

GUANGZHI TANG

[Personal Website](#) - [Google Scholar](#) - [GitHub Profile](#)

RESEARCH INTERESTS

Edge AI, Robotics, Brain-inspired Computing, Neuromorphic Computing

EDUCATION

Ph.D Computer Science

Sep 2017 - July 2022

[Rutgers, The State University of New Jersey](#), United States

Doctoral Advisor: Prof. Konstantinos Michmizos

Thesis: Biologically Inspired Spiking Neural Networks for Energy-Efficient Robot Learning and Control

M.Sc Computer Science

Sep 2015 - May 2017

[Rutgers, The State University of New Jersey](#), United States

Master's Advisor: Prof. Konstantinos Michmizos

Thesis: Gridbot: Towards a Neuroinspired Navigation System For Robot Planning.

B.Sc Computer Science

Sep 2011 - May 2015

[Nanjing University](#), China

RESEARCH EXPERIENCE

Researcher

Sep 2022 - Present

Hardware Efficient AI Team, [IMEC Netherlands](#)

Eindhoven, The Netherlands

- **Overview:** Core member of an interdisciplinary edge AI hardware and software research team. My research focuses on efficient deep learning algorithms and software for near-sensor edge applications.
- **Edge AI Processor:** Contributing to the design of a neuromorphic edge AI processor that exploits the sparse activities in neural networks for low-latency and energy-efficient edge computing.
- **On-device Learning:** Enabled low-cost on-device learning capability on the neuromorphic edge AI processor for data-efficient few-shot learning towards real-world online learning applications.
- **Hardware-aware Training:** Developed hardware-aware activation sparsification and parameter quantization fine-tuning algorithms for neural networks to enable efficient hardware deployment.
- **Optimize CNN Inference:** Introduced event-driven depth-first convolution to optimize memory and latency of CNN inference for high-resolution visual processing on a multi-core edge processor.
- **Event-based Vision:** Proposed sparse CNNs for low-latency recognition, optical flow, and object detection with event-based cameras targeting automotive, drone, and industrial applications.
- **Sensor Fusion:** Built sensor fusion algorithms combining cameras and radars toward robust and low-cost solutions for automotive, industrial robotics, and smart office applications.

PhD Research Intern

May 2021 - Aug 2021

Neuromorphic Computing Lab, [Intel Labs](#)

Oregon, United States

- **Overview:** Research internship in an international neural network algorithm research team. My research focused on robot perception and brain-inspired learning algorithms.
- **Drone Perception:** Proposed gradient-based training method for sparse sigma-delta neurons in deep CNNs for drone-based object detection using the large-scale VisDrone challenge dataset.
- **Continuous Learning:** Developed variational autoencoder with disentangled image feature extraction for brain-inspired continuous learning for detection of unknown objects.

Graduate Research Assistant

Computational Brain Lab, [Rutgers University](#)

Sep 2016 - July 2022

New Jersey, United States

- **Overview:** My doctoral and master's thesis research focused on energy-efficient neuromorphic robot perception, navigation, control, and learning for always-on computing on various robot platforms.
- **Reinforcement Learning:** Proposed SOTA deep reinforcement learning framework for training spiking neural networks to learn optimal policies for energy-efficient high-dimensional control.
- **Robot Navigation:** Built radar-based mobile robot navigation solution trained by deep reinforcement learning showing virtual-to-real generalizability and robustness in complex test environments.
- **Edge Robot System:** Constructed head robot, hexapod, and their ROS-based edge computing systems. Integrated bio-inspired control algorithms on edge neuromorphic processors to robots.
- **Brain-mimicking SLAM:** Introduced brain-inspired SLAM solution for robot navigation on the neuromorphic processor with orders of magnitude of energy reduction.
- **Online Learning:** Developed an online and backprop-free gradient-based learning method for deep spiking neural networks, achieving competitive performance compared to backpropagation.
- **Brain-computer Interface:** Built deep convolutional and recurrent neural networks for spatial-temporal learning of brain EEG signals resulting in an energy-efficient brain-computer interface.

Undergrad Research Assistant

RL Research Group, [Nanjing University](#)

Sep 2014 - May 2015

Nanjing, China

- **Overview:** My undergraduate research focused on applying game theory-based algorithms to multi-agent systems and applications.
- **Multi-agent Game:** Developed an online adaptive algorithm based on game theory to play Texas Hold'em poker against different types of players.

FUNDED PROJECT EXPERIENCE

EU Project Management - [REBECCA](#)

KDT JU No.101097224

Mar 2023 - Present

Status: Ongoing

- **Topic:** The main topic of the project is developing an efficient and secure edge AI ecosystem with RISC-V architecture for robotics and industrial edge computing applications.
- **Experience:** Coordinating the hardware development and verification work package consists of 10 partner institutions. Jointly creating system specifications and integration plans based on use cases.
- **Result:** Drafted and submitted deliverable reports on system specifications and integration plans.

EU Project Participation - [DAIS](#)

KDT JU No.101007273

Sep 2022 - Present

Status: Ongoing

- **Topic:** The main topic of the project is advancing AI and machine learning in distributed edge AI systems for industry-driven applications, including digital life, digital industry, and smart mobility.
- **Experience:** Developing a multi-sensory fusion privacy-aware edge AI solution for smart office applications on people detection and behavior monitoring.
- **Result:** Collaborated with colleagues and students to build a multi-sensory edge computing system consisting of 5 kinds of sensors (radar, event-based camera, RGB camera, LiDAR, microphone).

EU Project Participation - [ANDANTE](#)

ECSEL JU No.876925

Sep 2022 - Nov 2023

Status: Finishing

- **Topic:** The main topic of the project is defining hardware/software platforms based on neuromorphic, artificial, and spiking neural network solutions for a wide range of edge application domains.

- **Experience:** Collaborated with the use case provider (Philips) on advancing low-latency neuro-morphic image processing solutions for medical X-ray image processing and device tracking.
- **Result:** Collaborated with colleagues to develop a hardware-aware YOLO-based network for X-ray video object detection on a multi-core neuromorphic architecture emulated in the FPGA.

TEACHING EXPERIENCE

Daily Supervisor for Master's Thesis Projects

Jan 2023 - Present

IMEC Netherlands

- **Overview:** Supervising three master's students to complete their thesis projects on event-based vision, active vision, and efficient transformer during their 9-month internship at IMEC.
- **Activity:** Daily supervision including project planning, weekly discussion meetings, and joint hands-on sessions. Teaching students the craft of research using the project as an example.
- **Result:** Successfully graduated one student (TU/e) on Aug 2023 with a paper in preparation. The invention of another student (Lund Univ.) is in progress for patent filing.

Teaching Assistant for Brain-inspired Computing

Fall, 2017 and Spring, 2019, 2020

Computer Science, Rutgers University

Instructor: Prof. Konstantinos Michmizos

- **Course Overview:** Multidisciplinary course combining neuroscience, cognitive computing, and neuromorphic computing. Opened for both undergraduate and graduate students.
- **Teaching:** Taught one lecture per semester on spiking neural networks and neurorobotics. Hosted weekly office hours to help students progress on their projects.
- **Project Design:** Jointly designed Jupyter Notebook-based assignments to improve hands-on experience for the students. Worked with students on their research-oriented projects.

Teaching Assistant for Introduction to Computational Robotics

Fall, 2018

Computer Science, Rutgers University

Instructor: Prof. Kostas Bekris

- **Course Overview:** Undergraduate-level course introducing the basic concepts of robotics algorithms on planning, control, SLAM, and reinforcement learning.
- **Teaching:** Taught weekly recitation classes reviewing and extending the materials covered in the lectures. Hosted weekly office hours to resolve programming problems on robot systems and projects.
- **Project Design:** Implemented a mobile robot-based project using ROS and the Gazebo simulator to enable students to do hands-on programming of planning and reinforcement learning algorithms.

Teaching Assistant for Computer Architecture

Spring, 2018

Computer Science, Rutgers University

Instructor: Prof. Abhishek Bhattacharjee

- **Course Overview:** Undergraduate-level course introducing the computer architecture of the digital CPU and the compiler translating high-level programming language to assembly codes.
- **Teaching:** Taught weekly recitation classes reviewing and extending the materials covered in the lectures. Hosted weekly office hours to resolve assignment questions and programming problems.

Teaching Assistant for Introduction to Computer Science

Summer, 2016

Computer Science, Rutgers University

Instructor: Prof. Louis Steinberg

- **Course Overview:** Undergraduate-level course introducing the basics of computer science, including programming languages, data structures, and algorithms.
- **Teaching:** Taught weekly recitation classes reviewing and extending the materials covered in the lectures. Hosted weekly office hours to resolve assignment questions and programming problems.

WORK EXPERIENCE

Research & Development Intern

Jul 2014 - Sep 2014

Mobile Search Ranking Team, Baidu

Beijing, China

- Proposed personalized search ranking recommendation algorithms for different searching habits.
- Developed methods to find search query correlations in daily search data using Hadoop clusters.

HONORS & AWARDS

ISCAS Neural Systems and Applications Best Paper Award Honorary Mention IEEE CAS, 2023

NeurIPS Outstanding Reviewer Award NeurIPS, 2021

IROS Student Travel Award IEEE RAS, 2019

Microsoft & IEEE Young Fellow Scholarship Award MSRA, 2014

PUBLICATIONS

Journals

- **Tang G**, Vadivel K, Xu Y, Bilgic R, Shidqi K, Detterer P, Traferro S, Konijnenburg M, Sifalakis M, Schaik GJ, Yousefzadeh A. (2023). [SENECA: Building a fully digital neuromorphic processor, design trade-offs and challenges](#). *Frontiers in Neuroscience*.
- Kumar N, **Tang G**, Yoo R, Michmizos K. (2022). [Decoding EEG With Spiking Neural Networks on Neuromorphic Hardware](#). *Transactions on Machine Learning Research (TMLR)*.
- Polykretis I, **Tang G**, Balachandar P., Michmizos K. (2022). [A Spiking Neural Network Mimics the Oculomotor System to Control a Biomimetic Robotic Head without Learning on a Neuromorphic Hardware](#). *IEEE Transactions on Medical Robotics and Bionics*.

Conferences

- **Tang G**, Safa A, Shidqi K, Detterer P, Traferro S, Konijnenburg M, Sifalakis M, Schaik GJ, Yousefzadeh A. (2023). [Open the box of digital neuromorphic processor: Towards effective algorithm-hardware co-design](#). *IEEE International Symposium on Circuits and Systems (ISCAS)*. (**ISCAS Neural Systems and Applications Best Paper Award Honorary Mention.**)
- Patiño-Saucedo A, Yousefzadeh A, **Tang G**, Corradi F, Linares-Barranco B, Sifalakis M. (2023). [Empirical study on the efficiency of Spiking Neural Networks with axonal delays, and algorithm-hardware benchmarking](#). *IEEE International Symposium on Circuits and Systems (ISCAS)*.
- **Tang G**, Kumar N, Yoo R, Michmizos K. (2020). [Deep Reinforcement Learning with Population-Coded Spiking Neural Network for Continuous Control](#). *Conference on Robot Learning (CoRL)*, Cambridge, MA.
- **Tang G**, Kumar N, Michmizos K. (2020). [Reinforcement co-Learning of Deep and Spiking Neural Networks for Energy-Efficient Mapless Navigation with Neuromorphic Hardware](#). *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Las Vegas, NV.
- **Tang G**, Michmizos K. (2020). [Real-time mapping on a neuromorphic processor](#). *Neuro Inspired Computational Elements Workshop (NICE)*, Heidelberg, Germany.

- Polykretis I, **Tang G**, Michmizos K. (2020). [An Astrocyte-Modulated Neuromorphic Central Pattern Generator for Hexapod Robot Locomotion on Intel's Loihi](#). *International Conference on Neuromorphic Systems (ICONS)*, Oak Ridge, TN. **(Featured in international news, including [Tech Xplore](#) and [Chinese Global Science](#).)**
- **Tang G**, Shah A, Michmizos K. (2019). [Spiking Neural Network on Neuromorphic Hardware for Energy-Efficient Unidimensional SLAM](#). *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Macau, China.
- **Tang G**, Polykretis I, Ivanov V, Shah A, Michmizos K. (2019). [Introducing the Astrocytic Processing Unit into Neuromorphic Hardware: Synchronization, Local Plasticity and Edge of Chaos](#). *Neuro Inspired Computational Elements Workshop (NICE)*, Albany, NY.
- **Tang G**, Michmizos K. (2018). [Gridbot: An autonomous robot controlled by a Spiking Neural Network mimicking the brain's navigational system](#). *International Conference on Neuromorphic Systems (ICONS)*, Knoxville, TN.

Preprints

- Consortium authors, **Tang G**, et al. (2023). [NeuroBench: Advancing neuromorphic computing through collaborative, fair and representative benchmarking](#). *arXiv preprint*. Updated manuscript in preparation. Target submission: Nov, 2023 to *Nature Communications*.
- **Tang G**, Kumar N, Polykretis I, Michmizos K. (2021). [BioGrad: Biologically Plausible Gradient-Based Learning for Spiking Neural Networks](#). *arXiv preprint*.

Thesis

- **Tang G** (2022), [Biologically Inspired Spiking Neural Networks for Energy-Efficient Robot Learning and Control](#). *PhD Dissertation*.
- **Tang G** (2017), [Gridbot: Towards a Neuroinspired Navigation System For Robot Planning](#). *Master's Thesis*.

PRESENTATIONS

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| European Conference on EDGE AI Technologies and Applications
EEAI Website | 17-19 Oct 2023
Athens, Greece |
| <ul style="list-style-type: none"> • Gave a talk titled "SENECA: Flexible and Scalable Neuromorphic Processor for Efficient Event-driven Neural Processing" discussing optimizing CNN on an edge neuromorphic processor. | |
| Third Neuromorphic Computing in the Netherlands Workshop
NCN2023 Website | 2 Oct 2023
Groningen, The Netherlands |
| <ul style="list-style-type: none"> • Gave a talk titled "SENECA: Building a fully digital neuromorphic processor, design trade-offs and challenges" discussing our neuromorphic processor design choices and edge application advantages. | |
| TinyML EMEA Innovation Forum
EMEA Website | 26-28 Jun 2023
Amsterdam, The Netherlands |
| <ul style="list-style-type: none"> • Presented a poster titled "SENECA: Flexible and Scalable Neuromorphic Processor" showing the fundamental benchmarking results of our neuromorphic processor. | |

SURF Research Day

[*SURF Website*](#)

23 May 2023

Amersfoort, The Netherlands

- Invited to join a panel discussion on the state and future of neuromorphic computing with scientists from TU Delft and Radboud University.

Brain-inspired Navigation Workshop UPINLBS2022

[*Workshop Website*](#)

20 Mar 2022

Online

- Gave an invited talk titled "Biologically Inspired Spiking Neural Networks for Energy-Efficient Robot Navigation and Control" discussing my works on robotics and neuromorphic computing.

ACADEMIC SERVICES

Reviewer

Frontiers in Neurorobotics	2023 - Present
Transactions on Machine Learning Research (TMLR)	2022 - Present
IEEE Robotics and Automation Letters (RA-L)	2022 - Present
ACM Journal on Emerging Technologies in Computing Systems (JETC)	2021 - Present
International Conference on Machine Learning (ICML)	2023
Neural Information Processing Systems (NeurIPS)	2021-2023
International Conference on Learning Representations (ICLR)	2021, 2022
IEEE Engineering in Medicine and Biology Society Conference (EMBC)	2018-2021
International Conference on Biomedical Robotics and Biomechatronics (BioRob)	2020

SKILLS

Programming Language	Python, C, C++, Java
Machine Learning Framework	PyTorch, TensorFlow
Robotics Software	Robot Operating System (ROS), Gazebo
Robotics Platform	Baxter Robot Arm, Turtlebot2, Phantomx Hexapod
Edge Sensing Platform	Depth Camera, LiDAR, Event-based Camera, FMCW Radar
Edge Compute Platform	Arduino Robocontroller, Raspberry Pi, Nvidia Jetson
Neuromorphic Computing	IMEC SENECA, Intel Loihi, NxSDK, Lava