CNeuro2022: Application Form

Saturday, 14th – Saturday, 21st August 2022

Theoretical and Computational Neuroscience Summer School

Thank you for your interest in our CNeuro2022 Summer School!

To apply, please take the time to fill in the form below. Please submit this together with your CV and any additional documents in a single PDF file to info@cneuro.net before Saturday, 21st May 2022 at the latest.

Applicant Information

Full Name: Aohua (*First*) Middle Cheng (*Last*)

Phone: 86-18639075297 **Email:** aohuacheng18@gmail.com

Where are you currently based?: Tsinghua University, Beijing, China

Education

University: Tsinghua University **Degree & Programme:** Engineering Mechanics(Tsien Excellence in Engineering Program)

From: 2018 **To:** 2023 **Did you graduate?** YES ☐ NO ☑ **Grade Average:** 4

University: _____ **Degree & Programme:** _____

From: _____ **To:** _____ **Did you graduate?** YES ☐ NO ☐ **Grade Average:** _____

University: _____ **Degree & Programme:** _____

From: _____ **To:** _____ **Did you graduate?** YES ☐ NO ☐ **Grade Average:** _____

Other Schools: _____ **Degree & Programme:** _____

From: _____ **To:** _____ **Did you graduate?** YES ☐ NO ☐ **Grade Average:** _____

Related Coursework

Please list at least three relevant courses related to the topic of 'Learning, Memory and Decision-Making in Brains and Machines'.

Course 1: Theoretical Neuroscience: computational and mathematical modeling of neural system

Course 2: Pattern Recognition and Machine Learning

Course 3: Thermodynamics and Statistical Physics

Course 4:

Course 5:

Motivation

Please describe in 5 lines why you are applying for the CNeuro2022 Summer School.

Firstly, I have watched some of the videos of CNEURON 2021 on youtube. These inspiring lectures make me believe that CNeuron is worth coming to. Secondly, another summer school, AI and Brain Computation organized by Prof. Si Wu and Jun Zhang last year provided me with lots of basic knowledge of learning, memory, and decision making. Also, it deeply influenced my research direction. Thus I hope to join CNeuron 2022 to blow me up again.

Is there anything else that you would like us to know?

Would you be needing financial assistance for travel to attend CNeuo2022? If so please explain in a few short lines (a few fellowships are available, but complete coverage of travel cannot be guaranteed):

Do have any special Dietary Requirements?:

YES ☐ **NO** ☑

If yes, please explain:

I certify that my answers are true and complete to the best of my knowledge. I understand that false or misleading information in my application may result in my disqualification from attending the CNeuro2022 Summer School.

Signature: 程奥华 **Date:** 2022.5.20

AOHUA CHENG

Address: Tsinghua University, Beijing || Cell: +86 18639075297 || Email: aohuacheng18@gmail.com

EDUCATION

Tsinghua University Beijing, China

Bachelor of Engineering, Major in Engineering Mechanics **Aug. 2018 – July 2022 (Expected)**

- **GPA**: 3.72/4.00; top 1% (5/983800) on National College Admissions Exam
- Enrolled in Tsien Excellence in Engineering Program (top 5% on basis of outstanding research performance)

Massachusetts Institute of Technology Cambridge, Massachusetts, United States

Exchange Student, Department of Brain and Cognitive Sciences **Aug. 2021 – Jan. 2022**

- Working on flexible working memory project in Guangyu Robert Yang Lab

Cold Spring Harbor Asia Suzhou, China

Student, AI and Brain Computation Summer School **Aug. 2021**

- Learned mathematical skills, computational models, and Python-based programming with practical sessions
- Completed project of a spiking circuit model for working memory in Python

PUBLICATIONS

1. Y. Tian, **A.H. Cheng**, Y.H. Xu, H.D. Hou, W.H. He, G.Q Li, and P. Sun, *Neural morphological development for brain modeling and neuromorphic learning*, to be submitted in ***Applied Physics Review***.
2. **A.H. Cheng**, Y.K. Qiu, H. Hao, Y.Z. Xu, Y.X. Nie, Y.H. Jiang, X. Wu, Z. Guo, G.T. Zheng, *Autonomous Intubation Robot System based on Visual Servoing and Hybrid Control*, submitted to ***IEEE Trans. Medical Robotics and Bionics***.
3. **A.H. Cheng**, Y.K. Qiu, H. Hao, Y.Z. Xu, Y.X. Nie, Y.H. Jiang, Z.X. Liu, G.T. Zheng, *A tracheal intubation robot that simulates doctors' operation*, **Patent**, Application Number CN: 202110672198.8.
4. **A.H. Cheng**, Y.K. Qiu, H. Hao, Y.Z. Xu, Y.X. Nie, Y.H. Jiang, G.T. Zheng, *A laryngoscope for assisting robot intubation*, **Patent**, Application Number CN: 202121316350.0.
5. **A.H. Cheng**, Y.K. Qiu, H. Hao, Y.Z. Xu, Y.X. Nie, Y.H. Jiang, X.R. Yang, G.T. Zheng, *A force-displacement-visual hybrid control method of robot tracheal intubation*, **Patent**, Application Number CN:202110615405.6.
6. **A.H. Cheng**, Y.K. Qiu, H. Hao, Y.Z. Xu, Y.X. Nie, Y.H. Jiang, X.M. Ma, G.T. Zheng, *A method for path planning of mechanical arm*, **Patent**, Application Number CN: 202110616257.X.
7. **A.H. Cheng**, Y.K. Qiu, H. Hao, Y.Z. Xu, Y.X. Nie, Y.H. Jiang, Z.J. Pan, G.T. Zheng, *A method for recognizing and locating human mouth by robot*, **Patent**, Application Number CN: 202110617884.5.

RESEARCH EXPERIENCE

Massachusetts Institute of Technology Cambridge, Massachusetts, United States

Exchange Student with Professor Guangyu Robert Yang, Department of Brain and Cognitive Sciences

Project: Multi-modality ANN's model of flexible working memory **Aug. 2021 – Present**

Inspired by ANN recent achievements of multi-task training in neuroscience, this project is building a systematic NN model to understand the flexibility of Working Memory (WM). Different from previous work on WM, our model can conduct delay-match or N-back tasks from a few modalities, like vison, auditory, text, etc.

- Trained cognitive tasks from vision and auditory datasets.
- Added new modalities of natural language process and ring attractor
- Analyzed the relationship between flexibility and capacity of WM based on multi-modality inputs

Tsinghua University Beijing, China

Research Assistant to Professor Pei Sun, Tsinghua Brain and Intelligence Lab

Project: Neural morphological development for brain modeling and neuromorphic learning **May 2021 – Present**

Here we present a unified and analytical framework of neural morphological dynamics, covering the main biophysical processes underlying synapse development. Moreover, an integrated framework is designed to realize the dynamic coupling between our system and the training process of artificial neural networks (ANNs). Such a framework guides neural population development by learning process and trains ANNs with biophysical mechanisms, serving as a promising technique to design neural morphological computation and learning architectures.

- Derived concentration distribution of calcium ion from multiple sources with reaction-diffusion equations
- Simulated the neuronal axon development driven by time-varying Calcium concentration
- Built a biologically feasible back-propagation model based on the relationship between neuron synergy and synaptic plasticity
- Realized the learning-task-regulated neural morphological development and the biophysics-based artificial neural network training based on our semi-analytical framework of neuromorphic development
- Acquired basic knowledge of theoretical/computational neuroscience

Tsinghua University Beijing, China

Independent Researcher to Professor Gangtie Zheng, Medical Robot Research Center

Project I: Autonomous Intubation Robot System (AIRS) **Aug. 2020 -- Oct. 2021**

During COVID-19, endotracheal intubation is an effective and common method to save patients as the virus causes lung fibrosis and thus patients are unable to breathe spontaneously. Medical staff need to insert a tube close to the patient's mouth, thereby leading to a high risk of cross-infection. To protect medical staff, we proposed an autonomous intubation robot system (AIRS) based on visual navigation and hybrid control.

- Delivered a 30-min report at International Conference of Robotics and Automation (ICRA) 2021
- Validated phantom experiment with UR robots, USB cam, and Laryngoscope under 2-min operation
- Developed a mono 3D environmental construction method based on Shape from Shading
- Designed a new multifunctional real-time video laryngoscope
- Communicated and collaborated with doctors in ICU and professors from Purdue University
- Learned robot kinematics, control theory, image recognition, and machine learning

Project II: Hepatobiliary surgery robot **Sep. 2019 – Aug. 2020**

Provided feasibility analysis and technical solution for independently developing hepatobiliary surgery robot.

- Acquired set of ultrasound detectors, electrosurgical units, and UR robotic arms for lab
- Investigated the feasibility of a hepatobiliary surgery robot with doctors
- Learned general ways to use an Ultrasound system

SELECTED AWARDS AND HONORS

- Grand Prize in the 11th Capital University Student Academy and Technology Competition (Highest award among top college students at academic competition in Beijing) 2021
- Tsinghua University Comprehensive Excellence Fellowship (top 10% of 3800 students, three times) 2019-2021
- Tsinghua University Science and Technology Innovation Excellence Fellowship 2021
- Tsinghua University Social Work Excellence Fellowship 2020
- Tsinghua University Academic Excellence Fellowship 2019
- Tsinghua University Volunteer Charity Excellence Fellowship 2019
- Tsinghua University Freshman Fellowship 2018
- Second Prize in the 29th High School Student Mathematics Olympiad of Henan Province 2017
- Second Prize in the 29th High School Student Physics Olympiad of China 2017

SOCIAL WORK AND EXTRACURRICULAR EXPERIENCES

Social work Beijing, China

- **Deputy Minister of the Student Science and Technology Association** **Sep. 2019 – May 2021**
  Organized more than ten academic salons in different fields and held the first THU Drone Competition
- **Vice-chairman, Students Association of Educational Poverty Alleviation (SAEPA)** **May 2020 – June 2021**
  SAEPA is affiliated with the Poverty Alleviation Office of Tsinghua University and has been awarded "Top 10 Student Associations of Tsinghua University" for 10 consecutive years
- **Deputy Minister, Department of Weekend Voluntary Teaching in SAEPA** **May 2019 – June 2020**
  Department has supported 1,608 volunteers, benefited 20,000+ students, and won the Beijing Volunteer Service Project Competition

Volunteer Charity Beijing, China

Tsinghua University five-star volunteer (highest), 303 hours of volunteer service and 18 projects **Sep. 2018 – Present**

- Taught Street Dance and Tsinghua Martial Arts for elementary school kids in Shannan, Tibet for two weeks
- Organized "Enjoyable Reading" 6.0 social practice detachments for more than 2000 students from Hebei, Fujian, and Hunan provinces; won Bronze Award for social practice and was interviewed by the local TV station, reaching an audience of more than one million viewers

ADDITIONAL INFORMATION

Interests

- Swimming, tennis 3.0 (Captain of college tennis team), Go amateur 3.0, and street dance

Courses taken

- Mathematical Physics Methods, Statistical Physics, Machine Learning, and Theoretical Neuroscience

Computer and Language Skills

- MATLAB, Python, PyTorch, Neural Network, Git, Linux, ROS, OpenCV, Latex, Markdown
- Fluent in Mandarin, Proficient in English, TOEFL 97/120