

# Karthi Srinivasan

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## Education

### Bachelor of Technology + Master of Technology

Jul 2017 - Present

Department of Electrical Engineering, Indian Institute of Technology, Madras

CGPA: 9.14/10.00

**Research Interests:** Neuromorphic Computing, Analog Design, Neuroscience

**Relevant Courses:** Neuromorphic Computing, Computational Neuroscience, Analog IC Design, RF IC Design, Information Theory, Convex Optimization, Nonlinear Control, VLSI Data Conversion Circuits, LPTV Systems Analysis, Phase Locked Loops

## Research Experience

### Master's Thesis Project

#### Unsupervised Learning in Spiking Neural Networks

Sep 2021 - Present

Indian Institute of Technology, Madras

Guide: Prof. Bhaswar Chakrabarti

- Exploring the use of lateral inhibition in shallow spiking neural networks to create self-organizing maps.
- Designing SNN models for low-power classification of tactile datasets.

### Research Projects

#### Silicon Retina Chip Design

Aug 2021 - Present

Johns Hopkins University, Baltimore

Guides: Prof. Andreas Andreou, Prof. Gert Cauwenberghs

- Designing and implementing analog circuits for a silicon retina using open-source tools.

#### Legendre Memory Units for Silicon Cochleas

Jul 2021 - Sep 2021

University of Waterloo

Guide: Dr. Terrence C. Stewart

- Implemented and tested LMU networks on audio and spiking datasets (tonic datasets, ST-MNIST).
- Implemented winner-take-all mechanisms for emulation of cochlear processing.
- Network is to be used in a silicon cochlea for the SSCS PICO Design Contest 2021.

[GITHUB]

#### Izhikevich Neuron CMOS Circuit Design

May 2021 - Aug 2021

Concordia University, Montreal

Guide: Prof. Glenn Cowan

- Designed and implemented a neuron circuit in 65nm CMOS that emulates the Izhikevich neuron model.
- Achieved 12fJ/spike energy consumption, which is a significant improvement over state of the art for biological timescale implementations.
- Manuscript under review at ISCAS 2022.

[MANUSCRIPT]

#### Motion Detection Using Spiking Neural Networks

Dec 2020 - May 2021

Indian Institute of Technology, Madras

Guide: Prof. Bhaswar Chakrabarti

- Proposed an SNN architecture to detect motion in a 2D visual field.
- Simulated the network using the BRIAN2 simulator on a biological timescale.
- Implemented the network in SPICE, using CMOS LIF neurons and RRAM synapses.
- Manuscript under review at ISCAS 2022.

[PREPRINT]

#### Quasiconvex Relaxations for $l_0$ Optimization Problems

Jan 2020 - May 2020

Indian Institute of Technology, Madras

Guide: Prof. Rachel Kalaimani (Course Project)

- Proposed a new algorithm to convert  $l_0$  optimization problems to more tractable quasiconvex forms.
- Implemented the algorithm in MATLAB for an image compression task.
- Demonstrated superior performance compared to conventional  $l_1$  relaxation on some tasks.

[REPORT]

## Multiple-Output Switching Power Regulator

May 2019 - Jul 2019

Indian Institute of Technology, Madras

Guide: Prof. Sankaran Aniruddhan

- Designed, simulated, built and tested a constant-on-time based control system, with frequency regulation loop for single-input multiple-output switched mode power supplies.
- Achieved 2mV output ripple at 100 kHz and output ranges from 30% to 70% of input level.

## Modular Object Tracking Gimbal

May 2018 - Dec 2018

Indian Institute of Technology, Madras

Computer Vision and Intelligence Club

- Developed a 3-axis object tracking gimbal system with particle-filter-based object tracking algorithm and cubic time regression.
- Developed the tracking algorithm, mobile app and motor control algorithm.
- Achieved close to state-of-the-art fidelity in non-occluded tracking and good occlusion handling. [GITHUB]

## Professional Experience

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### Teaching Assistant, EE6347: Neuromorphic Computing

Aug 2021 - Present

Indian Institute of Technology Madras

Instructor: Prof. Bhaswar Chakrabarti

- Presented basic concepts related to SNNs.
- Conducted tutorial sessions on the usage of the BRIAN2 and Nengo simulators. [SLIDES]

### Analog Intern, Texas Instruments, Bangalore

May 2020 - Jul 2020

Manager: Sarangan Valavan

Mentors: Manasa Gadiar, Madhu Sudhan

- Analyzed parametric and multiprobe wafer test programs for two ICs.
- Proposed improvements, on the basis of statistical analyses, to the test program to increase efficiency and reduce testing time for these parts.
- Designed a passive high-voltage ESD testing circuit to convert an input IEC standard waveform to the HBM standard waveform while maintaining constant output resistance.
- Simulated the ESD testing circuit in SPICE to verify functionality and compliance with standards. [REPORT]

## Awards and Fellowships

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### MITACS Globalink Research Fellowship

2021

- The MITACS Globalink Research Fellowship is offered to **meritorious undergraduate or graduate students** from foreign universities to pursue their research at a Canadian university for a period of 12 weeks.

### Winner, TATA Makerthon

2018

- Won a national competition organized at the Indian Institute of Technology Bombay, by the TATA group, to develop a object detection and tracking gimbal system.

### Branch Upgrade Awardee

2017

- Awarded to freshman students with the **highest GPAs** at the end of one semester in each stream to change their stream to one of their choice.

### KVPY Fellow

2016, 2015

- KVPY is a national competitive science examination to select and fund students intending to pursue undergraduate degrees in pure science at IISc and IISER.

### National Qualifier, INOI

2015

- Indian National Olympiad for Informatics is an olympiad that serves as a qualifier to the International Olympiad in Informatics.

### Certificate of Merit, HRD Ministry, Govt. of India

2015

- Awarded for excellent performance in the CBSE Class X Examination, 2015.

## Skills and Tools

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- **Circuit Design:** Cadence Virtuoso/Spectre, LTSpice, Mentor Graphics Eldo, Verilog HDL, Magic, Xschem, Ngspice, KiCAD, ARM Assembly
- **Programming Languages:** Python, C++, Bash, TeX, Julia
- **Software Tools:** Nengo, BRIAN2, MATLAB, Octave

## Extracurricular Activities

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### **Shaastra Super-Coordinator**

**May 2019-Jan 2020**

- Shaastra is the annual technical festival of IIT Madras.
- Managed a team of 5 coordinators and hosted various competitive events.
- Oversaw events with a total participation of 1,000+.

### **Convenor, IITM Quiz and Word Games Club**

**May 2019-May 2020**

- Managed a team of 20 coordinators and hosted intra-institute quizzing and word-games events throughout the academic year.

### **National Cadet Corps**

**Aug 2017-May 2018**

- Part of National Cadet Corps, the youth wing of the Indian Armed Forces.
- Recipient of NCC A-Certificate.