flow is observed in forms of total Pressure, total temperature and mach number contour.

Finite Element Analysis of Shear Stress Distribution in SS 304 and Ti6Al4V substrates during reciprocation

Rajneesh Pandey, Mentor: Dr. K. Balani

In this project FEA of shear stresses developed during Pin on disc wear test or mimicking joint articulation of biomaterials is being performed. Steps include 3D Geometry creation, assignment of material properties to the geometry, meshing, application of the boundary conditions and solving the simulation so as to generate the stress profiles.

Selves Within the Self

Ravi Prakash Tripathi, Mentor: Dr. Lalit Saraswat

The paper examines the notion of self-experience, experience by self, and ego-dissolution under altered states of Consciousness (waking, sleeping, dreaming, and under drug influence) to explain the phenomenological approach to its continuum (if there is one). It also assesses the claims about the 'minimally self-aware' along with memory related arguments and with the arguments stemming from 'DIED' (Drug Induced Ego Dissolution). Overall, it paves way to assess the concept, status, role, and functioning of Self, experience, and ego. The interactionist and non-epiphenomenalist models of self would be assessed to evaluate the arguments for a plausible connection between the Self, its causal ability, representation along with how the binding / unbinding (Self) of it occurs.

CFD Analysis of Spray Painting Process by Electrostatic Rotary Bell Sprayers
Riddhideep Biswas, Mentor: Dr. Kamal K Kar

Electrostatic Spray Painting is a very efficient process used widely in industries in order to increase the transfer efficiency. The process is very complex and involves interaction between a fluid flow field and an electrostatic field.

The present work utilises Computational Fluid Dynamics (CFD) methods to analyse this complex phenomenon and the impact of various parameters on the transfer efficiency.

Stochastic Uncertainty Quantification of Material Properties (Elastic and Shear Modulus) and Poisson's Ratio for 2-Dimensional Multiplanar Hexagonal Nano Materials.

Ritam Paul, Mentor: Dr. Tanmoy Mukhopadhyay

This project deals with the importance of considering source uncertainties in developing a stochastic analysis of Uncertainty Quantification of material properties for a 2-D multiplanar hexagonal nano structural material.

Detection of Heavy Metals

Sampada Sinha, Mentor: Dr. Siddhartha Panda

To estimate the concentration of heavy metals we need to know the current due to reaction at the potential of the change. Modelling of a complete set of steps for a single-step single electron transfer reaction was performed, and it was identified that material of the electrode, as well as solution, also plays an important role in the kinetics of the reaction, thereby affecting the sensitivity and the limit of detection of the sensor.

Neuronal Tracing

Sanket Garg, Mentor: Dr. Nitin Gupta

I am tracing the projection neurons from the Antennal Lobe till the Mushroom Body and the Lateral Horn. I currently using neuTube for carrying out the tracings. I am referring to Drosophila papers for understanding the olfactory pathways. These tracings will then be analysed using the natverse packages on R.

To study the working of current collector and find out the most efficient current collector for a 100 Farad Supercapacitor.

Satyam Agrawalla, Mentor: Dr. Kamal K Kar

the project was to search for an efficient and commercial current collector being used and see its properties under different conditions and varying parameters. In the project we have dealt with various parameters of current collectors like thickness, dimension, type (foam, foil etc.) that determine or effect the specific capacitance. The most used current collectors are that of nickel and copper and slowly the trend is shifting to layer of graphene composites on metallic foils. We have to tried to determine a suitable current collector for generating a specific capacitance of 100 F/g and we found Copper with some coating as the suitable material which is both efficient and can be used commercially.

Numerical investigation of flow through Bypass and Core nozzles of a turbofan engine

Shipali, Mentor: Dr. Abhijit Kushari

To understand significant advances in mixing of bypass and core jets in exhaust mixer, CFD simulations using ANSYS Fluent are performed on three cases to observe the flow properties. First and second case is 2D axisymmetric and third case is a 3D problem consisting of bypass and core nozzles of a turbofan engine. For numerical investigation, the Spalart-Allmaras Turbulence Model has been applied.

Simulating photonic devices and integrated circuits using finite-difference time-domain method

Shivi Gupta, Mentor: Dr. Shilpi Gupta

FDTD is a numerical approximation to solve Maxwells equations. Lumerical FDTD and Mode solver use this to simulate light propagation in devices. The project involves

simulating devices such as waveguides, grating couplers, photonic crystals and, further, photonic integrated circuits using these devices.

Designing of a separator layer for 100uF supercapacitor

Shree Patnaik, Mentor: Dr. Kamal K Kar

The separator layer for 100uF supercapacitor is developed in this study, major emphasis is given on the dimension of the separator layer for the design of the 100uF supercapacitor considering suitable separator layer material.

Automatic Data collection from Power supply and Demand graph using python and online web plot digitiser

Shubham Raj, Mentor: Dr. Anoop Singh

Lots of daily aggregate demand supply curve gets generated on Indian energy exchange(IEX) website. Data points can be extracted from the graphs using an online web plot digitiser for analysis. Manually extracting the data can become very tedious and time consuming as there are so many graphs. This repetitive process can be automated using python.

Conductivity for Different Structures in Carbon Micro-tubules: Tight Binding Model Explanation

Shubhrangshu Biswas, Mentor: Dr. Anjan K. Gupta

In this project we expect to explain certain properties shown by carbon micro-tubules of different structures. These are explained mainly by the Tight Binding Method, also some concepts of geometry, basic condensed matter physics are applied to explain the results up-to a good extent and predict for other structures of the micro-tubule.

Data analysis on levels of various ambient air pollutants during the Diwali week of 2019 in Kanpur.

Siddhant Nayak, Mentor: Dr. Anubha Goel

This project gives an insight into the decrees in air quality of Kanpur city during Diwali. There is a surge in level of various pollutants post burning of fire crackers. Data Analysis is being carried out using the data available in CPCB website. It has been noticed that there is an alarming increase in level of pollutants which is far more than permissible limits.

Understanding the effect of grain size and strain path on the evolution of intragranular misorientation in copper using viscoplastic fast Fourier transform based crystal plasticity simulations

Sita choudhary , Mentor: Dr. N. P. Gurao

Synthetic microstructures of single-phase Cu having different average grain size were created using DREAM.3D, to perform VPFFT simulations under various modes of deformation. The deformation behaviour is being studied in terms of microstructural evolution with the plotting of IPF maps, KAM maps, stress and strain maps using paraview.

Data analysis of tariff regulations of large hydro power generation plants.

Smita, Mentor: Dr. Anoop Singh

The main objective of this project is collection of data from tariff regulations of CERC and state ERCs for the tariff period of 2004-2019. The project work includes data representation and plant specific classification based on different parameters and analyzing the differences in data of different regulations.

Visualizing LSTM networks for Traffic state prediction

Smriti Chhattani, Mentor: Dr. Pranamesh Chakraborty

For this study, Traffic flow data were taken from January 1, 2016, to March 31, 2016, with the updating frequency of 5 min, where the key information is timestamp and flow (that is, vehicle/5min). An LSTM model in Keras was developed for traffic flow prediction using which we predicted traffic flow for every next 5 min based on the previous data available.

Granular Flow in COMSOL

Soham Ghosal, Mentor: Dr. Anurag Tripathi

We study the two dimensional, fully-developed, gravity driven flow of granular material on an inclined plane. COMSOL uses a continuum approach and hence can be a promising tool for quick simulations of granular flows. We have modelled the granular material as a visco-plastic fluid in COMSOL simulations, which are performed using a single-phase laminar flow model in the CFD Module.

Macrosegregation in Binary Alloys

Soumalya Ghosh, Mentor: Dr. A. K. Singh

Simulation of this transient process was carried out in this work until complete solidification, and the results, depicting the influence of flow field on thermal and solutal field and vice versa, are shown at various stages of solidification. In our project, we have simulated the solidification behaviour of the alloy Sn-10%Sn in OpenFoam by using the SMACS benchmark solidification solver. The simulation result shows the variation of alloy composition.

Phase Field Modelling and Simulation of Microstructure Evaluation Based On Classical and Non-Classical Diffusion Equations Using Finite Difference and Spectral Techniques

Soumya Mitra, Mentor: Dr. A. K. Singh

The work aims to build Phase Field Model of microstructure evolution of binary heterogeneous solid solution based on the concepts of non-classical diffusion equations and solve with the help of Finite Difference technique and Spectral technique and simulation using build-in library modules or packages of MATLAB and FEniCS by Python. The models are primarily focussed on Spinodal Decomposition.

The flow characteristics of wall jet at low Reynolds number

Soumyadeep Ghosh, Mentor: Dr. Arun K Saha

We are doing flow characteristics of wall jet at low Reynolds number. We are considering the steady, two-dimensional incompressible laminar flow over a flat plate.

It will be done essentially on the finite difference and finite volume discretization and on the solution of a Poisson equation to determine the pressure distribution.

Performance analysis and fan design for conversion of a turbojet engine into a turbofan engine

Srinithi S, Mentor: Dr. Abhijit Kushari

The existing turbojet engine is to be converted to a turbofan by maintaining the core part unchanged. For this new engine, geometric design of fan, bypass nozzle and fan blade is conducted for a selected operating point which was pre-determined through performance analysis.

Modelling of Covid-19 kinetics

Sucharita Pal, Mentor: Dr. Harshwardhan H. Katkar

The model proposed here, basically has four major compartments namely Susceptible (S), Infected (I), Recovered (R), and Dead (D). I compartment is further divided into three sub-compartments namely, Asymptomatic (I_{ha}), Symptomatic (I_{hs}) and Detected (I_d). We have considered the total population of the country (N) to remain constant with time.

Phase field modelling and simulation based concepts on diffusion equations

Swetha G, Mentor: Dr. A. K. Singh

Diffusion refers to the movement of atoms in solids. Structural control in a solid to achieve the optimum properties is dependent on the rate of diffusion. The carburization of a steel or the oxidation of a metal is controlled by the diffusion rate of atoms (or ions) through the surface layer. The introduction of a very small concentration of an impurity in a solid-state device requires knowledge of the diffusion phenomena.

Device implementation of Low-Cost Indoor Occupancy and Climate Monitoring System

Unnathi.C, Mentor: Dr. Anoop Singh

Deals with the practical realization of the device and tests if data can be sent from any place to the server. It also suggests corrections in both the manuals and additional instructions that could make implementation easier for the end-user. For efficient utilization of the microcontroller module's memory, a literature survey has been done on the optimization of the Arduino code.

Exploring Research Opportunities in Modern Manufacturing: Rapid Prototyping and Magnetic Abrasive Machining

Utsav Sharma, Mentor: Dr. Ramkumar J

In the manufacturing industry, the Rapid Prototyping (RP) is becoming an important aspect for analysis of the product to be manufactured in large quantities. RP is a technology for producing the physical model from a computer model without any human interaction or with few interactions. RP is the term given to a set of processes that can quickly fabricate any given three-dimensional object into a model or prototype, directly from a CAD file via the additive deposition of individual cross-sectional layers

of the part. RP is getting successful in many industries and it is contributing to almost all engineering areas, like mechanical, electrical, and biomedical. RP is being used to shorten and simplify the product development cycle cost efficiently and act as an ideal method for many industries.

3D Effect in a Video chat

Yamini Singh, Mentor: Dr. Venkatesh K S

The main objective of this project is to provide a 3D effect in a video chat which can be anything from just two people normally conversing or a class being taught. In a video chat on obtaining one side of the video a program will mainly separate the background and all the other objects in the video like an image of a person.

Analysis of policy and meter data for tariff recommendations

Yash Pradhan, Mentor: Dr. Anoop Singh

A major focus is on analysing the trends in policy regulations of various state electricity regulatory commissions. This is followed by meter data analysis of the energy consumption in pilot projects for developing policy recommendations.

Processor Optimization for NVMe SSD using Kvell

Yatharth Bhargava, Mentor: Dr. Debadatta Mishra

Since the traditional KV stores are not able to fully utilise the bandwidth of NVMe SSD, attributed to the large amount of background processes like keeping the data sorted and no logic for random access, hence we can use Kvell which is based on share nothing and allows random access for using NVMeS."

SURGE 2020 Awards

“Dr. Elizabeth and Dr. Verkey Cherian Award” for Best Project who produce exceptional quality research during the SURGE program. Award of Rs. 10,000 plus a commendation certificate will be given to SURGE students for best project. This year SURGE Evaluation committee has been shortlisted the following SURGE participants for *SURGE 2020 Best Project Award*.

S. N.	Name of the Participant	Department	Award Name
1	Anshul Agrawal (IITK)	Electrical Engineering	Detecting auditory attention to instruments in polyphonic music by deep learning on EEG signals
2	Anshika Chaudhary (IITK)	Materials Science and Engineering	Finite Element Studies on Semi Coherent to Semi Coherent Transition of Precipitates in Crystalline Materials
3	Deeksha Hegde (Non-IITK)	Chemistry	Structural analysis of SARS-COV2 spike protein
4	Ananya Mohapatra (Non-IITK)	Physics	Exploration of Energy Transfers in KdV Equation

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6. Staff members of CCE office.

SURGE 2020 Batch



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