



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



SURGE 2021 Annual Report



Students-Undergraduate Research Graduate Excellence

Message from Head, Centre for Continuing Education

Dear SURGE Friends,

Congratulations to all the 2021 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 1200 applications were received from different colleges and 185 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!

B. V. Rathish Kumar

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 2021), 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 2021 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 20 students were selected under the Project Funded category and received stipend from various institute projects.

Self-Funded

This year 165 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 2021 from IITK

S.N.	Name	Mentor	Project Title
1	Aarjav Jain	Dr. Ramprasad Potluri	New model of wheel
2	Aaryansh Mohan Bansal	Dr. Mangal Kothari	Reinforcement Learning for Quadcopters
3	Aaryen Milan Mehta	Dr. Laxmidhar Behera	Autonomous Excavator Manipulation
4	Abhinav Aggarwal	Dr. Abhishek	Conceptual Design Of A Tethered coaxial rotor UAV
5	Achint Soni	Dr. Laxmidhar Behera	Autonomous Excavator Manipulation
6	Adarsh Chaudhary	Dr. Sachin Y. Shinde	Numerical Study of Flow Over Flapping Foils in Triangular Pattern
7	Aditya Gupta	Dr. Rik Dey	Theory of Edelstein magnetoresistance in heterostructures consisting of topological insulators and ferromagnetic materials.
8	Aditya Prakash	Dr. Dipak K Giri	Dynamic Velocity Error based Trajectory Tracking by Space Robotic Manipulator
9	Aditya Vats	Dr. Ishan Sharma	Impact Induced Acceleration on Small Bodies
10	Akarsh Raj	Dr. Sachin Y. Shinde	Implementing Active Motion Capabilities to rigid and flexible filaments in LUMA software.
11	Akash Mishra	Dr. Kanwar Singh Nalwa	Machine Learning approach to predict a better composition of Perovskite solar cell in terms of enhanced stability
12	Akashdeep Bhateja	Dr. Bharat Lohani	Testing Deep learning Models for LiDAR data segmentation
13	Akshat Chaudhari	Dr. Nilesh Prakash Gurao	Machine Learning Approach for Identification of Microstructure-Property Linkages in crystalline materials from Electron Back Scatter Diffraction using crystal plasticity simulations
14	Akshat Goyal	Dr. K. M. Sharika	Role of Affective Outcomes on Sequential Decision Making
15	Akshit Kanaujia	Dr. Amey Karkare	To collect and analyse data related to introductory programming courses and resolve the errors in codes.

16	Aman Jain	Dr. Veena Bansal	Yoga Recommendation System
17	Aman Jaiswal	Dr. Swaprava Nath	Covid Self-help Chatbot
18	Amitesh Singh Sisodia	Dr. Swamy Peruru	Effective Wireless Technology Identification using Deep Learning Techniques with SNR as an Additional Feature
19	Anand Patwa	Dr. Arjun Ramakrishnan	Learning and Decision making under uncertainty
20	Anish Garg	Dr. Sanjay Mittal	Effect of the height of Winglet on Aerodynamic Performance of the Wing
21	Anjali Rameswari	Dr. Manjesh Kumar Singh	Overview on Polymer Brushes and Molecular Dynamics Simulations of Linear Polymer Chains
22	Ankit Kumar Gond	Dr. Alakesh Ch. Mandal	Linear stability analysis of wake velocity profiles
23	Anmol Pabla	Dr. Ishan Sharma	Simulation of a Fragmented Warhead
24	Anshul Agarwal	Dr. Suwendu Samanta	Machine Learning Model deployment on Web-based platform
25	Anshul Kapoor	Dr. Pranav Joshi	Measurement of pressure distribution from velocity data.
26	Apoorv Rajput	Dr. Arvind Kumar	Design of solid vertical cylindrical heat sinks with branched fins for LED application
27	Arnab Maji	Dr. Madhav Ranganathan	PALE Growth Simulation of c-plane of GaN using kMC
28	Arush Kumar Singh	Dr. Abhishek	Estimation of Proprotor Design Parameters for Biplane Tailsitter UAS with 20 kg payload and 100 kg all up weight.
29	Aryan Kumar	Dr. Bharat Lohani	Mobile LiDAR System
30	Azhar Tanweer	Dr. Dipak K Giri	Adaptive Coordinated Control of a Dual Arm Space Robot with Nonplanar Dynamics
31	Bharat Bhusan Rath	Dr. Raj Pala	To observe the change in phase of a given material into another phase and also observe grain growth using MOOSE Platform
32	Bhavika Rangwani	Dr. Raghu Nandan Sengupta	Robust Regression with application in Human age detection using human faces

33	Chaitanya Sahni	Dr. Sachin Y. Shinde	Implementing Active Motion Capabilities to rigid and flexible filaments in LUMA software
34	Chitresh B. Chaudhari	Dr. Nisanth Nair	Neural Network based collective variable discovery for enhanced sampling of Alanine Tripeptide free energy surface
35	Debaditya Bhattacharya	Dr. Shubham Sahay	Design of a Neuromorphic Neuron using Ferroelectric Field-Effect Transistors
36	Deepanshu Rathi	Dr. Nilesh Badwe	Analysis of martensite temperature of steel using machine learning models.
37	Devang Uniyal	Dr. Sachin Y. Shinde	Numerical study of flow over flapping filaments in square pattern
38	Devansh Mishra	Dr. Shankar Prawesh	Causal Inference in Marketing
39	Dheeraj singla	Dr. Suwendu Samanta	Facial Expression Classification using Convolutional Neural Networks
40	Dhruv Mittal	Dr. Amit Mitra	Estimating Value at Risk using ANN
41	Diksha Banka	Dr. Raju Kumar Gupta	Development of nanostructured materials for removal of fluoride from wastewater
42	Dilip Parmar	Dr. Suwendu samanta	Vedabase Shloka Recommendation System
43	Disha Virmalwar	Dr. Kanwar Singh Nalwa	Predictive Modelling of Ion Migration Induced Degradation in Perovskite Solar Cells
44	Divya Adil	Dr. Sumit Basu	Continuum Mechanical Modeling of the Invagination Process of Forebrain Roof Plate
45	Diya Singhal	Dr. Indranil Saha Dalal	Mixing in Microchannel with Non-Newtonian Fluids
46	Faizan Ahmad Shah	Dr. Gautam Biswas	Dynamics of a Falling Liquid Drop in a Deep Liquid Pool
47	Gaurav Kumar	Dr. Dipak K Giri	Optimal Control for High Precision Rendezvous and Docking of Coulomb satellites
48	Harish Adsule	Dr. Shilpi Gupta	Photon correlations and Blinking in Quantum Dots
49	Harishankar K P S	Dr Amit Kumar Agarwal	Exploration of Nonlinear optical processes using density matrix formulation

50	Harshit Itondia	Dr. Subrahmanya Swamy Peruru	Graph Neural Networks with Continual Learning for Fake News Detection from social media
51	Himanshu Kishor Choubey	Dr. Gautam Biswas	Dynamics of a Falling Liquid Drop in a Deep Liquid Pool
52	Himanshu Mishra	Dr. Malay K. Das	Modelling and simulation of discharge-recharge cycle of lithium-air battery under different operating conditions.
53	Ishit Manojkumar Darania	Dr. Salil Goel	Aircraft Detection using LiDAR
54	Janhavi Bhoge	Dr. Suparno Mukhopadhyay	Structural optimization of truss bridges accounting for structural damage and preventing catastrophic collapse
55	Jignesh Mohanty	Dr. T. Sarkar	Developing algorithms on Strong gravitational lensing by specializing in Strong gravity scenario
56	Kartikeya Gupta	Dr. Mangal Kothari	Control of Dual Spin Systems using Piezoelectric Braking System
57	Kavya Agarwal	Dr. Deepak Dhingra	Development of Hyperspectral Data Analysis Routines for Mineral Mapping of Planetary Surface
58	Khushboo Sachdeva	Dr. Arjun Ramakrishnan	Effect of Anxiety on Working Memory and Decision Making
59	Khyathi Vagolu	Dr. Arjun Ramakrishnan	Suboptimal decision-making due to stress and anxiety in sequential foraging tasks
60	Kunal Sahu	Dr. Suwendu Samanta	Performance Analysis of feature extraction methods for drowsiness detection
61	Kushik	Dr. Raja Angamuthu	Organic Derivatives based reversible Redox batteries
62	Lakshita Mohanty	Dr. Ishan Sharma	Modeling Subsurface Mine Detonation
63	Manit Ajmera	Dr. Anikesh Pal	Drug Discovery for SARS-CoV-2 Virus Using Machine Learning
64	Maryam Raza Khan	Dr. Malay K. Das	Simulation of Discharge of a Lithium Oxygen Battery
65	Md. Kaif Faiyaz	Dr Amit Kumar Agarwal	Exploring Anomalous Hall effect
66	Mohammad Saad	Dr. Supratik Banerjee	Understanding the Physics of Neutron Star Crust Using Electron Magnetohydrodynamics (EMHD)

67	N Bhuvan	Dr. Rik Dey	Inverse Edelstein effect from topological insulator surface states in open and closed-loop circuits
68	Naivedya Amarnani	Dr. Amit Kuber	Understanding domestic string algebras and exploring their correspondence with rooted binary trees
69	Namgyal Lhamo Dolma	Dr. Arjun Ramakrishnan	Investigating the Effects of Depression and Anxiety on Foraging and Economic Tasks
70	Nirbhi Pareek	Dr. Raghu Nandan Sengupta	Optimal strategy for two player, stochastic games with application in cybersecurity
71	Nishant Arya	Dr. Vipul Arora	Remote Learning Platform for Musical Instruments
72	Nishant jain	Dr. Rajiv Sinha	Water quality analysis using Machine learning techniques
73	Nivedan Amarnani	Dr. Kantesh Balani	Molecular Dynamics Approach Towards Observing the Effect of pH on Interaction of Proteins with Bio-surfaces
74	Padam Sharma	Dr. Veena Bansal	Building a Yoga Recommendation System
75	Palak Shah	Dr. Prishati Raychowdhury	Analysis of machine foundation on non-homogeneous soil deposits
76	Perikala Sandeep	Dr. Shubham Sahay	Design and Analysis of Tunnel FET based Biosensors
77	Pragati Singh	Dr. Nilesh Prakash Gurao	Crystal Plasticity of fatigue damage in metallic materials
78	Prakhar Mishra	Dr. Malay K. Das	: Modelling and simulation of discharge recharge cycling of Lithium Oxygen battery under different operating conditions
79	Prakriti Singh	Dr. Kanwar Singh Nalwa	Modeling defects in Perovskite Solar Cells
80	Pranjal Praneel	Dr. Manoj K Harbola	Investigations of applying the variational principle in classical and quantum calculations using random numbers
81	Praveen Prabhat	Dr. Kanwar Singh Nalwa	The organic molecule as additives to improve the stability of perovskite solar cells by defect passivation.
82	Preeti Kumari	Dr. K S Venkatesh	Study and shape analysis of closed contours in 2D space
83	Raghavan Gopalan	Dr T.Sarkar	Smoothed Particle Hydrodynamics and its Applications in Astrophysics

84	Rahul Singh	Dr. P. Venkitanarayanan	Impact analysis of aluminium foam material by Finite element method
85	Raj Agarwal	Dr. Pradipta Kumar Panigrahi	Electrospraying Of Binary-Fluid
86	Raj Kumar Yadav	Dr. Suwendu Samanta	Facial Expression Recognition Through Convolutional Neural Network
87	Rajit Das	Dr. Deepak Dhingra	Compositional Mapping of an Anomalous Impact Melt Deposit on the Far Side of the Moon
88	Rishabh Katiyar	Dr. Shubham Sahay	Hardware Implementation of Reinforcement Learning Algorithms
89	Rishika Saraswat	Dr. Debopam Das	Engineering a Mechanical Model Imitating Butterfly Wing Motion
90	Rohit Sharma	Dr. Suparno Mukhopadhyay	Analysis of the effects of Dynamic loading and associated damages on Truss Bridges
91	Saankulp Jain	Dr. Rajdip Mukherjee	Phase-field modelling of microstructure evolution in Advanced High Strength Steel
92	Sahil Ranjan	Dr. K. Muralidhar	The turbulent flow of water and air water over flat surface and surface with protrusions
93	Saksham Pruthi	Dr. Jonaki Sen	To Hypothesize Interacting Partners of R cadherin and Integrins during Roof Plate Invagination Process of Chick Forebrain Morphogenesis
94	Saloni Dabgar	Dr Sivasurender Chandran	Dynamics of Bacterium in Biofilms - Influence of Salt Concentration
95	Samarth Sachan	Dr. Mangal Kothari	Control Of Dual Spin Systems Using Piezoelectric Braking System
96	Sankalp Sharma	Dr. Salil Goel	Generation of Labeled Point Cloud Data of any Virtual World
97	Sanyukta Agarwal	Dr. Mahendra K Verma	Solar Wind and Coronal Heating
98	Sayak Bhattacharjee	Dr. Sagar Chakraborty	Investigating the Connection Between Information Theory and Evolutionary Game Dynamics
99	Shivam Goel	Dr. Laxmidhar Behera	Autonomous Excavator Manipulation
100	Shivam Malhotra	Dr. Shubham Sahay	Hardware Security using Emerging Non Volatile Memories

101	Shivangi Srivastava	Dr. Indranil Saha Dalal	Comparison between mixing of Newtonian and Non-Newtonian fluids(pseudoplastic)
102	Shreyasi Roy Choudhury	Dr. Dharmaraja Allimuthu	Fluorescent chemical probes for understanding protein aggregation effects: Challenges & opportunities
103	Siddharth Gupta	Dr. Santosh K. Misra	Role of Carbon Materials in Drug eluting, 3D printed Biomedical Grafts
104	Som Tambe	Dr. Priyanka Bagade	Benchmarking deep learning workloads on docker containers vs. bare metal machines
105	Souvik Guriya	Dr. Vaibhav Arghode	Design Modification and CFD Analysis of the Standalone, Miniature Power Generation System
106	Sunny Kumar Bhagat	Dr. Vishal Agarwal	Modelling Pyrolysis of Methane in gas-phase Sodium clusters i
107	Suraj S.	Dr. Nisanth Nair	Neural Networks for representation of high dimensional Free Energy Surfaces of physiochemical processes
108	Swapnil Singh	Dr. Vipul Arora	Inter-Session Mental Workload Estimation for Passive Brain-Computer Interface
109	Tanishq Chourishi	Dr. Shakti S. Gupta	Comparison of different leg configurations for robust quadruped robot
110	Tanishq Gupta	Dr. Nitin Gupta	Automated Cognitive Behavioral Therapy
111	Tarun Agarwal	Dr. Rik Dey	Effect of prohibited direct-backscattering on spin-charge inter-conversion in diffusive and ballistic topological insulators
112	Vardhaman Jain	Dr. Abhishek	Simulation and Modelling of Compound Helicopter UAV
113	Vedang Tiwari	Dr. Mangal Kothari	Path planning and tracking methods for Quadruped robots
114	Vinoba Pandey	Dr. Chandraprakash C	Surface Energy Constant For Low Energy Solids
115	Vishrant Dave	Dr. Ashoke De	Multiphase Numerical Analysis for Latent Heat TES Systems
116	Vivek	Dr. Arvind Kumar	Design of cylindrical heat sink for CPU cooling.
117	Vivek Kumar Singh	Dr. Dootika Vats	Cloud-based visualizations for Markov chain Monte Carlo

118	Yash Gupta	Dr. Swaprava Nath	COVID Self Help Chatbot
119	Yash Srivastava	Dr. Sanjay Mittal	Analysis of Winglets and their Efficiency in flows with different Reynolds numbers & Angles of Attack

Participants of SURGE 2021 at IITK from Other Universities

S.N.	Name	Institute Name	Mentor	Project Title
1	Abhishek Roy	IEST, Shibpur	Dr. Arun K Perumal	Mach Reflection on Supersonic Jet of Over expanded Nozzle Flow
2	Aditi Singh	NIT Hamirpur	Dr. Anoop Singh	Impact Assessment of IME's Opinions on the CER Policies
3	Aditya Sharma	MANIT	Dr. Sudhanshu Shekhar Singh	Prediction of Hardness of Aluminum alloys using Machine learning techniques
4	Agam Swami	Faculty of Engineering, Dayalbagh Educational Institute	Dr. Anoop Singh	Demand Forecasting Approaches in the Power Sector - A Comparative Analysis
5	Akanksha Sharma	IIT BHU	Dr. Anand Singh	Latest Progress in Organic Solar Cells (OSCs) and Emergence of Semi-transparent Organic Solar Cells (ST-OSCs)
6	Akhila Aravind	Pondicherry Central University	Dr. Santosh, N.	A Study Of Young Tableaux
7	Akshat Uppal	NIT, Hamirpur	Dr. Vivek Verma	Agarose based hydrogel for wound healing dressings
8	Akshay Raina	Shri Mata Vaishno Devi University	Dr. Vipul Arora	Time delay estimation in audio signals using Signal Processing and Deep Learning

9	Amrit Anwesh	NIT, Rourkela	Dr. Twinkle Tripathy	Implementation of Distributed Event Triggered Control for Multi Agent Systems
10	Ankit Jaiswal	IIT BHU	Dr. Rakesh Kumar Mathpal	CFD Analysis of an Annular Plug (Aerospike) Nozzle
11	Anwasha Roy	Heritage Institute of Technology	Dr Appu Kumar Singh	Production of recombinant proteins using a bacterial expression system
12	Arnab Hazra	IEST, Shibpur	Dr. Ashoke De	Study the effect of molecular weights of different gases on the formation of triple points and vortices in a shock wave past a wedge for different Mach numbers.
13	Atharva Vilas Vyawahare	NIT,Durgapur	Dr. Niraj Mohan Chawake	Thermal Analysis in Spark Plasma Sintering
14	Aviral Chharia	Thapar Institute of Engineering & Technology	Dr. Ashwani Thakur	A de novo low cost Device Design for Insulin Peptide hormone drug Vial Storage to mitigate efficacy loss
15	Bhavya Bhardwaj	Amrita Vishwa Vidyapeetham	Dr. K Venkatesh	Demodulation and Detection of Digital Signal using Machine Learning
16	Debasish Panda	NIST, Berhampur	Dr. Santosh K. Misra	Designing of Bio-sensing Chip for Assessing Post COVID Neurological Complications
17	Deepak Ganesh	IIT, Madras	Dr. Tanmoy Mukhopadhyay	Developing a Theoretical Model of the Hard Magnetic Soft Material Beams to study Metamaterials
18	Dhairyadhar Bhelave	VNIT, Nagpur	Dr. Ashoke De	Numerical investigation of the Unsteadiness induced by a control surface in a supersonic flow.
19	Dikshansh Suryavanshi	MANIT	Dr. Nilesh Prakash Gurao	Investigation of Deformation behaviour of Single-phase and Multi-phase Alloy for different grain morphology using crystal plasticity based Finite Element method.

20	Divya Tripathi	MANIT BHOPAL	Dr. Anshu Gaur	Role of curvature on electronic properties on Carbon Nanotubes, Cnt to Graphene
21	Divyani	NIT, Goa	Dr. Anoop Singh	Extraction of Keywords from documents and summarization
22	Geetam Saha	Jadavpur University, Kokata	Dr. Rajesh Ranjan	Computational study of transitional flows in turbomachinery
23	Gowtham Reddy Uppunuri	NIT Raipur	Dr. Anoop Singh	Automation of downloading pdfs from various ERCs, storing essential details in a database and classifying these pdfs into Regulations, Orders and Tariff Orders
24	Harsh Vardhan Singh	VIT	Dr. Arvind Kumar	Design of turbine blade with internal cooling channels for aerospace application.
25	Harshil Pathak	Sardar Vallabhbhai National Institute of Technology	Dr. Kaushik Bal	Distributions and Sobolev Spaces
26	Hela Ambati	IEST, Shibpur	Dr. Tanmoy Mukhopadhyay	Study on the Effect of vibration on the elastic moduli of different lattice materials based on dynamic stiffness matrix of a beam element.
27	Jayanti	Hindu College, University of Delhi	Dr. Ritika Gautam	Recent advances, mechanistic strategies, and applications of metal-based antiviral, antibacterial, antifungal and antitumor drugs.
28	Karthika Kalyansundar	Stella Maris College, Chennai	Dr. R. Gurunath	Designing ligands that yield a square pyramidal geometry on complexing with Fe(III) ion: Active site mimics of the enzyme DMFase
29	Katakam Vishnu Sree Shanthanu	NIT, Warangal	Dr. Vaibhav Arghode	Study of Particle Deposition from the impact 2D axisymmetric dust-air flow on flat plate and optimization of flat plate profile using mesh morphing technique.

30	Kaustuv Ray	NIT, Rourkela	Dr. Abhas Singh	A Comprehensive Review of Aquifer Properties of Indian Alluvial Plains and its Impact on Fluoride Contamination.
31	Krishna Murali	Amrita Vishwa Vidyapeetham	Dr. Sathesh Mariappan	Investigation of Vortex Acoustic Lock-in for Turbulent Flows in Combustors
32	Kumar Harsh	NIT, Patna	Dr. Subhajit Roy	Classification of SQL Query Plans using Unsupervised Learning and Prediction of Optimal Execution Plan for a given Query
33	Kushal Kothari	MCT Rajiv Gandhi Institute Of Technology	Dr. Urbi Chatterjee	Security vulnerabilities and analysis of Yggdrasil encrypted IPv6 Yggdrasil Network
34	Leafy Behera	IISER Kolkata	Dr. Arjun Ramakrishnan	Feasibility of DREADDs in Non-Human Primates
35	M V Nitya	B.M.S. College Of Engineering	Dr. Rajesh Ranjan	Assessment Of Low-Cost CFD Methodologies For Two Computationally Challenging Problems
36	Madhav Ramesh	IIT Palakkad	Dr. Amit Verma	Stochastic resonance in ferroelectrics
37	Mainak Mallick	IEST, Shibpur	Dr. Pritam Chakraborty	Implementation of a User Subroutine in ABAQUS to simulate the Martensitic transformation in AISI 304L steel during indentation.
38	Muskan Khajuria	NIT Hamirpur	Dr. Ashutosh Modi	Indic legal text dataset creation and application of Named Entity Recognition on the same
39	Pranjal Anand	BITS, Pilani	Dr. Rajesh Ranjan	Prediction of Aerothermal Properties of Highly Loaded Turbine Guide Vane Using RANS Methods
40	Prasanna Shinde	Indian Institute of Petroleum and Energy	Dr. Harshwardhan H. Katkar	Adsorption of polymer chains with a different molecular architecture at surfaces, Scaling and Monte Carlo Analysis.
41	Prateek Gupta	NIT Rourkela	Dr. Rakesh Kumar Mathpal	Determination of Bulk and Shear Viscosity using EMD simulations

42	Prithu Mishra	Netaji Subhas University of Technology	Dr. Arvind Kumar	Thermal Analysis of TPMS Based Heat Sinks and their Manufacturing Simulation by 3D Printing
43	Purva Soni	Geetanjali Institute of technical Studies	Dr. Urbi Chatterjee	Analogous operation in elliptic curve cryptography to generate a signature to be used as a range proof of k-Times anonymous authentication.
44	Radha V	GMS Academy First Grade College	Dr. R. Gurunath	Altering the specificity of 3-nitrotoluene dioxygenase (3-NTDO) from diaphorobacter sp. strain DS2 to facilitate the degradation of nitroalkanes by site-directed mutagenesis.
45	Raghav Singh	NIT Hamirpur	Dr. Anoop Singh	Forecasting Future Energy Requirements
46	Rajashree Srikanth	Amrita Vishwa Vidyapeetham	Dr. Sathesh Mariappan	Investigation of Vortex Acoustic Lock-in for Turbulent Flows in Combustors
47	Ramanuja Srinivasan S	CSIR - Central Electrochemical Research Institute	Dr. Anandh Subramaniam	Coherent to Semi Coherent Transition of Precipitates in Van der Merwe Epitaxial Films
48	Ridhima Raina	St. Stephens College, University of Delhi	Dr. Ritika Gautam	Recent Advances, Mechanistic Strategies and applications of metal-based antiviral, antifungal and antibacterial drugs
49	Roshni Dhal	College of Engineering and Technology, Bhubaneswar	Dr. Abhas Singh	Surface Complexation Modelling of Uranyl adsorption on synthetic Rhodochrosite
50	S. R. Harshini	NIT, Tiruchirappalli	Dr. Arun K Perumal	Over expanded nozzle flows, Analytical expression for determining M_j at which the Mach reflection is eliminated and becomes a regular reflection, for a given design Mach number M_d and specific heats γ
51	Saanidhya Sharma	Vellore Institute of Technology, Bhopal Campus	Dr. Debadatta Mishra	Event Analysis for gemOS

52	Sanjam Kumar Panda	Silicon Institute Of Technology	Dr. Debadatta Mishra	Characterisation of Process-to-Process Memory Copy System Calls in the Linux Kernel
53	Shivam Prajapati	NIT agartala	Dr. Umesh Madanan	Computational study on jet break-up behavior of a high-density liquid jet entering a quiescent immiscible liquid pool
54	Shruti Sandipbhai Rajpara	IEST, Shibpur	Dr. Rajesh Ranjan	RANS prediction of the effects of varying Reynolds number and pitch distances on the flow past T106C low-pressure turbine cascade
55	Siddhartha Nanda	NIT Rourkela	Dr. Anshu Gaur	Determination of orbital overlap integrals and testing the correlation between orbital overlap integrals and effective mobility for semiconductors.
56	Sneha Suresh Kumar	NIT, Tiruchirappalli	Dr. Bharat Lohani	Labelling LiDAR point cloud
57	Somarya Bhattacharyya	NIT , Durgapur	Dr. Debopam Das	Numerical Analysis of Aerodynamic Performance of Airfoils based on the Atmospheric Conditions on Mars
58	Somesh Lahiri Chakravarty	IEST Shibpur	Dr. Rajesh M Hegde	Analysis of Spherical Microphone Array beam forming Techniques and Its Detailed Studies
59	Sonali Srivastava	Faculty Of Architecture and Planning, AKTU	Dr. Anubha Goel	The Impact of Building Materials on Environment: Traditional Versus the Contemporary Materials of Lucknow.
60	Sourav Kumar Sah	NIT Rourkela	Dr. Nilesh Prakash Gurao	Optimization of thermal energy in coal based DRI
61	Subhrajeet Pattnaik	NIT Rourkela	Dr. Amar Nath Roy Chowdhury	Studying the effects of graphene nanofiller on the mechanical properties of CSH gel using molecular dynamic simulation
62	Swagata Laxmi Sengupta	NIT Durgapur	Dr. Anurag Tripathi	Base wall dependent stress variation in granular column using DEM

63	Swarag. T	IISER, Pune	Dr. K. M. Sharika	How Consideration of Self and Stimulus Type affects Decision Making
64	T Kaartick	NIT Puducherry	Dr. Tanmoy Mukhopadhyay	Stochastic Approach for Flexural Waves Control in Smart Material Beam with Single and Multiple Resonant Shunt Circuit Using Spectral Element Method
65	Vaishnavi Patil	IIT, Dharwad	Dr. Ashutosh Modi	LEGAL NLP - Creation of a dataset for Indic legal texts and application of Named Entity Recognition (NER) on the same

Abstracts: SURGE 2021 Research Projects done at IIT Kanpur

New model of wheel

Aarjav Jain, Mentor: Dr. Ramprasad Potluri

In this project we tried to explain the motion of the wheel from a different perspective. We have posed certain questions as to what is the need for this, how the new model is better than the previous explanation and we are working on them. We have found certain answers to these questions and our work is about to complete.

Reinforcement Learning for Quadcopters

Aaryansh Mohan Bansal, Mentor: Dr. Mangal Kothari

The project is about designing an autonomous controller by using reinforcement learning. This would be very beneficial for the drone industry as the conventional controller are generally model-dependent. an RL-based controller would be model-independent.

Autonomous Excavator Manipulation

Aaryen Milan Mehta, Mentor: Dr. Laxmidhar Behera

We plan to build an autonomous excavator that helps miners to mine. This excavator can be controlled remotely by someone standing outside the mine. Several sensors including depth cameras and gas sensors have also been attached to the excavator.

Conceptual Design of A Tethered coaxial rotor UAV

Abhinav Aggarwal, Mentor: Dr. Abhishek

In this project, we are trying to carry out a conceptual design of a tethered coaxial rotor UAV. Using coaxial configuration keeps the design compact. Tether is used to transmit power from ground supply to fly the UAV for longer time duration to make the product fit for surveillance.

Mach Reflection on Supersonic Jet of Overexpanded Nozzle Flow

Abhishek Roy, Mentor: Dr. Arun K Perumal

Mach reflection is an important phenomenon in the study of supersonic flow. This type of phenomenon was originally observed by E Mach. Problems in the design of rocket motor, jet engines or turbine blades cannot be fully understood without the knowledge of exhaust plume flow field of the gas jet which relies on the study of Mach reflection in high-speed flow.

Autonomous Excavator Manipulation

Achint Soni, Mentor: Dr. Laxmidhar Behera

We plan to build an autonomous excavator that will help in mining. This excavator can be controlled remotely by someone standing outside the mine. We also plan to attach several sensors including depth cameras and gas sensors to the excavator.

Numerical Study of Flow Over Flapping Foils in Triangular Pattern

Adarsh Chaudhary, Mentor: Dr. Sachin Y. Shinde

The objective of our project is to study the hydrodynamic interaction of wake generated by rigid filament arrangements in free stream velocity. We installed LUMA (an LBM solver) with building dependencies and ran several test cases. We also compared the plots of different test cases to find similarities and dissimilarities.

Impact Assessment of IME's Opinions on the CER Policies

Aditi Singh, Mentor: Dr. Anoop Singh

This project aims to verify whether the opinion given by the IME department, IIT Kanpur on the CER draft has been taken into consideration and included into the finalized policy, or not.

Theory of Edelstein magnetoresistance in heterostructures consisting of topological insulators and ferromagnetic materials.

Aditya Gupta, Mentor: Dr. Rik Dey

We attempt to solve the Edelstein Magneto Resistance of the TI/NM/FMI stack and investigate its dependence on Ferromagnetic Insulator (FMI) magnetization magnitude and direction.

Dynamic Velocity Error based Trajectory Tracking by Space Robotic Manipulator

Aditya Prakash, Mentor: Dr. Dipak K Giri

Nowadays, a significant number of space missions are using robotic manipulators. Space manipulators have a wide range of applications in space missions, such as on-orbit satellite maintenance, scientific research or space debris removal, etc. The manipulator's end-effector needs to move from the current position to the desired position for all these operations. In most cases, the end-effector fol.

Prediction of Hardness of Aluminum alloys using Machine learning techniques

Aditya Sharma, Mentor: Dr. Sudhanshu Shekhar Singh

In this project, I have used Machine Learning techniques to predict the hardness of Aluminium alloys having particular composition and age hardening conditions (time & temperature). Out of the various Machine Learning algorithms, the results obtained from the Random Forest Regression model show the best accuracy having an R2 value of 0.9598, which suggests the given model can be used to efficiently.

Impact Induced Acceleration on Small Bodies

Aditya Vats, Mentor: Dr. Ishan Sharma

An important aspect when studying the nature of an asteroid is its surface. Surface of asteroids are covered by a blanket of small grains, called regolith, a layer of granular materials with sizes ranging from fine dust to coarse grains. The method of formation of this layer is of important to the behaviour of the asteroid. The dominant theory is that of disturbance caused by seismic waves generated by impacts on surface and that is what we are studying.

Demand Forecasting Approaches in the Power Sector - A Comparative Analysis
Agam Swami, Mentor: Dr. Anoop Singh

This project aims to analyse, select and apply the most effective demand forecasting technique for the given data. Some specific region has been selected as a case study area for this project. We discovered some key elements about data collection, model selection, variables under consideration, numerous factors that may affect energy demand, the impact of COVID-19.

Latest Progress in Organic Solar Cells (OSCs) and Emergence of Semi-transparent Organic Solar Cells (ST-OSCs)

Akanksha Sharma, Mentor: Dr. Anand Singh

In this project we will see various aspects of organic solar cells. What all methods previously used and what all ways we can use in future to improve its power conversion efficiency (PCE).

Implementing Active Motion Capabilities to rigid and flexible filaments in LUMA software.

Akarsh Raj, Mentor: Dr. Sachin Y. Shinde

Project include the development of an open-source CFD solver LUMA and adding capabilities of active motion to rigid and flexible filaments and self-propulsion in flexible filaments.

Machine Learning approach to predict a better composition of Perovskite solar cell in terms of enhanced stability

Akash Mishra, Mentor: Dr. Kanwar Singh Nalwa

In this project, we have tried to illustrate this phenomenon of stability change by changing the cation/anion composition with the help of Machine learning algorithms. The model can predict the stability value when given the values for independent variables. The testing and storage conditions (moisture, oxygen, ambient temperature, and light) strongly affect the device stability thus we chose constant testing and storage conditions (30-40% RH testing condition in this case).

Testing Deep Learning Models for LiDAR data segmentation

Akashdeep Bhateja, Mentor: Dr. Bharat Lohani

Deep Learning is used for the Segmentation of 3D Point Cloud data generated from LiDAR sensors. Rule-based classification algorithms have been used for classification of LiDAR point cloud data and extraction of power lines from those. This task of inspecting the lines can be done in a more efficient way using a deep learning approach for the classification of LiDAR point cloud. More suitable algorithm for detection of general-purpose objects such as tables, chairs, guns, etc. are PointNet, PointNet++ and PointCNN, as reported in the literature.

A Study Of Young Tableaux

Akhila Aravind, Mentor: Dr. Santosh, N.

In this project we aim to develop the basic combinatorics of Young Tableaux and study their applications in representation theory and geometry. We see different concepts

like young diagrams and skew tableaux with various examples and important algorithms in combinatorics like Row Bumping and Sliding. We learn jeu de taquin and Row Bumping Lemma. Topics like words, plactic monoids, Schur polynomials.

Machine Learning Approach for Identification of Microstructure-Property Linkages in crystalline materials from Electron Back Scatter Diffraction using crystal plasticity simulations

Akshat Chaudhari, Mentor: Dr. Nilesh Prakash Gurao

Performing crystal plasticity simulations on synthetic microstructures to study effect of grain size. Then to train an ML model to predict Taylor factor, elastic modulus. In this project we are generating synthetic microstructures of different grains sizes and textures (using Dream 3D) and performing crystal plasticity simulations on them using (DAMASK) to investigate the effect of a fixed von mises strain but different strain paths on these microstructures to compare their stress-strain curves and textures.

Role of Affective Outcomes on Sequential Decision Making

Akshat Goyal, Mentor: Dr. K. M. Sharika

My project involves exploring and investigating the role of outcome valence stimuli on planning of sequential movements. In simpler terms, through the online psychophysical test I planned to prepare over the summers, I plan to explore how knowing if the outcome is good or bad affects the decisions we make. The decisions in the test would be to make eye movements to randomized points on the screen which are being recorded via the webcam available on the PC device.

Agarose based hydrogel for wound healing dressings

Akshat Uppal, Mentor: Dr. Vivek Verma

Agarose is one of the best material for hydrogel dressings due to its good mechanical strength, good swelling capacity and non toxicity. Agarose is a linear polysaccharide made up of repeating units of agarbiose, which is a disaccharide of D-galactose and 3,6-anhydro-L-galactose repeating units. It is present in the cell walls of agarophytes commonly called as red seaweed.

Time delay estimation in audio signals using Signal Processing and Deep Learning

Akshay Raina, Mentor: Dr. Vipul Arora

In this project, we deal and attempt to solve the problem of estimation of temporal delays or offsets in signals, particularly audio signals using signal processing and deep learning. For this, firstly we analyzed the most classic approaches towards the same and are presently working upon developing a novel approach for the same.

To collect and analyze data related to introductory programming courses and resolve the errors in codes.

Akshit Kanaujia, Mentor: Dr. Amey Karkare

My Project involves analyzing python codes and checking for errors in them, fixing them using different frameworks, perform unit testing on these codes using the pytest framework, and connects tutors and students simultaneously on an IDE-like platform.

Yoga Recommendation System

Aman Jain, Mentor: Dr. Veena Bansal

This project attempts to develop a Machine Learning-Based system that can recommend yoga asanas for a user by considering the user's medical conditions. There is much information available in books and on the internet, but they fail to produce precise, accurate and authentic results. We searched for various medical conditions in books and on the internet, but they lack vital information like contraindications, benefits, breathing style or even proper procedure.

Covid Self-help Chatbot

Aman Jaiswal, Mentor: Dr. Swaprava Nath

The second wave of the COVID-19 pandemic caused a lot of demand for resources such as oxygen, hospital beds, plasma donors and medicines. A lot of databases were created for these resources by various groups, but the data was very scattered. To make it easier for those in need to find the right resources without much effort, we developed a chatbot in python from scratch to cater to these demands. It responds to the user's COVID related queries from an online database. We deployed it on Telegram using the HTTPS-based Telegram Bot API and used gspread to access the database. It catered to more than 2,500 people in the official Telegram group for COVID emergencies in IIT Kanpur.

Effective Wireless Technology Identification using Deep Learning Techniques with SNR as an Additional Feature

Amitesh Singh Sisodia, Mentor: Dr. Swamy Peruru

Wireless Technology Identification Project targets analyzing wireless signals in order to design and develop novel deep learning models to classify them effectively. An extensive simulative study is conducted on feature analysis and extraction across different wireless data types and formats.

Implementation of Distributed Event Triggered Control for Multi Agent Systems

Amrit Anwesh, Mentor: Dr. Twinkle Tripathy

Multi-agent systems consist of multiple autonomous and intelligent agents that interact with each other to achieve common objectives. Multi-agent systems are a part of extensive study in recent times due to their huge potential in systems such as autonomous driving, multi-machine plants, etc. In this project, we aim to implement multi-agent systems in an event-triggered framework.

Learning and Decision making under uncertainty

Anand Patwa, Mentor: Dr. Arjun Ramakrishnan

This project is aimed at trying to understand how human decision-making and learning is affected by the uncertainties that we face. Selecting the best course of action is often difficult for us due to the various uncertainties involved in the environment. Our decision making depends a lot on how we can estimate these uncertainties and it will certainly move towards being optimal if we get good at estimating. In uncertain environments we always have the conflict of continuing exploiting the current path

which is favoured and we have information about or go down the path of lesser-known options which may have been less rewarding in the past by exploring them.

Effect of the height of Winglet on Aerodynamic Performance of the Wing

Anish Garg, Mentor: Dr. Sanjay Mittal

Winglets are wingtip devices intended to disrupt the wing-tip vortices to reduce the effective drag force on the aircraft. Winglets appear in various shapes and sizes, but it is still unclear about how prominent, if any, effect it has on the drag force. Performing CFD Analysis on the variants of Wings with different Winglet Heights would potentially explain the effect of winglets. To reduce complexity and considering software constraints, a simple rectangular half-wing with rectangular winglets is selected for analyzing.

Overview on Polymer Brushes and Molecular Dynamics Simulations of Linear Polymer Chains

Anjali Rameswari, Mentor: Dr. Manjesh Kumar Singh

Polymer brushes bearing surfaces when sheared against each other in presence of a good solvent have very low coefficient of friction which makes it a good lubricant. The aim of this study is to study about polymer brushes and estimate radius of gyration for linear polymer chains of different lengths. Future scope of this study holds the formation of polymer brushes.

CFD Analysis of an Annular Plug (Aerospike) Nozzle

Ankit Jaiswal, Mentor: Dr. Rakesh Kumar Mathpal

We have studied a 15 ° conical annular aerospike nozzle in detail using computational fluid dynamics technique. The simulation has been carried out for 20% and 40% nozzles at different nozzle pressure ratios and it has been validated using the previous experimental results. Initial success with carrying out a simulation with sound results has been achieved.

Linear stability analysis of wake velocity profiles

Ankit Kumar Gond, Mentor: Dr. Alakesh Ch. Mandal

In this project, we are going to deal with the bi-global linear stability analysis of flow having some base state. The experimental data for this base state tell us about the velocity profile.

Simulation of a Fragmented Warhead

Anmol Pabla, Mentor: Dr. Ishan Sharma

We have modelled air as a collection of large number of small and smooth spherical particles and bullet as a larger metal sphere, and we are performing simulations on it using LAMMPS. Using LAMMPS we are studying the interaction of a metal sphere of a larger radius and much higher density with such a “particulate” form of air to determine the interaction model of the metal sphere and the “air particle” that represents the forces that are experienced by a bullet/warhead progressing through air, for this we move a pocket of air particles at speed towards a stationary metal sphere.

Machine Learning Model deployment on Web-based platform

Anshul Agarwal, Mentor: Dr. Suwendu Samanta

In this project, we deploy a pre-trained Machine Learning model on a web-based platform. It is very crucial to make these models available for naive users to facilitate easy go usage. We build our front end using the flask library for making the front end for a compound word classifier. Our work is inspired by earlier methods similar to Sanskrit Heritage Reader and Samsadhani Platform.

Measurement of pressure distribution from velocity data.

Anshul Kapoor, Mentor: Dr. Pranav Joshi

Semi Implicit Method for Pressure Linked Equations (SIMPLE) algorithm is used to measure the pressure distribution from 2D PIV velocity data.

Production of recombinant proteins using a bacterial expression system

Anwasha Roy, Mentor: Dr Appu Kumar Singh

As the quantity of structural information about protein targets grows, design cycles will definitely become more essential in drug creation. The protein structure-based strategy to drug development, in which the structure of a target protein is identified, is a logical approach. Molecular modelling can indicate hypothetical ligands, and Molecular Dynamics Simulations can estimate molecule movement.

Design of solid vertical cylindrical heat sinks with branched fins for LED application

Apoorv Rajput, Mentor: Dr. Arvind Kumar

The main goal is to compare the thermal performance of the existing heat sink model with the new heat sink model design. A solid vertical cylindrical heat sink with different geometries of branched fins is being evaluated for heat dissipation under natural convection heat transfer.

Study the effect of molecular weights of different gases on the formation of triple points and vortices in a shock wave past a wedge for different Mach numbers.

Arnab Hazra, Mentor: Dr. Ashoke De

Here in our project we took three different gases with significantly different molecular weight as working medium under same condition to compare the results among them and to compare with the air. Three different Mach numbers of 1.3, 1.9 & 2.5 were chosen for the experiment. Significant difference in the coordinates of the points have been noticed for different gases under same Mach no.

PALE Growth Simulation of c-plane of GaN using kMC

Arnab Maji, Mentor: Dr. Madhav Ranganathan

Pulsed Atomic Layer Epitaxy (PALE) is an MOCVD (Metal Organic Chemical Vapor Deposition) technique that can yield high-quality GaN layers with high precision control. The aim is to simulate the PALE growth of GaN lattice using a lattice kinetic Monte Carlo (kMC) method. The task is broadly classified into subparts: deposition and diffusion. Currently, the deposition simulation is executable.

Estimation of Proprotor Design Parameters for Biplane Tailsitter UAS with 20 kg payload and 100 kg all up weight.

Arush Kumar Singh, Mentor: Dr. Abhishek

The aim of this project is to determine proprotor design parameters for the octacopter tailsitter biplane of 105.03 Kg, and rotor radius 0.75 m for the conflicting requirement of optimal hover and forward flight.

Mobile LiDAR System

Aryan Kumar, Mentor: Dr. Bharat Lohani

we are using Deep Learning (DL) which has become a go-to tool for solving various complex problems. Compared to the classical machine learning algorithms, DL requires a lot of training data to learn.

Thermal Analysis in Spark Plasma Sintering

Atharva Vilas Vyawahare, Mentor: Dr. Niraj Mohan Chawake

Thermal Analysis in Spark Plasma Sintering is performed to understand the Temperature Distribution inside the specimen. Sintering is the process of making objects from powder, by heating the material in a furnace below its melting point so that bonding takes place by diffusion of atoms. This leads to individual powder particles adhering to each other in a dense compact.

A de novo low cost Device Design for Insulin Peptide hormone drug Vial Storage to mitigate efficacy loss

Aviral Chharia, Mentor: Dr. Ashwani Thakur

In this project, we aim to address the problem of Insulin hormone efficacy loss due temperature variations and lack of adequate low cost storage devices, affecting thousands of people in under-resourced regions of India and Africa, where refrigeration is not affordable. The project involved literature review, proposing a new design, modeling on CAD Software.

Adaptive Coordinated Control of a Dual Arm Space Robot with Nonplanar Dynamics

Azhar Tanweer, Mentor: Dr. Dipak K Giri

Space robotics is an emerging field. Control of a robotic manipulator on a floating base is difficult because of dynamic coupling between the robotic manipulator and base of the spacecraft. In this project we develop a controller for a dual arm space robot whose robotic arms are not constrained within a plane. This robot has advantages in on-orbit missions like target capturing and manipulation.

To observe the change in phase of a given material into another phase and also observe grain growth using MOOSE Platform

Bharat Bhusan Rath, Mentor: Dr. Raj Pala

We try to observe the phase change in a given component using MOOSE. The equation used was Allen Cahn. The equation was solved for a single component two-phase material and results were observed in Paraview. We also tried to observe grain growth in copper and tried to analyse the results.

***Robust Regression with application in Human age detection using human faces
Bhavika Rangwani, Mentor: Dr. Raghu Nandan Sengupta***

The human face image data with their corresponding human ages contains a lot of Outliers, therefore, models like Support Vector Regressor(SVR), Ordinary Least Squares(OLS) are not able to predict age correctly for a good number of data but robust models like Huber Model and Locally Adjusted Robust Regressor gave much better results for the dataset set, showing that only robust models could perform best when the data is contaminated with outliers.

***Demodulation and Detection of Digital Signal using Machine Learning
Bhavya Bhardwaj, Mentor: Dr. K Venkatesh***

This project is on constructing Machine Learning based Software defined-Radio for digital signal processing. Using varying modulation techniques, can then help reduce power consumption and improve noise invariance. Modulation techniques can generally be described as those that modulate the Amplitude, those that modulate the frequency and those that modulate the Phase.

Implementing Active Motion Capabilities to rigid and flexible filaments in LUMA software

Chaitanya Sahni, Mentor: Dr. Sachin Y. Shinde

We are trying to improve on an existing Open Source Computational Fluid Dynamics solver by adding active motion capabilities to it. These capabilities are added for rigid and flexible bodies alike.

Neural Network based collective variable discovery for enhanced sampling of Alanine Tripeptide free energy surface

Chitresh B. Chaudhari, Mentor: Dr. Nisanth Nair

We are attempting to find an efficient method to use artificial neural networks (ANN) to predict new lower dimensional CVs from a set of higher dimensional CVs. These low dimensional CVs will then be used to perform Temperature Accelerated Sliced Sampling (TASS) simulations. For this purpose, we will study Alanine Tripeptide to demonstrate our proposed method.

Design of a Neuromorphic Neuron using Ferroelectric Field-Effect Transistors

Debaditya Bhattacharya, Mentor: Dr. Shubham Sahay

Most modern neural networks use artificial neuron models which have stemmed from the Integrate and Fire Neuron. However, Hodgkin Huxley Neurons are more complex and can perform more complex operations than Integrate and Fire Neurons, but require more power and memory. We design an Electronic Hodgkin - Huxley Neuron using Ferroelectric Field-Effect Transistors.

Designing of Bio-sensing Chip for Assessing Post COVID Neurological Complications

Debasish Panda, Mentor: Dr. Santosh K. Misra

In this project we are planning to develop a biosensor using polymer-carbon composite where graphene will be used as a carbon nanomaterial for acting as the interacting

surface for the detection whereas a biomolecule with cytokine binding will be used as selectivity agent. Till now, we are in progress to design the bio sensing platform.

Developing a Theoretical Model of the Hard Magnetic Soft Material Beams to study Metamaterials

Deepak Ganesh, Mentor: Dr. Tanmoy Mukhopadhyay

Hard Magnetic Soft Material Beams come under the category of Soft active materials but with Magnetic particles embedded in them. In this study, we focus primarily on developing a theoretical model for the Hard Magnetic Soft Material Beams under the Influence of both Magnetic field and bending forces acting at the tip of the beam. This model can serve as a template for metamaterials analysis.

Analysis of martensite temperature of steel using machine learning models.

Deepanshu Rathi, Mentor: Dr. Nilesh Badwe

To analyse the database of martensite temperature of a variety of steel having different compositions of C, Mn, Si, Cr, Ni., Mo, etc. We are provided with the database of the composition of alloying elements and their corresponding martensite temperature. We have applied various machine learning regression models like Multiple Linear Regression, Polynomial Regression, Support Vector Regression, Decision Tree Regression, and Random Forest Regression to find the accuracy of the database and also used machine-learning algorithms to find the correlation coefficient of different alloying elements and martensite temperature.

Numerical study of flow over flapping filaments in square pattern

Devang Uniyal, Mentor: Dr. Sachin Y. Shinde

We attempt to investigate the effects of change in amplitude, frequency of pitching, inter-filament distance and phase difference on the flow pattern. We also tried some new cases involving hydrodynamics of flexible fins propelled in square configuration to get a better understanding of fishes' schooling pattern.

Causal Inference in Marketing

Devansh Mishra, Mentor: Dr. Shankar Prawesh

In this report, we first understand what we imply by causal inference and where it is used in marketing. Further on, we discuss about important terminologies like Conditional Average Treatment Effect (CATE) and Individual Treatment Effect (ITE). Methods to calculate the CATE and ITE are then discussed. We then learn about meta-learning algorithms, their uses, the mathematics behind them and their implementation. In the end, we use a simulation example to provide clarity on the different methods used to estimate the treatment effect.

Numerical investigation of the Unsteadiness induced by a control surface in a supersonic flow.

Dhairyadhar Bhelave, Mentor: Dr. Ashoke De

Unsteady DES carried for supersonic flow across a short flap protruding out of a slender missile body, inclined at different angles to missile axis. The wake field

generated downstream and shock waves and flow produced upstream of the flap is visualised. Here is the link to video file showing Mach number variation with time.

Facial Expression Classification using Convolutional Neural Networks

Dheeraj singla, Mentor: Dr. Suvendu Samanta

Computer Vision (CV) is one of the most exciting and discussed topics due to its wide range of applications. One such application is in the domain of facial expression Classification. This is an incredible technology which can be used to predict emotions. This will lead to the next level of interaction between humans and computers. Through this paper, we demonstrate how to classify facial emotions.

Estimating Value at Risk using ANN

Dhruv Mittal, Mentor: Dr. Amit Mitra

I studied about VaR and its importance. I looked at various methods used to calculate VaR and studied their underlying mathematical and statistical concepts. I looked at their pros and cons. I implemented quantile auto regression neural network using R. I tested the efficacy of my model by testing it on real time stock data indices like S&P 500.

Development of nanostructured materials for removal of fluoride from wastewater

Diksha Banka , Mentor: Dr. Raju Kumar Gupta

The aim of the project is to find suitable nanostructure material that can serve as an electrode for selective removal of fluoride from wastewater. It has an industrial application as more than 200 million people worldwide are exposed to drinking water with excess fluorine levels which can directly lead to dental fluorosis and arthralgia.

Investigation of Deformation behaviour of Single-phase and Multi-Phase Alloy for different grain morphology using crystal plasticity based Finite Element method.

Dikshansh Suryavanshi, Mentor: Dr. Nilesh Prakash Gurao

Microstructural morphology directly affects the mechanical behaviour of the material. In this work, different synthetic microstructures were generated with different morphologies by Neper software, which was meshed and then deformed. For this, they were tested under uniaxial tensile load for understanding the deformation behaviour. For single-phase, microstructure copper-based material parameters.

Vedabase Shloka Recommendation System

Dilip Parmar, Mentor: Dr. Suvendu samanta

This project Aims to a machine learning model for recommends the verse with similar meaning as verse inputted, so to do it we scrape data from Vedabase and create data from it in such format so that it can be used to train our model for that we used library pandas, regex and translation and will use KNN and cosine-similarity as our training model.

Predictive Modelling of Ion Migration Induced Degradation in Perovskite Solar Cells

Disha Virmalwar, Mentor: Dr. Kanwar Singh Nalwa

Grasp a strong knowledge on important features of solar cells. Examined several important trends of features of solar cell to understand the cause of degradation. Studied about various recombination processes.

Continuum Mechanical Modeling of the Invagination Process of Forebrain Roof Plate

Divya Adil, Mentor: Dr. Sumit Basu

We conduct an in-depth study of continuum mechanics and hyperelastic materials. We model the brain tissue as a continuum body through balance equations for cell number, mass and momentum. We decompose the deformation of the neural tissue into growth and elastic deformation and use the properties of hyperelastic materials for understanding the equations obtained in the reference text.

Role of curvature on electronic properties on Carbon Nanotubes, Cnt to Graphene

Divya Tripathi, Mentor: Dr. Anshu Gaur

This project aims at first calculating the coordinates for different curvatures of unfolded CNT, and then calculating the electronics properties like DOS and band structures for the same. The tool used is Quantum Espresso, and hence comparing the effect of curvature on tubes with different chirality.

Extraction of Keywords from documents and summarization

Divyani, Mentor: Dr. Anoop Singh

The project deals with automating the process of summarization and extraction of keywords from documents. It includes extracting text from pdfs (with machine-encoded or scanned text), followed by summarizing, and extracting keywords from the text obtained from the previous step. The outcomes of the project can be highly useful in simplifying working with a large number of documents and classifying.

Mixing in Microchannel with Non-Newtonian Fluids

Diya Singhal, Mentor: Dr. Indranil Saha Dalal

Mixing is crucial yet challenging work in the laminar, low Reynolds number microfluidic devices. In this project, a method is proposed to design a T-shaped microchannel containing a mixing unit for making simple and efficient micromixer devices by increasing the mixing quality through various geometrical modifications. To make a significant contribution to chemical and biological applications.

Dynamics of a Falling Liquid Drop in a Deep Liquid Pool

Faizan Ahmad Shah, Mentor: Dr. Gautam Biswas

When a drop falls on a liquid pool, one of many scenarios can occur. The liquid drop may coalesce with the liquid pool. It may pinch off or create bubbles in the liquid pool. We intend to study these phenomena and virtually compute them using the CLSVOF

(Coupled Level Set and Volume of Fluid) methods along with the proper application of boundary conditions for pressure and velocities.

Optimal Control for High Precision Rendezvous and Docking of Coulomb satellites

Gaurav Kumar, Mentor: Dr. Dipak K Giri

Here, in this project we develop dynamics and control for on-track docking for Coulomb actuated satellites. First we derive the system dynamics by considering the chaser and the target as a rigid system perturbed from the equilibrium axis which can be quantified by 3-2-1 Euler angle sequence. The rotations of chaser is also taken into account with respect to the target as docking requires very precise attitude configurations. Then charge control is transformed into voltage control, which is more practical in physical systems using capacitance matrix of the system. This gives us the system dynamics governing the length and the attitude configurations in the form of coupled differential equations.

Computational study of transitional flows in turbomachinery

Geetam Saha, Mentor: Dr. Rajesh Ranjan

The present work was focused upon studying the complex transitional flows which appear on the blades of axial compressors and low-pressure turbines present in jet engines. This flow is of very complex nature because of the variety of boundary layer phenomenon which takes place simultaneously on these blades such separation, transition, and relaminarization.

Automation of downloading pdfs from various ERCs, storing essential details in a database and classifying these pdfs into Regulations, Orders and Tariff Orders

Gowtham Reddy Uppunuri, Mentor: Dr. Anoop Singh

Learned Web Scrapping. Implemented web spider on various ERCs. Connected to Database, stored essentials details in sql database. Also learned various queries in Mysql. Classified documents into categories like Regulations, Orders and Tariff Orders using Naive Bayes Classifier in Machine Learning.

Photon correlations and Blinking in Quantum Dots

Harish Adsule, Mentor: Dr. Shilpi Gupta

Quantum Dots are semiconductor nanocrystals with properties distinct from those of bulk semiconductors. They have found applications in medicine, photovoltaics, and many other quantum information processing tasks. We attempt to explain the second-order correlations and blinking in a Single Quantum Dot.

Exploration of Nonlinear optical processes using density matrix formulation

Harishankar K P S, Mentor: Dr Amit Kumar Agarwal

Nonlinear optics is the study of phenomena that occur as a consequence of the modification of the optical properties of a material system by the presence of light. We have used the density matrix formulation to study some of the nonlinear optical properties.

Design of turbine blade with internal cooling channels for aerospace application.

Harsh Vardhan Singh, Mentor: Dr. Arvind Kumar

Previous design of the turbine blades was having straight channels but in the new design which we have created, it contains internal cooling channels for the convection heat transfer which could lower the temperature of these blades. Firstly, designing of the blade is done in Autodesk fusion 360, since the cooling channels are not straight and they are of certain fashion such as the serpentine shape, in order to manufacturing these additive manufacturing process typically SLM (Selective Laser melting) can be used.

Distributions and Sobolev Spaces

Harshil Pathak, Mentor: Dr. Kaushik Bal

This project gives the knowledge about theoretical basics of Partial Differential Equations. So we define a general notion known as Distributions. We can also define Convolution and Fourier Transform on it, using these distributions we can further define Sobolev Space and use it to solve Partial Differential Equations.

Graph Neural Networks with Continual Learning for Fake News Detection from social media

Harshit Itondia, Mentor: Dr. Subrahmanya Swamy Peruru

In the modern world, social media is playing its part in several ways, for instance in the news dissemination and the information sharing through social media outlets, such as Twitter, Facebook, and Instagram, which have been proved very effective. Although significant effort has been applied to fact-checking, the prevalence of fake news over social media, which has profound impact on justice.

Study on the Effect of vibration on the elastic moduli of different lattice materials based on dynamic stiffness matrix of a beam element.

Hela Ambati, Mentor: Dr. Tanmoy Mukhopadhyay

The project is about characterizing effective elastic properties of different lattices as a function of frequency. The frequency-dependent effective elastic moduli are studied by deriving closed-form expressions using the dynamic stiffness matrix of beam elements based on the Euler-Bernoulli beam theory and the Timoshenko beam theory.

Dynamics of a Falling Liquid Drop in a Deep Liquid Pool

Himanshu Kishor Choubey, Mentor: Dr. Gautam Biswas

We intend to study drops falling into pool of liquid at different velocities and viscosities and virtually compute them using the CLSVOF (Coupled Level-Set and Volume-of-Fluid) methods.

Modelling and simulation of discharge-recharge cycle of lithium-air battery under different operating conditions.

Himanshu Mishra, Mentor: Dr. Malay K. Das

Modelling Lithium-Oxygen batteries using computational methods to evaluate the performance of the battery and improve the efficiency of the battery. The model

simulates the deposition of reaction products like lithium peroxide and lithium carbonate during the discharge of the battery using macroscale transport equations.

Aircraft Detection using LiDAR

Ishit Manojkumar Darania, Mentor: Dr. Salil Goel

This project developed successful mechanism for generating viable training data for 3d object detection and setup libraries which contained various object detection models like PVRCNN etc.

Structural optimization of truss bridges accounting for structural damage and preventing catastrophic collapse

Janhavi Bhoge, Mentor: Dr. Suparno Mukhopadhyay

For this we will use the MATLAB videoReader function it can read video data. Then by using the Kande-Lucas-Tomasi (KLT) algorithm we will estimate the 2D displacements (displacement of corner points of ROI, region of interest, averaged) after the Pixel to meter conversions of the displacements.

Recent advances, mechanistic strategies, and applications of metal-based antiviral, antibacterial, antifungal and antitumor drugs.

Jayanti, Mentor: Dr. Ritika Gautam

It provides the information about recent advancement of metal in different drugs like antitumor, antibacterial etc. From this we can know how important the oxidation state play their role like one oxidation state is good for our health and other is not.

Developing algorithms on Strong gravitational lensing by specializing in Strong gravity scenario

Jignesh Mohanty, Mentor: Dr. T. Sarkar

In this project, I reproduced the trajectories of the light rays that undergoes gravitational lensing by heavy and compact objects called black bounces. By varying a parameter, black bounce geometry could either be a black hole or a traversable wormhole. Next, I produced the intensity maps for accretion disks of Kerr black holes, which are essentially black holes rotating about their central axis.

Designing ligands that yield a square pyramidal geometry on complexing with Fe(III) ion for synthesizing complex molecules as mimics of the active site of the enzyme DMFase from paracoccus sp. Strai

Karthika Kalyansundar, Mentor: Dr. R. Gurunath

In this project, we attempt to design a novel Fe³⁺ square pyramidal complex that can mimic the active site of DMFase. The enzyme dimethylformamidase (DMFase) catalyzes and degrades DMF thus removing it from the environment.

Control of Dual Spin Systems using Piezoelectric Braking System

Kartikeya Gupta, Mentor: Dr. Mangal Kothari

The project aims to design a modified drum braking system involving piezoelectric materials to stabilize dual spin systems. The PZT actuator helps us by providing massive forces in dimension and voltage constraints. Also, the PZT actuator helps in

creating a high precision braking system. We mathematically model our piezo actuator from industrial datasheets keeping in mind the tight voltage and dimension constraints for the braking system to fit. We studied various piezoelectric mathematical models to model our actuator for dynamic response.

Study of Particle Deposition from the impact 2D axisymmetric dust-air flow on flat plate and optimization of flat plate profile using mesh morphing technique.
Katakam Vishnu Sree Shanthanu, Mentor: Dr. Vaibhav Arghode

We attempt to study the particle deposition Computationally by obtaining the particle accretion rate in a fundamental case of Impact of 2D axisymmetric discrete phase flow on a flat plate. We further plan to deform the wall based on the obtained data and optimize the shape of wall for minimum particle accretion on wall by using mesh-morphing technique.

A Comprehensive Review of Aquifer Properties of Indian Alluvial Plains and its Impact on Fluoride Contamination.

Kaustuv Ray, Mentor: Dr. Abhas Singh

The objective of the project work is to review various physical and hydrological properties of alluvial aquifers and study the relationship between aquifer properties and fluoride contamination in the aquifers of the Indo-Gangetic plains.

Development of Hyperspectral Data Analysis Routines for Mineral Mapping of Planetary Surface

Kavya Agarwal, Mentor: Dr. Deepak Dhingra

Motivation for working on the design and documentation of various mathematical parameters is that it enables the mineral mapping of planetary surfaces using hyperspectral data of the Moon, sourced from a NASA instrument, Moon Mineralogy Mapper(M3) which flew on ISRO's Chandrayaan-1 mission. It measured the spectral range from 430 to 3000 nm, had a 40-km-wide field of view from a 100-km orbit.

Effect of Anxiety on Working Memory and Decision Making

Khushboo Sachdeva, Mentor: Dr. Arjun Ramakrishnan

Explored the concepts of math anxiety, decision making, working memory capacity and their correlations. Established a hypothesis that people with math anxiety will have poor decision-making. Designed and researched various tasks and surveys that would provide relevant data for quantifying these parameters involved in the study. Designed a task on Psychopy to assess verbal memory.

Suboptimal decision-making due to stress and anxiety in sequential foraging tasks

Khyathi Vagolu, Mentor: Dr. Arjun Ramakrishnan

We aim to study foraging behavior by designing a naturalistic patch foraging task and analyzing the data collected using suitable mathematical models to test whether stress and anxiety affect decision-making. Neuro-ethological decision-making refers to the decision-making involved in natural behavioral tasks done by animals in their day-to-day life.

Investigation of Vortex Acoustic Lock-in for Turbulent Flows in Combustors
Krishna Murali, Mentor: Dr. Sathesh Mariappan

Influence of turbulent air flow on vortex acoustic lock-in will be analysed by incorporating an additive noise term into the mathematical model for vortex shedding and solving it numerically. The resulting changes to the behaviour of the solution will be investigated during the course of this project.

Numerical methods of solving stochastic differential equations, such as the Euler-Maruyama method must hence be used.

Classification of SQL Query Plans using Unsupervised Learning and Prediction of Optimal Execution Plan for a given Query

Kumar Harsh, Mentor: Dr. Subhajit Roy

In this project, we present a different view of Parametric Query Optimization. The aim of this project is to cluster SQL query plans (of queries having different parameters but same structure) on the basis of physical operators used (select, joins, sort, filter, scan etc.) and the join order.

This will help in determining the plan which suits the best for a particular query after running it.

Performance Analysis of feature extraction methods for drowsiness detection
Kunal Sahu, Mentor: Dr. Suvendu Samanta

US National Highway Traffic Safety Administration is recognizing Driver drowsiness leading to sleepiness as an integral component of several road accidents. Driver drowsiness detection can be reframed as a machine learning classification problem. This work develops and evaluates linear and nonlinear approaches for driver drowsiness detection and making it difficult for linear class.

Security vulnerabilities and analysis of Yggdrasil encrypted IPv6 Yggdrasil Network

Kushal Kothari, Mentor: Dr. Urbi Chatterjee

We investigated the security vulnerabilities of Yggdrasil which is an encrypted IPv6 wireless ad hoc network. Before getting into the solution of our analysis and all its vulnerabilities, we performed a wide range of experiments using various exploitation tools such as Nmap, OpenVAS etc. We also documented the countermeasures to this exploit and testing of yggdrasil in production.

Organic Derivatives based reversible Redox batteries

Kushik, Mentor: Dr. Raja Angamuthu

Here we are dealing with organic material which can be used as alternative for Lithium ion batteries, Li-battery, energy storage, organic electroactive materials. Batteries are improved or evolved on the basis of various parameters like energy density, power density, cycle life, gravimetric density, electronic conductivity, energy efficiency, cost, and resource availability. We research in this field, more focus on the intrinsic electronic conductivity and charge density of organic materials, after which optimization of batteries be performed under relevant conditions.

Modeling Subsurface Mine Detonation

Lakshita Mohanty, Mentor: Dr. Ishan Sharma

The world is polluted with an estimated 45-50 million mines in over 60 countries; which makes neutralisation of mines very crucial. Current practices of the same centre on manual demining, a slow, labour intensive, and often a high risk and expensive process. Mechanised flail systems are often proposed to speed up the process, reduce the cost, and the risk associated with the neutralisation.

Feasibility of DREADDs in Non-Human Primates

Leafy Behera, Mentor: Dr. Arjun Ramakrishnan

We intend to come up with a centralized database focusing on DREADD attempts on non-human primate model. This collection is going to be very valuable for the scientific community using/ planning to use DREADDs in their research.

Assessment of low-cost CFD methodologies for two computationally challenging problems

M V Nitya, Mentor: Dr. Rajesh Ranjan

Over the last few decades, CFD has been emerging as an irreplaceable tool for engineering design and analysis. In this study, RANS methodology has been explored to solve two computational complex problems, Transitional flow over NACA 0012 airfoil and Low Enthalpy Hypersonic flow over a Double-Wedge.

Stochastic resonance in ferroelectrics

Madhav Ramesh, Mentor: Dr. Amit Verma

In this project, we are developing a comprehensive understanding of the phenomenon of stochastic resonance (SR) in ferroelectrics for constructive purposes such as weak signal detection. By solving the relevant Stochastic Differential Equations (SDEs) in MATLAB, we are able to gather considerable insights into the polarisation switching behaviour in a noisy environment, which contains information.

Implementation of a User Subroutine in ABAQUS to simulate the Martensitic transformation in AISI 304L steel during indentation.

Mainak Mallick, Mentor: Dr. Pritam Chakraborty

Indentation simulation is generally used to predict the hardness of a metal. Similarly, in this project, from the uniaxial tensile data, the load-depth curve, and the indentation profile curve, we aimed to arrive at the appropriate parameters of a constitutive material model for AISI 304L steel, during indentation. In the first phase, we have validated the von Mises material model in ABAQUS.

Drug Discovery for SARS-CoV-2 Virus Using Machine Learning

Manit Ajmera, Mentor: Dr. Anikesh Pal

The project aims to transform drug discovery in the context of treating COVID-19 from a slow and expensive process to a rapid and inexpensive one. We intend to develop an artificial neural network (ANN) based machine learning model to perform virtual drug screening to identify potential drugs that can act as PI of the main protease of the SARS-CoV-2 virus and use GANs to generate novel variation.

Simulation of Discharge of a Lithium Oxygen Battery

Maryam Raza Khan, Mentor: Dr. Malay K. Das

This project aims to bring out suitable conditions for developing a battery model with higher specific capacity and optimized geometry than the current existing models by exploring the extent of effects of the operating conditions on the challenges faced while using Lithium oxygen battery which offers numerous advantages over the generally used Li-ion battery.

Exploring Anomalous Hall effect

Md. Kaif Faiyaz, Mentor: Dr Amit Kumar Agarwal

This project explores the hall effect, especially the anomalous hall effect of how it arises and the subtle concepts in quantum physics that cause this effect. It also looks at the various real-world effects it has on materials such as graphene.

Understanding the Physics of Neutron Star Crust Using Electron Magnetohydrodynamics (EMHD)

Mohammad Saad, Mentor: Dr. Supratik Banerjee

My project goes beyond the regime of ordinary MHD to study the neutron star crust in the electron MHD regime and discuss the turbulence therein. In this project we try to understand the nature of the magnetic field using the EMHD formulation which would further lead to the study of instabilities in the neutron star crust.

Indic legal text dataset creation and application of Named Entity Recognition on the same.

Muskan Khajuria, Mentor: Dr. Ashutosh Modi

This project aims to perform NER on Indic legal texts. It consists of building scrapers to collect relevant data from the websites. It would then use tools like Spacy to analyse the performance for pre-existing tools for NER.

Inverse Edelstein effect from topological insulator surface states in open and closed-loop circuits

N BHUVAN, Mentor: Dr. Rik Dey

In this project we have modeled a theoretical framework to investigate different parameters associated with Inverse Edelstein effect and Edelstein effect for the Topological Insulator (TI)/Non-Magnetic Metal (NM)/Ferromagnetic Metal (FM) heterostructure. We found the efficiency of spin-to-charge and charge-to-spin conversion of IEE in both closed-loop and open-loop circuits, EE respectively.

Understanding domestic string algebras and exploring their correspondence with rooted binary trees

Naivedya Amarnani, Mentor: Dr. Amit Kuber

The main objective of the project is to develop two algorithms which will establish an 'equivalence relation' between rooted binary trees and string algebras, and also to give a different presentation for 'pointed' domestic string algebras using linked binary rooted trees.

Investigating the Effects of Depression and Anxiety on Foraging and Economic Tasks

Namgyal Lhamo Dolma, Mentor: Dr. Arjun Ramakrishnan

We aim to show how subjects with depression/anxiety are more ambiguity averse than healthy controls in both economic and foraging tasks, to understand the adverse effects of mental disorders and understand whether the distinction between risk and ambiguity in a neuroethological environment is identical to what is observed in an economic task.

Optimal strategy for two players, stochastic games with application in cybersecurity

Nirbhi Pareek, Mentor: Dr. Raghu Nandan Sengupta

In this project we analyze game-theoretic models for cyber-attacks. An attack is modeled as a two-player, stochastic game between attacker and defender. We represent our system as a markov chain, taking into account privilege escalation for the attacker. We evaluate the optimal strategy for both players.

Remote Learning Platform for Musical Instruments

Nishant Arya, Mentor: Dr. Vipul Arora

We are developing a web application to teach playing MIDI musical instruments. Remote learning has become extremely important in the current climate with the COVID19 pandemic, but current live video classes are not sufficient for musical education. We try to tackle this issue by building a platform dedicated to it.

Water quality analysis using Machine learning techniques

Nishant jain, Mentor: Dr. Rajiv Sinha

Working on historical datasets to find the correlation between various factors which pollute the river and applying ML models for the prediction of BOD, water quality index etc. Different metrics are used to compare the predicted value with the actual value and root mean squared error (RMSE) so that we could cross validate.

Molecular Dynamics Approach Towards Observing the Effect of pH on Interaction of Proteins with Bio-surfaces

Nivedan Amarnani, Mentor: Dr. Kantesh Balani

In this project, we aim to simulate SpA protein with silica substrate at different pH levels. To do this, we are using NAMD as well as VMD software for running the simulation and for visualization, respectively.

Building a Yoga Recommendation System

Padam Sharma, Mentor: Dr. Veena Bansal

Yoga Recommendation System is a complete machine learning system which recommends yoga poses and asanas for specific medical conditions. We gathered relevant data from various yoga books and websites by employing web scraping. We utilized Laravel, a PHP framework to design and develop the frontend and the backend and utilized MySQL for database management.

Analysis of machine foundation on non-homogeneous soil deposits

Palak Shah, Mentor: Dr. Prishati Raychowdhury

Modelled the behavior of boundaries of the uniform as well as layered soil deposit through the use of the software PLAXIS 2D to analyze the effect of dynamic response on soil foundation. Soil foundations may be subjected to periodic vibrations under heavy loads like moving vehicles or machines and turbines which should be studied well by understanding the dynamic response of the foundations.

Design and Analysis of Tunnel FET based Biosensors

Perikala Sandeep, Mentor: Dr. Shubham Sahay

Over the past years, Dielectric modulated field-effect transistors have attracted a lot of interest for label-free detection of biomolecules. However, the inherent short channel effects limit their sensitivity, scalability and energy efficiency. Therefore, to realize the true potential of the DM-FET based biosensors, we propose a Nanotube tunnelling FET with Germanium core source (CSNT-TFET).

Crystal Plasticity of fatigue damage in metallic materials

Pragati Singh, Mentor: Dr. Nilesh Prakash Gurao

At the core of DAMASK is a flexible and hierarchically structured model of material point behavior for the solution of elastoplastic boundary value problems along with damage and thermal physics. Its main purpose is the simulation of crystal plasticity within a finite-strain continuum mechanical framework. We will work on cyclic loading which is very important.

Modelling and simulation of discharge recharge cycling of Lithium Oxygen battery under different operating conditions

Prakhar Mishra, Mentor: Dr. Malay K. Das

Simulation of Li-O₂ battery was done by taking into account deposition of Li₂O₂, electrolyte degradation, and variation in cathode porosity, and results were plotted. The results are being studied, to get a more optimal model for such batteries, than the currently available ones.

Modeling defects in Perovskite Solar Cells

Prakriti Singh, Mentor: Dr. Kanwar Singh Nalwa

This project is about figuring out the possible defects in perovskite solar cells, trying to decrease them, develop a correlation between the experimental and simulation results in the presence of defects and then predict the expected efficiency on decreasing the effects of some defects.

Prediction of Aerothermal Properties of Highly Loaded Turbine Guide Vane Using RANS Methods

Pranjal Anand, Mentor: Dr. Rajesh Ranjan

The project is aimed at investigating aerothermal properties of a high pressure turbine cascade geometry using RANS methods and different turbulence models. A computational fluid dynamic code (FLUENT) is used to perform a two dimensional

analysis for a linear cascade which has been studied previously, to improve upon and investigate the experimental data achieved in those studies.

Investigations of applying the variational principle in classical and quantum calculations using random numbers

Pranjal Praneel, Mentor: Dr. Manoj K Harbola

The project revolves around using random numbers and the variational principle to formulate the ground state properties of quantum mechanical systems. This project report explains the fundamentals of the topic required to understand the method developed along with the algorithm required to implement it. An advantage of the method is that all calculations could be run on a standard. Further fine-tuning of the results will be done with better computing facilities available at the institute when that becomes possible.

Adsorption of polymer chains with a different molecular architecture at surfaces, Scaling and Monte Carlo Analysis.

Prasanna Shinde, Mentor: Dr. Harshwardhan H. Katkar

Adsorption is the adhesion of polymer to a surface. When a polymer chain in solution interacts with an atomically smooth solid substrate, its conformational properties are change anonymously. Conformations of polymer chains near an energetically attractive surface is studied by using Monte Carlo simulations on a cubic lattice.

Determination of Bulk and Shear Viscosity using EMD simulations

Prateek Gupta, Mentor: Dr. Rakesh Kumar Mathpal

My project involves estimating the shear viscosity and volume viscosity of Nitrogen gas using equilibrium molecular dynamics simulations. Viscosity is a crucial property which characterizes a fluid and hence it is important to have viscosity data.

The organic molecule as additives to improve the stability of perovskite solar cells by defect passivation

Praveen Prabhat, Mentor: Dr. Kanwar Singh Nalwa

Working on Perovskite solar cell optimization and defect passivation by different additive engineering techniques to get enhanced perovskite solar cell efficiency along with stability in the open environment so that this low cost and environmental riendly solar cell can be commercialized in market.

Study and shape analysis of closed contours in 2D space

Preeti Kumari, Mentor: Dr. K S Venkatesh

It refers to the study of boundary outlines of continuous shapes in 2D space. It also interests in defining hull for every shape. We will be exploring and analyzing the features on which the shape of closed contours depends. The goal of this project is to research and test different algorithms that calculates the concave hull for a set of points in two dimensions for extending the study of closed contours. Finding the concave or convex hull for a set of points is a very general problem that can be useful in many different situations. It can be used to define the shape of a set or find minimal

area that encloses the set. It can be applied in many different areas, for example pattern recognition and image processing.

Thermal Analysis of TPMS Based Heat Sinks and their Manufacturing Simulation by 3D Printing

Prithu Mishra, Mentor: Dr. Arvind Kumar

A heat sink is a heat exchanger which is utilized for dissipating the unwanted heat generated by an electronic or mechanical device to a fluid medium like air or liquid coolant and thereby assisting in regulation of the device's temperature. Heat sinks are important element in the circuit design as they not only provide an efficient path for transferring of heat to the ambient air but also assist in thermal energy management of the electronic components in the system.

Analogous operation in elliptic curve cryptography to generate a signature to be used as a range proof of k-Times anonymous authentication.

Purva Soni, Mentor: Dr. Urbi Chatterjee

Construction of an analogous operation in elliptic curve cryptography to generate the signature which can be used as a range proof of k-times anonymous authentication. Anonymous authentication allows a user to log in without prompting them for any user name or password. It allows users to access unrestricted areas and the end-user doesn't even have to log on to that site.

Altering the specificity of 3- nitrotoluene dioxygenase (3-NTDO) from diaphorobacter sp. strain DS2 to facilitate the degradation of nitroalkanes by site-directed mutagenesis.

Radha V, Mentor: Dr. R. Gurunath

Diaphorobacter sp. DS2 is one of the three bacterial strains isolated by D. Singh et al. The strain DS2 has 3NTDO (3 Nitrotoluene Dioxygenase) which has degrading specificity towards aromatic nitro compounds and it degrades 3NT to give methyl catechols as intermediates and then proceed with meta ring cleavage. However, 3NTDO cannot degrade Nitroalkanes.

Forecasting Future Energy Requirements

Raghav Singh, Mentor: Dr. Anoop Singh

In this project, firstly we study about the important terms related to Time series data analysis. Afterwards we try to apply these concepts to forecast future electricity consumption of India using different methods of forecasting.

Smoothed Particle Hydrodynamics and its Applications in Astrophysics

Raghavan Gopalan, Mentor: Dr T. Sarkar

My project involves learning the various concepts of Smoothed Particle Hydrodynamics, a computational simulation method that has a lot of importance in astrophysics and a method called the Leap Frog Time Integrator that is used to extrapolate velocities and positions of particles after a time step using previous values is looked into as well. After exploring this, we apply it to simulate the evolution of a toy star model from a random state to equilibrium.

***Impact analysis of aluminium foam material by Finite element method,
Rahul Singh, Mentor: Dr. P. Venkitanarayanan***

This paper presents modelling techniques for achieving convergent and accurate solutions in simulating quasi-static indentation of closed-cell aluminium foams with aluminium foam core using the commercial finite-element software ABAQUS/Standard.

ELECTROSPRAYING OF BINARY-FLUID

Raj Agarwal, Mentor: Dr. Pradipta Kumar Panigrahi

Simulate ElectroHydroDynamics of a jet coming out of a thin nozzle under applied Electric potential. Solve the incompressible Navier-stokes equations along with the Indicator equation. Electrostatic and Surface tension forces enter the NS equations through the body-force term. Level-set-method for interface tracking is used to keep track of the jump in viscosity and density of the fluid.

Facial Expression Recognition Through Convolutional Neural Network

Raj Kumar Yadav, Mentor: Dr. Suvendu Samanta

In this project will be classifying the emotion of different person based on their facial expression using Advanced Deep Learning Technologies such as Convolution Neural Network (CNN). Till now I have built the model and trained the dataset and next I will be deploying the model on web-based platform.

Investigation of Vortex Acoustic Lock-in for Turbulent Flows in Combustors

Rajashree Srikanth, Mentor: Dr. Sathesh Mariappan

The vortex acoustic lock-in phenomenon is analyzed for the case of a deterministic and turbulent flow field. The turbulence is modelled as Gaussian White Noise, which is a stochastic process. The equation modelling the flow is in the form of a stochastic differential equation, which is solved numerically. The solution is then analyzed to locate the regions of lock-in.

Compositional Mapping of an Anomalous Impact Melt Deposit on the Far Side of the Moon

Rajit Das, Mentor: Dr. Deepak Dhingra

Impact cratering is a process typical to all Terrestrial bodies, therefore it is essential for us to understand the working of this process. I have worked with M3 data to verify a possible source for an anomalous impact melt deposit, on the far side of the moon. Impact melt is a key component in all large craters and therefore studying about its transportation and emplacement provides important insights into this component of the cratering process.

Coherent to Semi Coherent Transition of Precipitates in Van der Merwe Epitaxial Films

Ramanuja Srinivasan S, Mentor: Dr. Anandh Subramaniam

Using the model example of the precipitation of NbH in a Nb/Sapphire epitaxial system, we compute the critical radii for illustrative geometries. Eigenstrains are imposed in selected regions of numerical domains in a Finite Element Simulation

(FEM), to simulate a growing film, an interfacial misfit edge dislocation, a precipitate and an interfacial misfit dislocation loop.

Application of pH responsive drug loaded Carbon Nanoparticle as Theranostics in Cancer Tissue

Ramesh Niraula, Mentor: Dr. Santosh K. Mishra

Herein, we are planning to passivate an anticancer drug e.g., niclosamide on the surface of carbon nanoparticles (CNPs) which will further be encapsulated inside a pH responsive polymer. This is well established that cancer tissue possesses lower pH in compared to healthy tissue, which will be helpful for the degradation of pH responsive polymer coating and thereby will assist to release the CNP.

Recent Advances, Mechanistic Strategies and applications of metal-based antiviral, antifungal and antibacterial drugs

Ridhima Raina, Mentor: Dr. Ritika Gautam

As a part of this summer project, we are working on a review article which discusses the recent advances in the metal-based drugs and I have been working specifically on antiviral drugs. Compounds like polyoxometalates, auranofin, organotin, arsenic oxide and complexes of cobalt along with silver nanoparticles have been studied.

Hardware Implementation of Reinforcement Learning Algorithms

Rishabh Katiyar, Mentor: Dr. Shubham Sahay

We are working on the hardware implementation of RL algorithms on memristors or Resistive RAMs. Memristors are non-volatile memories capable of storing the weights of the Neural Network (encoded) as their conductance-states. Our aim is to reduce the number of weight updates done in the memristors by investigating different algorithms.

Engineering a Mechanical Model Imitating Butterfly Wing Motion

Rishika Saraswat, Mentor: Dr. Debopam Das

Engineering a Mechanical Model of Butterfly Wing Motion using Autodesk Fusion 360. Building over the simple flapping motion, we aim to implement a quick-return mechanism, elliptical motion of wings and a changing angle of attack. We want to achieve a model which boasts of higher thrust and lift for better speed and altitude limits.

Analysis of the effects of Dynamic loading and associated damages on Truss Bridges

Rohit Sharma, Mentor: Dr. Suparno Mukhopadhyay

In this project, the objective will be to simulate this damage in a truss bridge and identify the damage based on the response of the bridge. To analyse the effects of dynamic loading on truss bridges, we will be required to calculate all the forces and damages on its members. After that, we need to visualize it using simulation software. So far, we have predominantly worked on understanding the concept for solving different types of trusses and tried to code the theoretical method using MATLAB to verify the results obtained from both approaches.

Surface Complexation Modelling of Uranyl adsorption on synthetic Rhodochrosite

Roshni Dhal, Mentor: Dr. Abhas Singh

Surface Complexation Model (SCM) is a form of modelling that considers the adsorbates to bind to specific sites on the adsorbent surface. The model defines Intrinsic Adsorption Constants (K_{int}) for corresponding Surface Complexation Reactions (SCR) governing the models. K_{int} is an important parameter in determining the extent of adsorption.

Over-expanded nozzle flows

S. R. Harshini, Mentor: Dr. Arun K Perumal

In order to prevent the high levels of shock associated noise, occurs during the mach to regular reflection transition in over-expanded convergent divergent nozzle, we find correlation for M_j fully expanded jet mach no.

Event Analysis for gemOS

Saanidhya Sharma, Mentor: Dr. Debadatta Mishra

The OS on most computers and smartphones provides a graphical user interface (GUI) with icons and/or menu options. GUI provides functionality to manage Gem OS project, with options to create a new project and upload Gem OS source code. Debugging will helps detect page fault helps running program access only memory page i.e. currently mapped by memory management unit into virtual address.

Phase-field modelling of microstructure evolution in Advanced High Strength Steel

Saankulp Jain, Mentor: Dr. Rajdip Mukherjee

In this project, we intend to set up a Phase-field framework to study grain growth and segregation behaviour in Advanced High Strength Steels. Grain growth is a process in which the average grain size of a single-phase polycrystalline material rises over time while the total grain-boundary energy decreases.

The turbulent flow of water and air water over flat surface and surface with protrusions

Sahil Ranjan, Mentor: Dr. K. Muralidhar

Skin friction drag reduction due to water flow on superhydrophobic surface at high Reynolds number is of interest. Simulation of turbulent flow of water, two phase flow of air and water over flat surface is carried out. Hydrophobicity of the surface will be achieved using ridged surface and bubbly flow. Effect of different scale protrusions on drag reduction will be studied.

To Hypothesize Interacting Partners of R cadherin and Integrins during Roof Plate Invagination Process of Chick Forebrain Morphogenesis

Saksham Pruthi, Mentor: Dr. Jonaki Sen

I investigated the interacting partners of R cadherin during roof plate invagination process of chick forebrain morphogenesis. I studied the stages of chick forebrain morphogenesis and the knock-down effect of cell adhesion molecules and found the

role and interaction of cadherins, specifically R cadherin, integrins, and ECM molecules during RP invagination and cortical development.

Dynamics of Bacterium in Biofilms - Influence of Salt Concentration

Saloni Dabgar, Mentor: Dr Sivasurender Chandran

The objective is to identify the spatial position of each individual bacteria in a colony of bacteria, trace and analyze its trajectory to get an understanding of their local structure formation and local dynamics.

Control of dual spin systems using piezoelectric braking system

Samarth Sachan, Mentor: Dr. Mangal Kothari

The project aims at designing a modified drum braking system involving piezoelectric actuators for controlling dual-spin systems.

Characterisation of Process-to-Process Memory Copy System Calls in the Linux Kernel

Sanjam Kumar Panda, Mentor: Dr. Debadatta Mishra

The two system calls copy data between the local address space and the remote address space without requiring any intermediate buffers in the kernel space. In this project, we want to study the efficiency of the system call for large buffers and multiple remote addresses. Moreover, we would also like to study the CPU overhead for pinning pages in the memory for various buffers.

Generation of Labeled Point Cloud Data of any Virtual World

Sankalp Sharma, Mentor: Dr. Salil Goel

As training real LiDAR is quite a heavy process we aim to make a virtual world to train the sensor to work in the real world. The goal of this project is to make a virtual environment/world and generate labelled point cloud data for it. The environment should be easily customizable as per the requirements and the sensor should be easily configurable including its position and orientation w.r.t. time.

Solar Wind and Coronal Heating

Sanyukta Agarwal, Mentor: Dr. Mahendra K Verma

Use statistical methods to evaluate the intermittency in the data from the Switchback region and interval, observed by the Parker Solar Probe to understand the effects of MHD turbulence in near-sin solar wind. We particularly analysed regions where magnetic flux was observed to show fluctuations and deflections, known as switchback (SB) regions and their occurrence intervals referred to as switchback intervals.

Investigating the Connection Between Information Theory and Evolutionary Game Dynamics

Sayak Bhattacharjee, Mentor: Dr. Sagar Chakraborty

We study the discrete-time replicator equation and show how the Kullback-Leibler divergence is the discrete-time Lyapunov function for the dynamic if the fixed point is under the ESS condition. This idea is extended to obtaining the information-theoretic extension of ESS for states in a periodic orbit governed by the discrete-time replicator equation, namely the ISO condition.

Autonomous Excavator Manipulation

Shivam Goel, Mentor: Dr. Laxmidhar Behera

We plan to build an autonomous excavator that will help in mining. This excavator can be controlled remotely using devices like PC, Tablets, etc. Several sensors, including depth cameras and gas sensors, will be attached to the excavator to avoid human deaths by dangerous gas.

Hardware Security using Emerging Non Volatile Memories

Shivam Malhotra, Mentor: Dr. Shubham Sahay

In this era of big data, there has been a tremendous explosion in cloud-based services. There are concerns about equipment hijacking, data theft and corruption, and ransomware, especially critical applications like medicine, transportation, and industrial processes. While it was once acceptable to address security almost entirely with software, the attacker efficiency has increased to the extent.

Computational study on jet break-up behavior of a high-density liquid jet entering a quiescent immiscible liquid pool

Shivam Prajapati, Mentor: Dr. Umesh Madanan

This study focuses on performing the 2D isothermal computational fluid dynamics simulations in multiphase flows when a melt jet enters into sodium coolant in nuclear plants during a disruptive accident. It attempts to capture the variation in jet breakup physics for low Ohnesorge number laminar regimes.

Comparison between mixing of Newtonian and Non-Newtonian fluids (pseudoplastic)

Shivangi Srivastava, Mentor: Dr. Indranil Saha Dalal

Comparison between mixing of Newtonian and Non-Newtonian fluids(pseudoplastic) using CFD Simulations in different microchannels. The process of mixing is extremely crucial in some chemical processes especially in the production of fine chemicals and pharmaceutical products. Traditional mixing methods are not the most effective in terms of energy conversion and time taken.

Fluorescent chemical probes for understanding protein aggregation effects: Challenges & opportunities

Shreyasi Roy Choudhury, Mentor: Dr. Dharmaraja Allimuthu

In this SURGE 2021 project, we have reviewed 5 leading papers from top-notch International Journals that introduce promising fluorescent imaging probe designs and pave the way for future research and developments in protein aggregation diagnostics. The Pros and Cons of each paper have been highlighted and the structure and of each probe has been analyzed in depth. Four major probe designs base.

RANS prediction of the effects of varying Reynolds number and pitch distances on the flow past T106C low-pressure turbine cascade

Shruti Sandipbhai Rajpara, Mentor: Dr. Rajesh Ranjan

Turbomachinery has been an integral part of abundant technologies used in our daily lives. The flow within turbomachines is essentially complex, involving separation

induced transition, leading to formation of separation bubble. The flow mechanism can be resolved using scale resolving approaches such as Large-Eddy Simulation (LES) or Direct Numerical Simulation (DNS).

Role of Carbon Materials in Drug eluting, 3D printed Biomedical Grafts

Siddharth Gupta, Mentor: Dr. Santosh K. Misra

In this project, my aim was to understand the role of carbon materials in biodegradable drug eluting stents. Also, we are planning to work on the design of a cardiovascular stent using a combination of Nano carbon i.e., graphene auto fluorescent carbon nanoparticles with PCL polymer. It might improve the mechanical strength of the composite and serve the purpose of bio imaging. This study introduces the material for developing cardiovascular stents that might be able to solve the issue of restenosis and can be prototyped into a stent with the help of 3D printing technology that will be patient-specific.

Determination of orbital overlap integrals and testing the correlation between orbital overlap integrals and effective mobility for semiconductors.

Siddhartha Nanda, Mentor: Dr. Anshu Gaur

Determination of orbital overlap integrals and testing the correlation between orbital overlap integrals and effective mobility for semiconductors. In polycrystalline single metal oxide semiconductors, such as ZnO, SnO₂, In₂O₃, Ga₂O₃ etc., the conduction band is made of large overlapping outermost s-orbitals of metal cations. The extent of overlapping provides a conduction path for free electrons. We are interested to understand the correlation between the electron effective mass and orbital overlap integrals.

Labelling LiDAR point cloud

Sneha Suresh Kumar, Mentor: Dr. Bharat Lohani

The project work involved learning and applying the primary steps in deep learning-labelling of LiDAR point clouds based on visual inspection. Deep learning requires a lot of simple concepts to train the machines. The training data is labelled before being fed into the machine, to train the machine, the simple concepts.

Benchmarking deep learning workloads on Docker containers vs. bare metal machines

Som Tambe, Mentor: Dr. Priyanka Bagade

Docker has become extremely prevalent as opposed to VMs today. The lightweight features of docker are also the reason they are used on IoT endpoints. In this project, we will be benchmarking docker containers vs. bare metal machines for running deep learning workloads, which are run widely on the edge devices these days.

Numerical Analysis of Aerodynamic Performance of Airfoils based on the Atmospheric Conditions on Mars

Somarya Bhattacharyya, Mentor: Dr. Debopam Das

Martian Atmospheric conditions are quite different than that of Earth which makes an atmospheric flight difficult at Mars. ANSYS Fluent software is used to perform CFD

simulations of Low Reynolds Number and high subsonic Mach Number flow across airfoils in Mars atmosphere. k omega SST turbulence model is with low Reynolds number correction.

Analysis of spherical microphone array beamforming techniques and its detailed studies

Somesh Lahiri Chakravarty, Mentor: Dr. Rajesh M Hegde

Beamforming is an efficient and useful method to convey information with important applications in many fields like 5G technology, wireless communications, etc. Unlike normal antennas which transmit the signal uniformly in all directions, a directional beamformer enhances the signal in a particular direction whereas it attenuates the sounds from other sources in other directions.

The Impact of Building Materials on Environment: Traditional Versus the Contemporary Materials of Lucknow.

Sonali Srivastava, Mentor: Dr. Anubha Goel

The research deals with understanding the materials that have gone into making of both, the traditional Lucknow and the Contemporary Lucknow, thereby having an impact on the built-environment.

Optimization of thermal energy in coal based DRI

Sourav Kumar Sah , Mentor: Dr. Nilesh Prakash Gurao

Coal-based DRI process is widely used in the production of sponge iron with the help of a Rotary kiln. Therefore, it is desired to have a detailed study of the process and the equipment used in this process. In this process, coal is used as fuel and also as a source of Carbon monoxide which is a reducing agent in this process and currently, the coal resources are depleting.

Design Modification and CFD Analysis of the Standalone, Miniature Power Generation System

Souvik Guriya , Mentor: Dr. Vaibhav Arghode

Development of combustion-based, standalone, miniature power generators were undertaken in the past. In the modified design, heat conducted through the combustor walls was used to preheat the inlet air. The combustion chamber was made larger and the cold side of the TEM was used for the dual purpose of vaporizing the liquid fuel and also to reject heat through water. This project aims to detailed description of the constituent components and the CFD analysis which evaluates the performance of the modified system.

Studying the effects of graphene nanofiller on the mechanical properties of CSH gel using molecular dynamic simulation

Subhrajeet Pattnaik, Mentor: Dr. Amar Nath Roy Chowdhury

Studying the mechanical response of nano filler reinforced C-S-H gel using molecular dynamic simulations. Using LAMMPS to model the structure of monolayer graphene and C-S-H gel and study their elastic behaviour and strength. Then introducing the nano filler material into the C-S-H microstructure to enhance its mechanical properties.

Modelling Pyrolysis of Methane on gas-phase Sodium Clusters

Sunny Kumar Bhagat, Mentor: Dr. Vishal Agarwal

Through this project, we aimed to understand the chemistries of methane pyrolysis using Sodium clusters as gas-phase catalysts. We considered sodium(Na), disodium(Na₂), trisodium (Na₃) and tetrasodium (Na₄) as the “major” gas phase sodium clusters which goes hand-in-hand reasonable with the results obtained using equilibrium population algorithm at high temperatures (1273K) in MATLAB.

Neural Networks for representation of high dimensional Free Energy Surfaces of physiochemical processes

Suraj S., Mentor: Dr. Nisanth Nair

Artificial Neural Networks (ANNs) and Convolutional Neural Networks (CNNs) are capable of mapping the input vector to the corresponding output, thereby mathematically fitting the data (regression). In this work, smoothing of the low dimensional free energy landscapes was done using the ANN and CNN. This was achieved by mapping the free energy values to their corresponding coordinates, to generate the Free Energy Surface.

Base wall dependent stress variation in granular column using DEM

Swagata Laxmi Sengupta, Mentor: Dr. Anurag Tripathi

The project aims to predict the timescale required for stress saturation in a granular bin. Identification of the simulation parameters in different contact force models is very much crucial and importance has been given to the same in this work.

In the end, the different contact force models used have been compared to predict the most suitable model that should be used for further simulations.

Inter-Session Mental Workload Estimation for Passive Brain-Computer Interface

Swapnil Singh, Mentor: Dr. Vipul Arora

In this research, we focus on mental workload classification for a given subject (intra-subject estimation) using the EEG data from another session (inter-session adaptation). We employed Riemannian Geometry for pre-processing the filtered data and feature extraction. The obtained features are classified by Support Vector Machine (SVM), Minimum Distance to Mean (MDM), Fisher Geodesic Minimum Distance to Mean.

How Consideration of Self and Stimulus Type Affects Decision Making

Swarag. T, Mentor: Dr. K. M. Sharika

Decision-making could be modeled as the noisy accumulation of evidence modeled by the drift-diffusion model, which was introduced by R Ratcliff. People make decisions by gradually accumulating evidence that is sampled from a noisy environment until it reaches either of the boundaries. Typically, four parameters intersect—the rate of information accumulation(v), which captures stimulus quality and task difficulty. Threshold height captures the level of caution; a higher threshold would give lesser errors but take more time to respond. Initial point(z) represents a priori bias, and t_0 represents all non-decisional processes.

Stochastic Approach for Flexural Waves Control in Smart Material Beam with Single and Multiple Resonant Shunt Circuit Using Spectral Element Method
T Kaartick, Mentor: Dr. Tanmoy Mukhopadhyay

Vibration control strategies depend on the accurate prediction of the dynamic characteristics of a structure. Piezoelectric shunt damping has been one of the best methods in small and mid-scale applications. The spectral element method is used to model the system as it provides accurate solutions for structural dynamic response. Emphasis is on the stochastic approach to finding the most effective.

Comparison of different leg configurations for robust quadruped robot
Tanishq Chourishi, Mentor: Dr. Shakti S. Gupta

One of the most critical parts of a quadruped robot is its legs, as they are the ones that interact with the environment and provide mobility. A robot can carry different loads off and on its torso and perform a variety of dynamic motions. In order to successfully achieve these abilities, we study various leg designs, structural strength requirements, and dimensions of the individual links.

Automated Cognitive Behavioral Therapy
Tanishq Gupta, Mentor: Dr. Nitin Gupta

Helped in the development of Tread Will which digitizes the practices of cognitive behavioral therapy to remove the big barriers causing higher disability claims like cost, wait times, geographic limitations, and stigma.

Effect of prohibited direct-backscattering on spin-charge inter-conversion in diffusive and ballistic topological insulators
Tarun Agarwal, Mentor: Dr. Rik Dey

Boltzmann Transport Equation involving the charge electrochemical potential on the TI surface is solved after taking the angular momentum average on both sides and with the boundary conditions due to the reservoirs at the two ends.

LEGAL NLP - Creation of a dataset for Indic legal texts and application of Named Entity Recognition (NER) on the same
Vaishnavi Patil, Mentor: Dr. Ashutosh Modi

The project is divided into different main phases - building web scrapers, data collection, data cleaning, and using pre-existing NER tools. The first phase of the project: Making of a Data scraper, was built in Python using libraries like Beautiful Soup and Selenium. The last phase of NER involved using tools like Spacy, NLTK on the collected data. This would give insights into and help compare these tools and perform modifications for better performance for Indic legal texts. This would in turn help develop NER tools that work efficiently on Indic legal texts.

Simulation and Modelling of Compound Helicopter UAV
Vardhaman Jain, Mentor: Dr. Abhishek

The compound helicopter is a hybrid of a helicopter and a fixed-wing aircraft developed to make use of the features of a rotary-wing aircraft, like hover and low-speed performance, as well as the high-speed capabilities of a fixed-wing aircraft.

Incorporating an auxiliary propulsion system reduces the load on the main rotor required to produce forward thrust during high-speed flight. An auxiliary lifting device contributes towards the total force necessary to counter the weight of the aircraft.

Path planning and tracking methods for Quadruped robots

Vedang Tiwari, Mentor: Dr. Mangal Kothari

Robust Path Planning for quadruped robots for defence application subject to uncertain conditions like scarce illumination, fog, and dust. Investigated and compared different State Estimation approaches. Studied and set up Elevation Mapping software, formulating probabilistic elevation mapping process from a robot-centric perspective on ROS storing and updating data using Grid Map library.

SURFACE ENERGY CONSTANT FOR LOW ENERGY SOLIDS

Vinoba Pandey, Mentor: Dr. Chandraprakash C

Whether a liquid is lyophobic or lyophilic with its supporting/base solid, or miscible with its surrounding liquids is decided by the contact angle and the surface energies and surface tensions of the solids and liquids, respectively, and viscosity of the fluids.

Multiphase Numerical Analysis for Latent Heat TES Systems

Vishrant Dave, Mentor: Dr. Ashoke De

This project aims to develop a numerical solver using Finite Volume Method, that can simulate the behavior of Phase change materials, used in TES systems. It aims at simulating the multiphase flow obtained during the melting of PCM.

Design of cylindrical heat sink for CPU cooling.

Vivek, Mentor: Dr. Arvind Kumar

The objective of the project is to design the best possible heat sinks for the colling of the CPU. Currently, an air cooling device comprised of various finned sinks with a fan is popular. In this project, we do a comparative study between different profiles like rectangle, trapezoidal, circular inline, and staggered as heatsinks for extracting heat from the electrical part of the CPU.

Cloud-based visualizations for Markov chain Monte Carlo

Vivek Kumar Singh, Mentor: Dr. Dootika Vats

The main goal of this project is to understand and implement various MCMC algorithms and host an interactive applet on the cloud for visualizations. This will allow new users of MCMC to understand the concepts and develop an intuition of the algorithms using animations.

COVID Self Help Chatbot

Yash Gupta, Mentor: Dr. Swaprava Nath

Developed a chatbot from scratch which responds to the user's COVID related queries from an online database. Deployed it on Telegram using the HTTPS-based Telegram Bot API and used gspread to access the database. Catered to more than 2,500 people in the official Telegram group for COVID emergencies in IIT Kanpur.

Analysis of Winglets and their Efficiency in flows with different Reynolds numbers & Angles of Attack

Yash Srivastava, Mentor: Dr. Sanjay Mittal

Winglets appear in various shapes and sizes, but it is still unclear about how prominent, if any, effect it has on the drag force. Performing CFD Analysis on the Wing with Winglet at different values of Reynolds number & Angle of Attack would potentially explain the effect of winglets.

SURGE 2021 Award

“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 2021 Best Project Award*.

S. N.	Name of the Participant	Department	Award Name
1	Sayak Bhattacharjee (IITK)	Physics	Investigating the Connection Between Information Theory and Evolutionary Game Dynamics.
2	Aaryansh Mohan Bansal (IITK)	Aerospace Engineering	Reinforcement Learning for Quadcopters.
3	Ridhima Raina (Non-IITK)	Chemistry	Recent Advances, Mechanistic Strategies and applications of metal-based antiviral, antifungal and antibacterial drugs.
4	Hela Ambati (Non-IITK)	Aerospace Engineering	Study on the Effect of vibration on the elastic moduli of different lattice materials based on dynamic stiffness matrix of a beam element.

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6. Staff members of CCE office.

