南方科技大学
SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

课程详述
COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	**面向机器视觉的数字电路实践 Digital Circuit Practice for Machine Vision**
2.	**授课院系 Originating Department**	深港微电子学院 School of Microelectronics
3.	**课程编号 Course Code**	SMES209
4.	**课程学分 Credit Value**	1
5.	**课程类别 Course Type**	专业选修课 Major Elective Courses
6.	**授课学期 Semester**	夏季 Summer
7.	**授课语言 Teaching Language**	中英双语 English & Chinese
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation& Contact （For team teaching, please list all instructors）**	安丰伟，深港微电子学院，anfw@sustech.edu.cn 黄嘉炜，深港微电子学院，huangjw3@mail.sustech.edu.cn
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	待公布 To be announced
10.	**选课人数限额(可不填) Maximum Enrolment （Optional）**	20

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
学时数 Credit Hours	0	0	32	0	32

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	SME202, 集成电路基础 II-数字集成电路, Fundamentals of Integrated Circuit II-Digital Integrated Circuit EE202, 数字电路，Digital Circuits CS207，数字逻辑，Digital Logic
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	No
14. 其它要求修读本课程的学系 Cross-listing Dept.	No

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本实验课程通过一个机器视觉的 FPGA（Field-Programmable Gate Array）实践项目，学习数字电路设计中的映射技术。具体而言，学习如何把 3-5 个常见的机器视觉算法映射到 FPGA 芯片上。本实验课程致力于提高学生的数字电路设计能力、算法文档查阅能力、项目实践能力，特别是与机器视觉算法的应用结合。

This experimental course engages students in a practical FPGA (Field-Programmable Gate Array) project for machine vision to learn about mapping technologies in digital circuit design. Specifically, it teaches how to map 3 to 5 common machine vision algorithms onto an FPGA chip. The course is dedicated to enhancing students' abilities in digital circuit design, documentation research for algorithms, and project practice skills, with a particular focus on integrating machine vision algorithms into real-world applications.

16. 预达学习成果 Learning Outcomes

学习本实验课程，学生预期可达到：

1、初步了解常见的机器视觉算法，如：图像基础处理、图像滤波、边缘检测、目标识别。

2、深入理解数字电路设计的 3 类约束：时序、存储器带宽和资源约束。

3、掌握数字电路设计中的映射技术，并实践克服和减缓以上约束。

4、初步了解项目设计流程

Through the study of this experimental course, students are expected to:

1， Gain a preliminary understanding of common machine vision algorithms, such as fundamental image processing techniques, image filtering, edge detection, and object recognition.

2， Develop a deep comprehension of the three major constraints in digital circuit design: timing requirements, memory bandwidth constraints, and resource limitations.

3， Master mapping techniques in digital circuit design and practically apply these to overcome and alleviate the aforementioned constraints through hands-on experience.

4， Acquire an initial grasp of the overall project design process.

17. **课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）**
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

1-4 学时，背景介绍

- 机器视觉常见算法
- FPGA 及映射技术

5-8 学时，实验一：图像基础处理

- FPGA 实验：几何变换，颜色空间转换

9-12 学时，实验二：图像滤波

- FPGA 实验：高斯滤波，形态学处理

13-16 学时，实验三：边缘检测

- FPGA 实验：Sobel 边缘检测算子，Canny 边缘检测算法

17-24 学时，实验四：目标识别

- FPGA 实验：道路、门框、球体、方块、路障等物体识别

25-32 学时，项目实践

- 基于 FPGA 的摄像头模块，应用于机器人/机械臂等场景中

1-4 Hours，Background Introduction

- Common Machine Vision Algorithms
- FPGA Technology and Mapping Techniques

5-8 Hours，Experiment 1：Basic Image Processing

- FPGA Experiment：Geometric Transformations, Color Space Conversion

9-12 Hours，Experiment 2：Image Filtering

- FPGA Experiment：Gaussian Filtering, Morphological Operations

13-16 Hours，Experiment 3：Edge Detection

- FPGA Experiment：Sobel Edge Detection Operator, Canny Edge Detection Algorithm

17-24 Hours，Experiment 4：Object Recognition

- FPGA Experiment：Identification of objects such as roads, door frames, spheres, cubes, and roadblocks

25-32 Hours，Project

- Camera module based on FPGA, applied in scenarios involving robots/manipulators, etc.

18. **教材及其它参考资料 Textbook and Supplementary Readings**

参考书 References:

《FPGA-Based Implementation of Signal Processing Systems》, Roger Woods, John McAllister, and Gaye Lightbody

《基于 FPGA 嵌入式图像处理系统设计》，电子工业出版社，ISBN: 978-7-121-19597-6

课程评估 ASSESSMENT

19.

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance				
课堂表现 Class Performance		10%		
小测验 Quiz				
课程项目 Projects		90%		
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation				
其它（可根据需要改写以上评估方式） Others (The above may be modified as necessary)				

20. 记分方式 GRADING SYSTEM

☐A. 十三级等级制 Letter Grading
■ B. 二级记分制（通过/不通过） Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority