FILM A228: PHOTOGRAMMETRY AND VOLUMETRIC IMAGE CAPTURE

Item	Value
Curriculum Committee Approval Date	12/08/2021
Top Code	061410 - Multimedia
Units	3 Total Units
Hours	90 Total Hours (Lecture Hours 36; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S)

Course Description

An overview of photogrammetry and volumetric image capture techniques used currently in Immersive Media (VR/AR), gaming, animation, and film production, exploring a wide range of potential equipment setups, from a single DSLR camera and free software, to synchronized multi-camera rigs, to drones and other UAVs. Using the techniques discussed, this class will focus on the basics of capturing existing 3D objects in physical space to translate them digitally into 3D computer generated objects that can be used and manipulated in a variety of media. Students will work independently and in groups to produce a range of visual projects, including potential cross-class collaborations, based on current offerings and equipment availability. ADVISORY: PHOT A123 and DMAD A281. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Discriminate between a variety of Photogrammetry and Volumetric Capture camera setups, digital image formats, 3D computer graphics formats, and imaging pipeline techniques for each.
2. Demonstrate a basic level of proficiency in: a. Setup and operation of photogrammetry equipment to capture still images of a physical object to be composited and transformed into a 3D computer graphics object/asset. b. Processing, cleanup, and integration of captured images and resulting composite into a usable 3D model of the original object. c. Preparation of the final 3D computer-generated model for use in a variety of immersive media.
3. Demonstrate basic theoretical understanding of related technologies using photogrammetry and how it is implemented in their respective industries, including filmmaking, photography, animation, immersive media, game design, and drone imaging for geology, archeology, architecture and real estate.

Course Objectives

- 1. Understand the history, current industry trends, and future potential of Photogrammetry and Volumetric Capture of still and moving objects used in a range of 3D entertainment media and enterprise applications.
- 2. List the basic techniques used in photogrammetry to collect still images with a range of equipment, sensors, and camera setups.
- 3. Understand the unique pre-production planning and image capture workflow of typical Photogrammetry session.
- 4. Understand essential industry-standard terminology used in Photogrammetry, Volumetric Video Capture, and of the related technologies in which the collected 3D imagery is commonly used.
- 5. View and critique professionally-produced and released media projects which have effectively used Photogrammetry and Volumetric Capture techniques to generate 3D computer-generated media assets.
- 6. Demonstrate effective setup and collection of photogrammetry images and volumetric capture data for a variety of use cases.
- 7. Demonstrate ability to work in a group to collect and process photogrammetry images, mirroring an industry-defined, professional team.
- 8. Understand related terms and techniques often used in tandum, especially with drone-based Photogrammetry, such as electromagnetic radiant imagery, infrared, sonar, radar, lidar, and stereoscopy.
- 9. Demonstrate applicable post-production techniques and multi-image processing for Photogrammetry, resulting in usable 3D media assets.
- 10. Recognize important technologies related to photogrammetry, including cameras and camera control systems, lighting and lighting control, multi-camera rigs and turn-tables, stitching and post-processing software, 3D modeling and mesh software, and game engines, from free open-source and DIY versions to top-level enterprise editions used by industry.
- 11. Demonstrate basic setup, calibration, testing, cleaning, and shutdown of a range of photogrammetry systems.

Lecture Content

I. Introduction to Photogrammetry and Volumetric Capture A. What are Photogrammetry and Volumetric Capture? B. Brief history C. Major companies, devices and technology involved D. Use cases, from basic to advanced E. The future of Photogrammetry and Volumetric Capture in a wide range of entertainment media and enterprise applications II. Workflow for Single-Camera Photogrammetry A. Essential terminology B. Production workflow for Single-Camera Photogrammetry C. Basic equipment types, optimal placement, and software operation D. Stitching and image processing considerations to generate composite images E. Safety, regulations, and ettiquette on-site F. Working independently and in groups to collect single-camera images for Photogrammetry, in contrast to large teams and multi-camera rigs III. Workflow for milti-camera Photogrammetry Rigs A. Essential terminology B. Production workflow for multi-camera Photogrammetry capture C. Basic multi-camera equipment types, optimal placement, and software operation D. Stitching and image processing considerations to generate composite images E. Safety, regulations, and ettiquette on-site using a variety of rigs F. Working with different types of Photogrammetry crews, from single indoor rigs, to outdoor ground-based setups, to airborn drone-based setups and pilots IV. Workflow for Volumetric Capture of Moving Subjects A. Essential terminology B. Production workflow for Volumetric Capture C. Basic Volumetric Capture equipment types, optimal placement, and software operation D. Stitching and image processing considerations to generate composite images E. Safety, regulations, and ettiquette on-site F. Working with a Director, Producter, and crew during a Volumetric

Capture project V. Generating 3D Computer-Generated Objects and Assets using Photogrammetry Data A. Standard formats and conversions for Photogrammetry and 3D CG files B. Stitching and image processing considerations effecting usability of composite images for 3D conversion C. Basic 3D Modeling techniques and overview of currently used software D. Integration of Photogrammetry-created 3D assets into 3D environments, animations, and games VI. Photogrammetry vs. Digital Sculpture of Objects from Scratch VII. Advanced Clean-up of 3D Object Data - Software and Methods VIII. Drone-based Photogrammetry of Large Areas and Objects in More Detail A. Non-standard sensors for collecting data B. Flight-planning considerations and auto-pilot features for automation C. Regulatory concerns IX. Overview of Photogrammetry and Volumetric Capture Career Paths

Lab Content

I. Getting familiar with single-camera Photogrammetry equipment A. Identifying various types of equipment used B. Identifying the working parts of each device C. Filming of a variety of test objects with a range of exposures, speeds, placements, and techniques to achieve optimal composite images II. Getting familiar with multi-camera Photogrammetry equipment A. Setting up and capturing images with a multi-camera rig C. Basic operation of cameras, lights, control systems, and auxillary items D. Following safety rules and regulations, and practicing proper ettiquette E. Working with a team on a Photogrammetry session III. Getting familiar with drone/UAV-based Photogrammetry equipment A. Setting up and capturing images with air and ground-based UAVs C. Basic commands, planning, and terminology used to work with a UAV operator D. Following safety rules and regulations, and practicing proper ettiquette E. Working with a team on a drone/UAV-based Photogrammetry session IV. Use of alternative sensors A. Setting up and capturing images with alternative sensors for capturing volumetric data V. Stitching and conversion of Photogrammetry data into composite images VI. Transformation of composite images into 3D-rendered CG objects/assets VII. Integration of Photogrammetry-collected 3D-rendered assets into a variety of end-use cases, including animation, games, and 360-degree Immersive Media experiences

Method(s) of Instruction

- Lecture (02)
- Lab (04)

Instructional Techniques

1. Lecture 2. Demonstration 3. Video examples 4. One-on-one instruction 5. Individual assignments 6. Group assignments 7. Assignment critique 8. Examinations

Reading Assignments

Students will Read 1-2 hours per week from assigned from handouts, equipment and software manuals, and online sources.

Writing Assignments

Students will spend 1 hour writing and drawing image capture diagrams and pre-production planning documents.

Out-of-class Assignments

Students will spend 2-4 hours creating 3D computer-generated objects using Photogrammetry and Volumetric Capture techniques. Students will also watch online tutorials.

Demonstration of Critical Thinking

A. Assigned individual projects B. Assigned group projects C. Examinations D. Visual planning excercises

Required Writing, Problem Solving, Skills Demonstration

Students will be writing and drawing image-capture plans, diagrams, and production documents to be used on location when imaging with the respective capture device. Students will demonstrate critical thinking and problem solving skills through the utilization of unique photogrammetry and volumetric capture techniques, and by working through production and postproduction challenges related to each capture device.

Eligible Disciplines

Broadcasting technology (film making/video, media production, radio/TV): Any bachelor's degree and two years of professional experience, or any associate degree and six years of professional experience. Multimedia: Any bachelor's degree and two years of professional experience, or any associate degree and six years of professional experience. Photographic technology/commercial photography: Any bachelor's degree and two years of professional experience, or any associate degree and six years of professional experience.

Other Resources

1. Online tutorial videos and equipment manuals for each device used.