# Madhur Sudarshan

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GRE 335/340 TOEFL 120/120

## Education

**Indian Institute of Technology Bombay** *2017-2022*

- B.Tech. and M.Tech. in Electrical Engineering, *CPI 9.22/10.0* *(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** *Ongoing 2021-2022*
*Guide: Prof. Parag Chaudhari, Prof. Subhasis Chaudhuri* *Masters Thesis / IIT Bombay*

- Recreated Learned Light Probes, which uses a CNN to extract Spherical Harmonic Information from objects with known geometry and BRDFs for each pose
- Identified limitations in robustness, training datasets and proposed realistic solutions
- 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
- Developed app in Unity to implement this approach with PBR based shaders
- Investigating Real time use of General Differentiable Renderers like Mitsuba Renderer

**Optimization for Edge Compute - Virtual Reality** *Ongoing 2020-2021*
*Guide: Prof. Sharayu Moharir, Prof. Nikhil Karamchandani* *RnD 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
- Investigating performance of Reinforcement Learning Policies on edge compute service caching

**Wavenet for Timbre Transfer** *Autumn 2020*
*Course Project Guide: Prof. Amit Sethi* *Advanced Machine Learning/ 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** *Summer 2020*
*Guide: Prof. Pramod Wangikar* *Clarity Biosystems / IIT Bombay*

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

## Technical Skills

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|---|---|
| **Programming** | Python, C++, C#, Matlab, R, Assembly, TensorFlow, PyTorch |
| **Software** | Blender, Unity, AutoCAD, Ableton Live, SolidWorks, Sketchup |

## Key Project Work

**Multi-View 3D reconstruction** *Spring 2021*
*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** *Autumn 2020*
*Course Project Guides: Prof. Suyash Awate, Prof. Ajit Rajwade* *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 limit segmentation along time

**Rocket Launch Simulation** *Autumn 2019*
*Course Project Guide: Prof. Parag Chaudhari* *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** *Spring & Autumn 2019*
*Course Project Guide: Prof. Virendra Singh* *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** *Summer 2018*
*Institute Technical Summer Project, Electronics and Robotics Club* *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, Advanced Machine Learning, Foundations of Intelligent and Learning Agents, Markov Chains and Queuing Systems, Computer Networks, Advanced Probability, Advanced Image Analysis, Digital Signal Processing, Communication Systems, Microprocessors, Introduction to Number Theory and Cryptography, Network Theory, Network Security |
| **Misc. Courses** | Design and Analysis of Algorithms, Introduction to Industrial Design, Linear Algebra, Graph Theory, Ordinary Differential Equations I and II, Complex Analysis, Control Systems, Analog Circuits, Digital Systems, Quantum Physics and application, Biology, Introduction to Linguistics |

## 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
- Contributed to IIT Bombay winning the Overall Championship as 1 of 2 sophomore captains

## Experience Abroad

**Semester Exchange - Technical University of Denmark (D.T.U)** *Spring 2020-2021*

- 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

## 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