

Sai Praveen Bangaru

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Education

Massachusetts Institute of Technology | PhD, Electrical Engineering and Computer Science

- Duration (Estimated): Aug 2019 – Aug 2024
- GPA: 5.0 (5.0 scale)

Carnegie Mellon University | Master's Degree (MScS), Computer Science Department

- Duration: Aug 2017 – Dec 2018
- QPA: 4.05 (4.3 scale. Only certain courses offer A+)

Indian Institute of Technology Madras | Bachelor's Degree (BTech), Computer Science Department

- Duration: Aug 2013 - Jul 2017
 - CGPA: 9.34 (10.0 scale)
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Important Coursework

- 16-651 Algorithms
 - 16-823 Physics-based Methods in Computer Vision
 - 15-618 Parallel Computer Architecture & Programming
 - 15-663 Computational Photography
 - 15-662 Computer Graphics
 - 16-720B Computer Vision
 - 15-640 Distributed Systems
 - CS6730 Probabilistic Reasoning (Bayesian Networks)
 - CS7011 Topics in (Deep) Reinforcement Learning
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Publications

Unbiased Warped-Area Sampling for Differentiable Rendering | SIGGRAPH ASIA 2020

S. P. Bangaru, TM. Li, F. Durand

Link: <https://www.saipraveenb.com/projects/was-2020/>

- To be presented as a talk at *SIGGRAPH Asia 2020* held virtually (originally scheduled to be held at Daegu, South Korea).
- First paper to show an unbiased area-sampling estimator for the differentiable rendering equation. Derived the estimator from first principles by applying the divergence theorem to the difficult-to-sample boundary term.

Towards Reflectometry from Inter-reflections | ICCP 2020

K. Shem-Tov, S. P. Bangaru*, A. Levin, I. Gkioulekas*

Link: https://imaging.cs.cmu.edu/multibounce_reflectometry/

- Presented as a talk at *ICCP 2020* held virtually (originally scheduled to be held at St. Louis).
- Showcased a differentiable variant of the BDPT rendering algorithm and used it to extract 4-6 times higher fidelity reflectance information by taking advantage of higher-order illumination in concave objects.

Exploration for Multi-task Reinforcement Learning with Deep Generative Models | NIPS DRL 2016

S.P. Bangaru, J.S. Suhas, B. Ravindran

Link: <https://arxiv.org/abs/1611.09894>

- Presented as a poster at the *NIPS Deep Reinforcement Learning Workshop 2016* at Barcelona.
 - Used a modified version of the deep *variational autoencoder* to encode the various task environments, as the agent explored them. This model is then used by the agent to obtain a Bayesian estimate of the unknown environment, leading to better performance when compared to a standard RL agent.
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Research Internships

Research Intern | GraphDeco research group, INRIA Sophia-Antipolis, France | MAY-JUL 2017

Advisor: Dr. George Drettakis

- Under the supervision of *Dr. George Drettakis*, our team extended the paper *Scalable InsideOut Rendering* to handle thousands of input viewpoints using a streaming architecture and a spatial data structure.
- Played a primary role in developing a framework comprised of PatchMatch stereo for mesh refinement, image segmentation for enforcing object boundaries, mesh decimation to control level-of-detail based on distance, and preemptive loading/unloading of images.

Research Intern | GraphDeco research group, INRIA Sophia-Antipolis, France | MAY-JUL 2016

Advisor: Dr. George Drettakis

- Worked under the mentorship of *Dr. George Drettakis*, to fix and enhance the pipeline of the popular algorithm *Multi-view intrinsic images with an Application to Relighting* which deals with decomposing the various components of lighting of an outdoor scene using images taken at different parts of the day.
 - The project involved a deep understanding of photorealistic rendering and the use of advanced C++ concepts to modify the popular *mitsuba* path tracer, which was used to quantify the algorithm's error at each stage.
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Professional Internships

Software Intern | Mobile 3D Graphics, NVIDIA, Santa Clara, CA, USA | MAY-JUL 2018

Advisors: Michael Chock, Donghan Ryu

- Contributed to the development of the immensely complex OpenGL & Vulkan drivers.
- Developed and implemented an optimization algorithm to intelligently select tests, thus significantly improving the effectiveness of the internal OpenGL testing suite. This was demonstrated at the bimonthly meeting attended by over a hundred engineers.
- Assisted in the development of Khronos' *Vulkan Validation Layer* for NVIDIA extensions. Created an internal process to guide future developers with validation layer development.

Software Intern | Web Operations & Computer Vision, HyperVerge, Chennai, India | MAY-JUL 2014

Advisor: Vignesh Krishnakumar

- Worked with HyperVerge during their pivotal Series A fundraising period.
 - Created a cloud scheduling platform that handles load balancing of incoming compute jobs and drives a simple front-end webpage. The web-page acts as a user-friendly front-end for the computer vision algorithms implemented by HyperVerge.
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Important Projects & Theses

High-fidelity Shape Reconstruction with Differentiable Path tracing | Master's Thesis | JUL-DEC 2018

Advisors: Prof. Ioannis Gkioulekas, Prof. Anat Levin *Link: <https://www.saiprveenb.com/diff-pt.html>*

- Built a differentiable BDPT renderer, that is used with a Tensorflow optimizer to recover precise shape and reflectance properties of the surface, in the presence of complex light transport effects like interreflections.
- This is the first optimization system that can reconstruct generalized (non-convex) meshes with arbitrary surface properties (BRDF) and under arbitrary lighting conditions.

CUDA Path Tracer with Dynamic Ray Scheduling | Parallel Computing | APR-MAY 2018

Course: 15-618 Parallel Computing

Link: <https://www.saiprveenb.com/cuda-raytracer.html>

- Implemented a path-tracer using CUDA, achieving 60-100x speedups over a multi-threaded CPU path tracer.
- Reimagined the standard tree traversal algorithm as a breadth-first (rather than a depth-first) algorithm. This version shows significantly improved SIMD utilization on incoherent rays. Performance is also boosted with the use of 8-way BVHs instead of binary BVHs.
- This method also shows significant gains over traditional recursive tree-traversal.

Action-Conditional Projection Neural Networks | Bachelor's Thesis | JAN-APR 2017

Advisor: Prof. Balaraman Ravindran

Link: <https://www.saiprveenb.com/acpnn.html>

- Applied the idea of ray-tracing to neural networks and redesigned the popular convolutional network with a completely different architecture to simulate and understand 2D/3D interactive scenes.
- Presented reconstruction results with both 2D and 3D perspective projection and provided a compelling argument for ACPNN's advantage over traditional recurrent CNNs.
- Won the "C Sivaram Murthy" Best Undergraduate Project award presented by IIT-M

Input-Conditional LSTMs for Weather Forecast Synthesis | Natural Language Programming | JAN-DEC 2016

Advisor: Prof. Sutanu Chakraborti

Link: <https://www.saipraveenb.com/rom-lstm.html>

- Modified LSTMs to use unlabelled weather data as input and trained them using the *Prodigy-METEO* dataset, using which the model was able to convert raw weather readings into user-friendly and coherent sentences.
 - Also created and tested several versions of this language model, some of which also included the use of placeholder text, which are later substituted with numeric data from the inputs.
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Test Scores

- GRE: 332 (Quantitative: 170, Verbal: 162, AWA: 4)
 - TOEFL: 112 (Reading: 30, Listening: 30, Speaking: 24, Writing: 28)
 - Joint Entrance Examination 2013 Advanced - All India Rank 211 (out of 150,000 shortlisted examinees)
 - Joint Entrance Examination 2013 Mains - All India Rank 10 (out of 1.3 million examinees)
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Technical Skills

- **Programming Languages:** C & C++, Python, Javascript, Java, MATLAB, Go, x86 Assembly
 - **Libraries & Frameworks:** TensorFlow, CUDA, OpenGL, OpenCL, Theano, Direct3D
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Academic Awards

- Harold E. "Doc" Edgerton Fellowship for the academic year 2019-2020 - MIT EECS
 - "C Sivaram Murthy" Best B.Tech (Undergraduate) Project in Computer Science Award 2017 - Indian Institute of Technology Madras
 - Charpak Research Scholarship 2016 - French Embassy in India
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