

## 计算机图形技术（双语）

### Computer Graphics Technology (Bilingual)

#### 一、基本信息 Basic Information

课程代码 Course Code: 【2140021】

课程学分 Course Credits: 【2】

面向专业 Major: 【数字媒体技术（双语）Bachelor in Digital Media Technology(Bilingual)】

课程性质 Characteristic of the Course: 【系级必修课 Department-level required courses】

开课院系 Department: 【国际教育学院 College of International Education】

使用教材 Teaching and Reference Materials:

教材 Textbook

【视觉计算基础：计算机视觉、图形学和图像处理的核心概念，阿娣提·玛珠德，机械工业出版社，2019.4】

【Majumder A , Gopi M . Techniques: Core Concepts in Computer Vision, Graphics, and Image Processing[M]. 2018.】

参考书目 Bibliography

1、【Fundamentals Of Computer Graphics, Steve Marschner, Apple Academic Press, 2020.1】

2、【计算机图形学基础教程(第2版), 孙家广等, 清华大学出版社, 2009.8】

【Basic course of computer graphics (2nd Edition), sun Jiaguang et al., Tsinghua University Press, August 2009】

#### 二、课程简介 Course Description

As a newly designed overview course, this course aims to provide students with basic knowledge in different fields such as computer graphics, computer vision and image processing. Teachers can use this course to teach the common basic knowledge in these fields, so that students have the opportunity to learn more widely before entering the specific fields of computer graphics, computer vision and image processing. Mastering a wide range of knowledge in the general field of visual computing is now considered to be a strength, which can help students easily devote themselves to the cross fields of computer science and other fields, which use a lot of general knowledge of visual computing.

本课程作为一门新设计的概述性课程，旨在为学生提供计算机图形学、计算机视觉和图像处理等不同领域的基础知识，教师可以借助此课程教授这些领域共通的基础知识，让学生在进入计算机图形学、计算机视觉和图像处理中的具体领域之前有机会更广泛地学习相关知识。掌握视觉计算通用领域的广泛知识如今被认为是一个强项，能帮助学生轻松投身到大量使用视觉计算通用知识的计算机科学与其他领域的交叉领域。

#### 三、选课建议 Suggestion for Selection of Course

This course is suitable for digital media technology students in the sophomore year and junior year.

该课程适合信息技术学院数字媒体技术学生在第二学年开设。

#### 四、课程与专业毕业要求的关联性 The Correlation between Curriculum and Graduation Requirements

Graduation Requirements	Relation
<p>LO1: Expressing communication</p> <p>Understand the views of others, respect their values, and communicate effectively in writing or orally on different occasions.</p> <p>能领会用户诉求、目标任务，正确表达自己的观点，具有专业文档的撰写能力。</p>	
<p>LO2: Self-learning</p> <p>Identify learning goals as needed and achieve them by gathering and analyzing information, discussing, practicing, questioning.</p> <p>能根据环境需要确定自己的学习目标，并主动地通过搜集信息、分析信息、讨论、实践、质疑、创造等方法来实现学习目标。</p>	●
<p>LO3: Professional ability</p> <p>LO31: Engineering literacy: master mathematics and natural science knowledge, have engineering awareness, and be able to combine computer Professional knowledge of digital media technology to solve complex engineering problems.</p> <p>工程素养：掌握数学、自然科学知识，具有工程意识，能结合计算机、数字媒体技术相关专业知识解决复杂工程问题</p>	
<p>LO32: Software development: master the mainstream design technology, programming thinking and related database technology, and have the ability to build a variety of terminal websites.</p> <p>软件开发：掌握主流设计技术、程序设计思维以及相关数据库技术，具备建设可运行于多种终端网站的能力；</p>	
<p>LO33: System maintenance: systematically master the basic theory and knowledge of computer hardware and software, and have the basic skills to ensure system operation and maintenance.</p> <p>系统运维：系统地掌握计算机硬件、软件的基本理论、基本知识，具备保障系统运行与维护基本技能。</p>	
<p>LO34: Material collection and processing: master the basic theory of digital media and the use technology of mainstream digital media application software, and have the ability of material collection, storage, processing and transmission.</p> <p>素材采集与处理：掌握数字媒体的基本理论、主流数字媒体应用软件使用技术，具备素材的采集、存储、处理以及传输的能力。</p>	
<p>LO35: Virtual reality design and production: be familiar with the basic principles of virtual reality, master the design and production process of virtual reality products and the mainstream design and integration platform, and have the ability to realize the content production and application development of virtual reality products combined with relevant hardware.</p> <p>三维设计与制作：熟悉并了解三维设计与制作全部流程，掌握物体构造原理以及三维空间运动规律，运用三维软件实现三维建模以及动画短片的设计与制作，具备建模、贴图、绑定、灯光、特效、渲染以及合成的能力。</p>	●
<p>LO4: Due diligence and pressure resistance</p> <p>Discipline, abide by the rules, with resistance to setbacks, the ability to resist pressure</p>	

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遵守纪律、守信守责；具有耐挫折、抗压力的能力。	
<p>LO5: Collaborative innovation</p> <p>Keep good cooperation with the team, be an active member of the group, be brave to think from different perspectives and put forward new ideas.</p> <p>能与团队保持良好关系，积极参与其中，保持对信息技术发展的好奇心和探索精神，能够创新性解决问题。</p>	●
<p>LO6: Information application</p> <p>Can apply information technology to solve problems in study and work, and have the ability to use computers to process information and technology exchanges in the field of work.</p> <p>能发掘信息的价值，综合运用相关专业知识和技能，解决实际问题。</p>	
<p>LO7: Service care</p> <p>Willing to serve others, enterprises and society; being enthusiastic, loving and grateful (gratitude, return, love is one of the contents of our school motto)</p> <p>愿意服务他人、服务企业、服务社会；为人热忱，富于爱心，懂得感恩。</p>	
<p>LO8: International Perspective</p> <p>With basic foreign language communication skills and cross-cultural understanding ability, able to read professional foreign language materials, with international competition and cooperation awareness.</p> <p>具有基本外语表达沟通能力，积极关注发达国家和地区信息技术发展新动向。</p>	

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## 五、Course Objectives / Course Expected Learning Outcomes

序号 No.	课程预期 学习成果 Course Expected Learning Outcomes	课程目标 (细化的预期学习成 果) Course Objectives (Detailed Expected Learning Outcomes)	教与学方式 Teaching and Learning Methods	评价方式 Assessment Methods
1	LO212: Be able to collect and obtain the learning resources needed to achieve the goals, implement the learning plan, reflect on the learning plan, and continuously improve to achieve the learning goals 能搜集、获取达到目标所需要的学习资源，实施学习计划、反思学习计划、持续改进，达到学习目标	Master the concepts and technologies related to computer vision, so that students can have an in-depth understanding of image filtering, edge detection, spectral analysis, geometric transformation, etc. 掌握计算机视觉相关概念和技术，使学生对图像滤波、边缘检测、谱分析、几何变换等有比较深入的认识。	Lecture, Discussion, Case Study 授课、讨论、 案例分析	Multiple Questions, Quiz, Case Study 各类问题，章节 测验，案例学习
2	LO353: master the whole process of 3D design and production, select reasonable tools (platforms), and be able to complete the design and production of 3D products. 掌握三维设计与制作全流程，选用合理的工具（平台），能够完成三维产品的设计与制作。	Complete the transformation, projection, texture and other effects of 3D graphics, and understand the rendering pipeline of computer graphics. 完成三维图形的变换、投影、纹理等效果，理解计算机图形学渲染管线。	Lecture, Discussion, Case Study 授课、讨论、 案例分析	Multiple Questions, Quiz, Case Study 各类问题，章节 测验，案例学习
3	LO514: Understand industry cutting-edge knowledge and technology 了解行业前沿知识和技术。	Understanding of rendering pipeline in computer graphics 计算机图形学渲染管线的理解	Autonomous Learning 课外自主学 习	Team work 团队项目

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## 六、课程内容 Course Contents

### Part 1 Preliminary Knowledge 第 1 部分 预备知识

Through the study of this part, we will introduce various visual data (such as two-dimensional image, video and three-dimensional geometric data), as well as the core mathematical technologies required in the fields of computer graphics, computer vision and image processing (such as interpolation and vector multiplication).

Theoretical class hours 4, experiment hours 0.

通过本章学习, 介绍各种不同的视觉数据(如二维图像、视频和三维几何数据), 以及计算机图形学、计算机视觉和图像处理领域所需的核心数学技术(如插值和向量乘法)。

理论课时数 4, 实践课时数 0。

### Part 2 image based visual computing 第 2 部分 基于图像的视觉计算

Through the study of this part, some basic technologies for processing two-dimensional images (such as convolution, spectral analysis and feature detection) are introduced, which correspond to the processing of low-level retinal images in human visual system.

This chapter focuses on the use of various linear and nonlinear filters, discrete Fourier transform and various feature detection.

Theoretical class hours 2, experiment hours 8.

通过本章学习, 介绍处理二维图像的若干基本技术(如卷积、谱分析和特征检测), 这些技术对应人类视觉系统中的低层视网膜图像处理。

本章重点是各种线性和非线性滤波器的使用, 离散傅里叶变换以及各种特征检测。

理论课时数 2, 实践课时数 8。

### Part 3 geometric based visual computing 第 3 部分 基于几何的视觉计算

Through the study of this part, we will introduce the basic technologies (such as linear transformation and projection transformation) used to synthesize the geometric information of multiple perspectives to form the three-dimensional information of the objects and the world around us. This is equivalent to the high-level processing technology in our brain, which can integrate the information seen by our eyes to help us move in the three-dimensional world.

This part focuses on understanding and mastering the virtual camera model, model transformation (translation, rotation, scaling and cutting) and projection transformation (perspective projection and orthogonal projection) in computer graphics, understanding the local coordinate system and world coordinate system, and knowing the homogeneous coordinates.

Theoretical class hours 4, experiment hours 2.

通过本章学习, 介绍用于综合多个视角的几何信息形成我们周围物体和世界的三维信息的基本技术(如线性变换、投影变换)。这相当于我们大脑中的高层处理技术, 能够综合双眼看到的信息以帮助我们三维世界中活动。

本章重点是理解并掌握计算机图形学中的虚拟照相机模型、模型变换(平移、旋转、缩放、剪切)和投影变换(透视投影、正交投影), 理解局部坐标系和世界坐标系, 知道齐次坐标。

理论课时数 4, 实践课时数 2。

### Part 4 visual calculation based on radiance 第 4 部分 基于辐射度的视觉计算

Through the study of this part, we will introduce the basic technologies required to process the information generated during the interaction between light and objects around us, involving the reflectivity, light intensity, color and other attributes related to light in the human visual system, and know the commonly used color models.

Theoretical class hours 2, experiment hours 0.

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通过本章学习，介绍为处理光线与我们周围物体交互过程中产生的信息所需的基本技术，涉及人类视觉系统中与光照相关的反射率、光强和色彩等属性，知道常用的颜色模型。

理论课时数 2，实践课时数 0。

### Part 5 visual content synthesis 第 5 部分 视觉内容合成

This part introduces the basic technology of creating a computer virtual world, which can simulate all the processing technologies described above, including interactive graphics flow, realism and performance. Understand graphics pipeline; Understand Blinn Phong lighting model, shading model and how to use texture to enhance realism.

This lecture focuses on lighting, material and texture.

Theoretical class hours 4, experiment hours 6.

通过本章介绍创建计算机虚拟世界的基本技术，该世界能够模拟前面介绍的所有处理技术，包括交互式图形流程以及真实感与性能。理解图形流水线；理解 Blinn-Phong 光照明模型、着色处理模型、如何使用纹理增强真实感。

本讲重点是光照、材质、纹理。

理论课时数 4，实践课时数 6。

## 七、In-Class Experiment and Basic Requirements 课内实验名称及基本要求

No.	Name of Experiment	Main Content of the Experiment	Experiment Hours	Experiment Type	Notes
1	Introduction to computer vision 计算机视觉入门	Help students master the concepts and technologies related to computer vision, and have an in-depth understanding of image filtering, edge detection, spectral analysis, geometric transformation, etc. 通过实验，帮助学生更好地掌握计算机视觉相关概念和技术，使学生对图像滤波、边缘检测、谱分析、几何变换等有比较深入的认识。	8	Verification 验证型	
2	Introduction to computer graphics 计算机图形学入门	In the tutors software, by adjusting the parameters, the transformation, projection, texture and other effects of 3D graphics are completed, and the rendering pipeline of computer graphics is understood. 在 tutors 软件中通过调整参数，完成三维图形的变换、投影、纹理等效果，理解计算机图形学渲染管线。	8	Verification 验证型	

## 八、评价方式与成绩 Assessment Index & Weightage

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<b>Grading Computation (1+X)</b>	<b>Assessment Index</b>	<b>Weightage (%)</b>
1	期末考核：个人项目报告（2000 words） Final Personal Report	50%
X1	过程考核：个人作业（800 words） Personal Work	20%
X2	过程考核：小组团队作业（1200 words） Team Work	20%
X3	过程考核：课堂表现、出勤等 Class Performance	10%

Tutor Signature: 余莉

Program Leader Signature: 张贝贝

Date: 2023.2.20