



# 东南大学

## 2023 年国际暑期学校

项目主题：FPGA 国际暑期学校

开课院系：电子科学与工程学院

开设课程：FPGA 并行编程设计

FPGA 高级应用

FPGA 设计实验

开课时间：2023 年 6 月 26 日-2023 年 7 月 22 日

# 目录

1.	项目介绍 .....	2
1.1.	项目主题：FPGA 国际暑期学校 .....	2
1.2.	开课院系：电子科学与工程学院 .....	2
1.3.	项目简介 .....	2
2.	课程介绍 .....	3
2.1.	课程安排 .....	3
2.2.	教学日历 .....	4
2.3.	外教介绍 .....	5
3.	课程总结及反馈 .....	8

# 1. 项目介绍

## 1.1. 项目主题：FPGA 国际暑期学校

FPGA International Summer School

## 1.2. 开课院系：电子科学与工程学院

School of Electronic Science and Engineering, Southeast University

## 1.3. 项目简介：

项目立足于东南大学电子科学与技术国家一级重点学科综合优势，坚持学术导向，强化国际间前沿研究专业教育、国际交流合作和原始创新思维培养有机结合，全面提升电子科学与技术专业领域学生综合素质。基于电子科学与工程学院已有的电子系统设计（FPGA 篇）课程，引进美国佐治亚理工的《Parallel Programming for FPGAs》（FPGA 并行编程设计）课程、英国剑桥大学基于 FPGA 的量子密钥分发系统搭建以及荷兰代尔夫特大学基于神经形态原理的循环神经网络 FPGA 加速设计，围绕“可重构计算先进前沿交叉技术”这一主题展开。东南大学 FPGA 暑期学校已经举办多年，先后经历 2013 年起校内 Xilinx 暑期学校、2017 年起全国大学生 FPGA 暑期学校和 2020 年线上全国大学生 FPGA 暑期学校，校内专任教师已有相关教学经验，并曾在英国剑桥大学开展过本科生教学工作的丰富经验。今年增加国产 FPGA 进展讲座，补充同学们对技术和产业前沿的国情认知。

通过本课程的建设，学生将体验国际顶级学府英国剑桥大学、美国佐治亚理工学院和荷兰代尔夫特大学等海外专家授课或讲座，接轨国际高校授课方式，紧密结合理论和应用，激发学生原始创新思维和自主学习能力，为从事集成电路设计、新一代人工智能以及量子信息相关领域的工作和研究建立坚实基础，具有重要的教育和现实意义。同时课程阐释与基本理论相关的科学思想，结合国家集成电路、量子信息、人工智能等未来产业的发展壮大，培养学生解决“卡脖子”问题的历史责任感和使命感，引导校内学生建立个人发展方向应契合国家、时代发展方向的正确观念。

The project is based on the comprehensive advantages of Southeast University's national key discipline of electronic science and technology, adhering to academic orientation, strengthening the education and collaboration of international cutting-edge research and cultivating students' original critical thinking, in order to comprehensively improve the comprehensive quality for students majoring in electronic and information engineering. Based on the existing courses in Electronic System Design (FPGA) at the

School of Electronic Science and Engineering, Southeast University, this summer school introduces the "Parallel Programming for FPGA" course from Georgia Institute of Technology, USA, and several cutting-edge FPGA-based research seminars, such as quantum key distribution hardware system from the University of Cambridge, UK, and neuromorphic machine learning from TU Delft, Netherland. This summer school focusses on the theme of "Interdisciplinary advanced techniques in reconfigurable computing". This FPGA summer school held at the Southeast University has been established for many years, including the Xilinx FPGA Summer School in 2013 and the National FPGA Summer School from 2017. The full-time teachers on campus have relevant teaching experiences, and Dr. He Li has had experiences in undergraduate teaching at the University of Cambridge. This year, a lecture on the progress of domestic FPGAs will be added to supplement students' understanding of the development of FPGA industry in China.

Through the construction of this course, students will have lectures given by overseas experts from top international universities such as the University of Cambridge, the Georgia Institute of Technology and the TU Delft. They will employ international teaching methods in the class, and stimulate students' original innovative thinking and self-learning abilities. We hope to building a solid foundation for students who are engaged in the integrated circuit design for the next generation artificial intelligence and quantum information. At the same time, the courses explain scientific ideas related to basic theories, combine the development and expansion of future national industries such as integrated circuits, quantum information, and artificial intelligence, and cultivate students' historical responsibility to solve the "neck-sticking" problems. Throughout the course, we hope to guides students to establish a correct concept of personal career path that follows the development direction of our country.

## **2. 课程介绍**

### **2.1. 课程安排**

The course arrangement mainly includes parallel programming for FPGAs, FPGA advanced applications and FPGA design experiments. This course enables students to understand the design principles of FPGA parallel optimization and gain knowledge about cutting-edge applications in the field, enhances students' overall design and research capabilities.

## 2.2. 教学日历

Date	Morning	Afternoon
7.10	<b>Prof. Yongming Tang</b> from Southeast University and <b>Mr. Lu, the representative of Xilinx</b> , delivered speeches respectively; <b>Asso. Prof. He Li</b> from Southeast University gives a lecture.	Introduction to Southeast University's self-developed FPGA board; Installation of Vitis HLS and SDK.
7.11	<b>Industry professionals</b> give a lecture. (Online lecture on signal processing experiments)	Demonstration and practice of simple design examples(Vector addition). Assignment: Vector addition, submit a complete project including simulation waveform diagram.
7.12	<b>Industry professionals</b> give a lecture. (Online lecture on image processing, introduction to HLS architecture)	Reproducing vector addition and expansion (Matrix-vector multiplication or dot product)
7.13	<b>Prof. Ray Cheung</b> from City University of Hong Kong gives a lecture about AI design	<b>LAB1 assignment</b>
7.14	<b>LAB1 assignment</b>	
7.15	Introduction to Domain Specific Architecture and FPGA ( <b>Prof. Callie Hao</b> from Georgia Tech)	<b>LAB1 assignment</b>
7.16	Introduction to High Level Synthesis and basic optimizations ( <b>Prof. Callie Hao</b> from Georgia Tech)	<b>Assignment: Matrix Multiplication</b>
7.17	Advanced HLS optimization: loops and memory ( <b>Prof. Callie Hao</b> from Georgia Tech)	HLS optimization for LAB1 (pipeline, loops, memory) <b>LAB2 assignment</b>
7.18	Quantization and streaming ( <b>Prof. Callie Hao</b> from Georgia Tech)	PS side coding trick (SDK) <b>LAB2 assignment</b>
7.19	Case study: data reuse in convolution ( <b>Prof. Callie Hao</b> from Georgia Tech)	<b>Assignment: Choose an algorithm and implement it.</b>
7.20	Specific management design	Energy-Efficient Recurrent Neural Network Accelerators for Real-Time Inference ( <b>Prof. Chang Gao</b> from TU Delft) (3pm-4pm)
7.21	Progress Report	

### 2.3. 外教介绍



**Callie Hao**

美国佐治亚理工大学（Georgia Tech）电气与计算机工程系助理教授, 2022 年亚马逊研究奖 Amazon Research Award IEEE ASAP、ACM GLSVLSI、ICASIC 等多个国际会议最佳论文奖;IEEE/ACM DAC 国际系统设计竞赛第一名;发表国际期刊/会议论文 60 余篇、十余个国际会议 TPC 委员等。

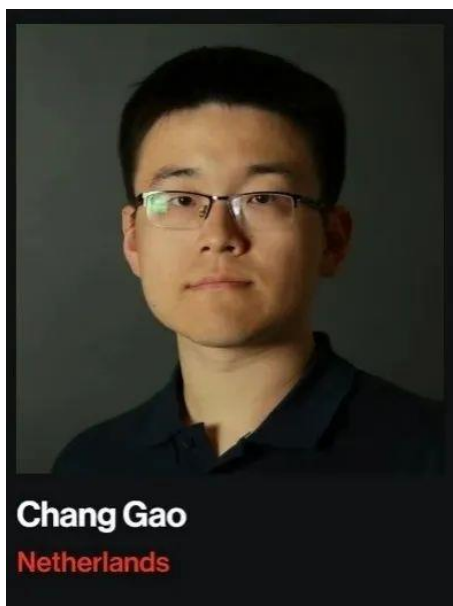
Professor Callie Hao, Assistant Professor in the School of Electrical and Computer Engineering at Georgia Tech, USA. She received the 2022 Amazon Research Award and has won several Best Paper Awards at international conferences such as IEEE ASAP, ACM GLSVLSI, and ICASIC. She also secured the first place in the IEEE/ACM DAC International System Design Contest. She has published over 60 papers in international journals/conferences and served as a member of the Technical Program Committee (TPC) for more than ten international conferences.



### **Ray Cheung**

香港城市大学电气工程学院副教授，他的研究方向包括密码芯片设计、片上网络及物联网系统设计、嵌入式系统等。

Prof. Ray Chak-Chung Cheung is currently an Associate Professor in the Department of Electrical Engineering at City University of Hong Kong, and with CityU-EE Xilinx Lab. His current research interests include cryptographic hardware designs and design exploration of System-on-Chip (SoC) designs, AIoT designs, and embedded system designs.

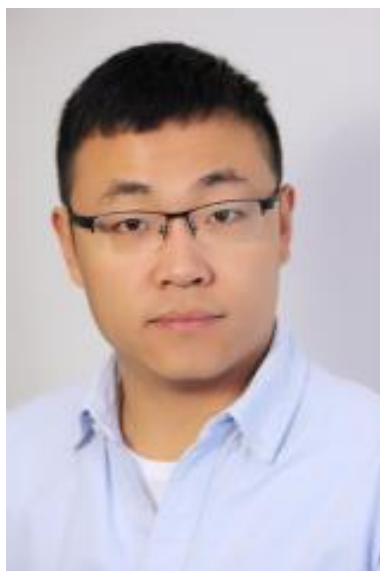


### **Chang Gao**

荷兰代尔夫特理工大学（TU Delft）Chang Gao 教授，微电子系助理教授，2023 年入选《麻省理工科技评论》35 岁以下欧洲创新者，2022 年欧盟玛丽·居里 (Marie-Curie) 学者基金，2021 年 Mahowald 神经形态工程 Early Career Award，2020 年 IEEE 人工智能电路与系统国际会议（AICAS）最佳论文奖。

Professor Chang Gao from Delft University of Technology (TU Delft) in the

Netherlands is an Assistant Professor in the Department of Microelectronics. In 2023, he was selected as one of the "Innovators Under 35 Europe" by MIT Technology Review. He received the Marie Curie Scholar Fellowship from the European Union in 2022 and the Mahowald Neural Engineering Early Career Award in 2021. In 2020, he won the Best Paper Award at the IEEE International Conference on Artificial Intelligence Circuits and Systems (AICAS).



**He Li**

李鹤副教授毕业于英国帝国理工学院，先后在英国剑桥大学（师从剑桥大学副校长、英国皇家工程院院士）担任量子信息处理方向博士后研究员和三一学院教学讲师。入选“中国科协青年人才托举工程”（青托）。李鹤博士在可编程芯片（FPGA）开发和系统优化、量子计算电路与系统、量子通信系统和集成电路硬件安全等领域取得一些独创性成果，在 IEEE TC、TCAD、TVLSI、TCAS-II、MICRO、OFC、DAC 等领域重要期刊会议上发表论文 40 余篇，授权/受理发明专利若干项，获得 IEEE FPT 2017 最佳论文展示奖。目前担任可编程芯片（FPGA）和集成电路 EDA 领域国际旗舰会议技术程序委员会（TPC）委员，如 DAC（CCF A）、ICCAD（CCF B）、ICCD（CCF B）、ISCAS、FCCM、FPL、FPT 等、Electronics 和电子与信息学报专题副主编，Frontiers in Electronics 期刊编委，IEEE FPT 2020-2022 宣传主席，IEEE/ACM FCCM、ASAP、GLSVLSI、ASPDAC、SOCC、CCF CHIP 等分会议主席，IEEE Young Professions 工作委员会委员以及十余个 ACM/IEEE 汇刊审稿人。

Associate Professor He Li graduated from Imperial College London and has served as a postdoctoral researcher in the field of quantum information processing at the University of Cambridge, under the supervision of the Vice-Chancellor of the University of Cambridge and a Fellow of the Royal Academy of Engineering. He has also worked as a teaching lecturer at Trinity College. He has been selected as a participant in the "Young Talents Program" by the China Association for Science and Technology (CAST).

Prof. He Li has made innovative contributions in the areas of FPGA development

and system optimization, quantum computing circuits and systems, quantum communication systems, and integrated circuit hardware security. He has published over 40 papers in prestigious journals and conferences such as IEEE TC, TCAD, TVLSI, TCAS-II, MICRO, OFC, and DAC. He has also been granted several patents and received the Best Paper Presentation Award at IEEE FPT 2017.

Currently, he serves as a Technical Program Committee (TPC) member for international flagship conferences in the fields of FPGA and integrated circuit Electronic Design Automation (EDA), such as DAC, ICCAD, ICCD, ISCAS, FCCM, FPL, and FPT. He is also an associate editor for Electronics and Journal of Electronics and Information Technology, a board member of Frontiers in Electronics, the Publicity Chair of IEEE FPT 2020-2022, and the chair of several sub-conferences such as IEEE/ACM FCCM, ASAP, GLSVLSI, ASPDAC, SOCC, and CCF CHIP. Additionally, he is a member of the IEEE Young Professionals Working Committee and serves as a reviewer for more than ten ACM/IEEE journals.

### 3. 课程总结及反馈

2023 年国际 FPGA 暑期学校在东南大学电子科学与工程学院成功举办。这次暑期学校以其学术导向和国际交流合作的特点，为学生们提供了一个深入学习和探索电子科学与工程领域的机会。

在本次暑期学校中，学生们参与了多个重要课程，其中包括电子系统设计（FPGA 篇）和美国佐治亚理工的《Parallel Programming for FPGAs》课程。这些课程不仅加深了学生们对 FPGA 技术的理解和应用，还介绍了最新的 FPGA 并行编程设计理论和方法，拓宽了他们的视野。

此外，荷兰代尔夫特大学和香港城市大学的前沿学术报告也为学生们带来了新的启发。他们学习了基于 FPGA 的人工智能系统搭建和基于神经形态原理的循环神经网络 FPGA 加速设计。这些前沿研究领域的介绍为学生们提供了宝贵的借鉴和学习机会，让他们了解到了 FPGA 在人工智能、机器人和先进计算等领域的广泛应用前景。

通过参与 2023 年国际 FPGA 暑期学校，学生们深刻认识到了电子科学与技术的前沿技术和研究方向。他们也意识到了终身学习的重要性，并将继续努力学习和创新，不断提升自己的综合素质。此外，他们也深刻感受到了国际交流的重要性，只有与世界各地的同行交流合作，才能推动学科的发展。

总而言之，2023 年国际 FPGA 暑期学校为学生们提供了宝贵的学习和交流机会。他们将充分利用所学知识，不断提升自己的技术水平和创新能力。感谢学校和学院支持我们组织这一活动，并期待未来能有更多类似的学术交流机会。



暑期学校回顾



暑期部分学校优秀学员