

MADHUR SUDARSHAN

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Research Interests -

<https://madhursudarshan.github.io/>
Augmented Reality, Visual Compute, Reinforcement Learning

EDUCATION

Indian Institute of Technology Bombay

2017-2022

- B.Tech. and M.Tech. in Electrical Engineering, *CPI 9.32/10.0* (As of Autumn 2021)
(Specialisation in Communication and Signal Processing)
- Minor in Computer Science and Engineering, *CPI 9.5/10.0*

Schooling

till 2017

- Intermediate/+2 - State Board :Percentage 90.46% (PACE Jr. Science College)
- Matriculation - CBSE: *CGPA 10.0/10.0* (Kendriya Vidyalaya IIT Powai)

SCHOLASTIC ACHIEVEMENTS

- Awarded **Institute Academic Prize** for exemplary academic performance Year 2019-20
- Currently ranked **6th** in the department amongst 60 students Autumn 2021
- Secured an **All India Rank of 384** in JEE Advanced among **159,540** candidates July 2017
- Obtained an **All India Rank of 423** in JEE Mains among **1,186,000** candidates April 2017
- Awarded Fellowship under **Kishore Vaigyanik Protsahan Yojana (KVPY)** May 2016
- Ranked in **top 1% Nationwide** in National Standard Examination in Physics Feb 2017
- Ranked in **top 1% Statewide** in National Standard Examination in Chemistry Feb 2017
- **Ranked 17th** across India in the National Science Olympiad organized by SOF March 2009

KEY RESEARCH EXPERIENCE

Coherent Rendering for Mixed Reality

(Preprint available soon) Ongoing 2021-2022

Guide: Prof. Parag Chaudhari, Prof. Subhasis Chaudhuri

Masters Thesis / IIT Bombay

- Recreated Learned Light Probes, which uses CNNs to extract Spherical Harmonic Information from objects with known geometry and BRDFs for each pose. Rendered datasets in Blender
- Identified limitations in robustness, proposed realistic solutions to create training datasets
- Investigated Augmentations to real world HDRI datasets, discovered flaws in generalizability
- Taking inspiration from Differentiable Rendering and Inverse Rendering, solutions investigated using rendered images as basis functions for illumination and BRDFs without texture
- Developing an app in Unity to implement this approach with PBR based shaders
- Investigating Real time use of General Differentiable Renderers like Mitsuba Renderer

Deep Reinforcement Learning for Service Caching on the Edge

Ongoing 2020-2021

Guide: Prof. Sharayu Moharir, Prof. Nikhil Karamchandani

Research Project / IIT Bombay

- Proposed Optimization Setting to enable policies for low latency Edge Cloud based services
- Theory based on Predictive Scheduling for VR developed for the Furion Framework for Unity
- Explored Mobile Compute Partitioning solutions for Graphics Streaming with focus on AR/VR
- Performed Literature Review of cloud based graphics and code streaming for Edge Servers
- First work Investigating Reinforcement Learning Policies on Edge Compute Service Caching

Wavenet for Timbre Transfer

Course Project Guide: Prof. Amit Sethi

Autumn 2020

Advanced Machine Learning Course/ IIT Bombay

- Tuned a Wavenet inspired model for novel real time paired timbre transfer between instruments
- Generated synthetic datasets, evaluated network performance on different instrument pairs
- Investigated Machine Learning Models for Audio that don't rely on conversion to image domain
- Identified drawbacks with stochastic note onsets, and dependence on input spectral spread

LCMS Data Processing for biological inference

Guide: Prof. Pramod Wangikar

Summer 2020

Start Up - Clarity Biosystems / IIT Bombay

- Contributed a novel pipeline for processing Liquid Chromatography - Mass Spectrometry Data
- Helped with work recreating and augmenting features from a CNN based peak detector
- Investigated a novel denoising approach based on Higher Order Singular Value Decomposition

TECHNICAL SKILLS

Programming	Python, C++, C#, GLSL, Matlab, Assembly (8051,8085)
Libraries	Tensorflow, Pytorch, OpenGL, OpenCV
Software	Blender, Unity, AutoCAD, Ableton Live, SolidWorks, Sketchup

KEY PROJECT WORK

Multi-View 3D reconstruction

Course Project Guide: Prof. Anders Bjorholm Dahl et. al.

Technical University of Denmark

- Implemented a pipeline to perform sparse 3D reconstruction from pairs of monocular images.
- Created and evaluated 3D reconstruction datasets for different objects and scenes.

Video Toonification

Course Project Guides: Prof. Suyash Awate, Prof. Ajit Rajwade

Autumn 2020

IIT Bombay

- Implemented end to end video toonification using 3 Dimensional Mean Shift Segmentation
- Demonstrated greater temporal consistency over conventional frame-frame bilateral filtering
- Implemented scene change detection within a video to introduce segmentation along time

Rocket Launch Simulation

Course Project Guide: Prof. Parag Chaudhari

Autumn 2019

IIT Bombay

- Designed a 3D modeling interface in OpenGL to create structures with voxels
- Implemented a modelling viewing pipeline to model different coordinate systems
- Created an interface to create curves, designed models to simulate the launch of a rocket

Multi-Cycle RISC Processors

Course Project Guide: Prof. Virendra Singh

Spring & Autumn 2019

IIT Bombay

- Designed two 16 bit computers in VHDL, using finite state machine and pipelined architecture
- Implemented 15 instructions (logic, arithmetic and memory) making it Turing complete
- Handled hazards associated with a pipelined processor, optimised number of states

Sudoku Solver

Institute Technical Summer Project, Electronics and Robotics Club

Summer 2018

IIT Bombay

- Worked on a Raspberry Pi 3 based build to read, solve and fill an unsolved Sudoku grid
- Implemented circuitry and mechanical build to control Servos for stamping digits on a grid

COURSES UNDERTAKEN

Key Courses	Computer Graphics, Computer Vision, Advanced Machine Learning, Foundations of Intelligent and Learning Agents, Advanced Image Analysis, Advanced Probability, Markov Chains and Queuing Systems, Digital Signal Processing, Microprocessors, Introduction to Number Theory and Cryptography, Computer Networks, Network Security
Misc. Courses	Design and Analysis of Algorithms, Linear Algebra, Graph Theory, Ordinary Differential Equations, Complex Analysis, Control Systems, Analog Circuits, Digital Systems, Quantum Physics and Application, Biology
Electives	Introduction to Industrial Design, Sociology, Introduction to Linguistics, Appreciation of Music (Music Theory and musicology)

POSITIONS OF RESPONSIBILITY

Teaching Assistant - Communications Lab (EE 340) *Autumn 2021*

- In-charge of evaluating and guiding 6 students through an online Communication System Lab

Inter IIT Culturals Contingent - Music Captain *Winter 2018*

- Led a contingent of 11 members to the second position in the music genre out of 23 teams
- Contributed to IIT Bombay winning the Overall Championship as 1 of 2 sophomore captains

Music Instructor *Winter 2018*

- Individually conducted (and assisted) workshops on bass guitar and jazz music theory

EXPERIENCE ABROAD

Semester Exchange - Technical University of Denmark (D.T.U) *Spring 2021*

- Nominated to and spent 6 months in Denmark, exchanging cultural and linguistic values
- Learned to work in group projects with peers from different countries both online and offline
- Learned Knitting, also learning Spanish and Norwegian in a casual conversation capacity

EXTRACURRICULARS

- Composed music for IIT's convocation programme that was broadcast on National Television
- Multi-Instrumentalist session musician and singer, performing **semi-professionally**
- Bandleader performing for **crowds of over 5000** opening for popular Bollywood singers
- Played Basketball tournaments at both school and college level, representing IIT Bombay
- Awarded Distinction by **Trinity College of London** for music theory and bass guitar
- Coordinated Publicity and design of U/I for an online rap competition by e-Yantra IITB
- Transcribed and Dubbed coding course lectures to make them accessible to Indian students