

Computational Photography

EEL 5406 Section 0001

Class Periods: T | Period 4 (10:40 AM - 11:30 AM)

R | Period 4 - 5 (10:40 AM - 12:35 PM)

Location: FLG 0230

Academic Term: Fall 2023

Instructor:

Sanjeev J. Koppal

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3523928942

Office Hours: Tuesday, 1130am-1230pm

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact through the Canvas website

- Jackson Arnold jarnold2@ufl.edu

Course Description

(3 credits) Fundamentals of computational photography, sensing, imaging and illumination.

Course Pre-Requisites / Co-Requisites

EEL 3135 (or equivalent) or consent of instructor

Course Objectives

The student will be able to demonstrate the basics of computational photography, as it relates to applications in computer vision, graphics and imaging. The student will be able to explain how models of light from radiometry and optics can be used to understand scene information from images, build novel sensors and create new photographs; the intersection between computing and light, a “camera culture” perspective of technology, professionally use sensors and cameras. The student will be able to write code to create new photographs. There will be in-class labs where practical knowledge of computational photography will be experiences.

Materials and Supply Fees

NA

Required Textbooks and Software

- Matlab, ideally with image processing / computer vision toolbox
- Access to a computer and a cellphone with a camera

Recommended Materials

- a. Title: Robot Vision (Recommended, not required)
Author: B. K. P. Horn
Publication date and edition: MIT Press 1986
ISBN number: 0262081598
- Title: Multiple View Geometry in Computer Vision (Recommended, not required)
Author: Richard Hartley and Andrew Zisserman
Publication date, edition, and company: Cambridge
ISBN number: 9780521540513

Course Schedule

Week 1:

Lec 1: History of cameras, sensors and light

Lec 2: Camera culture and computational photography

Lec 3: Pixels, Video and Art

Week 2:

Lec 4: Reflectance: basic principles

Lec 5: Image processing

Week 3:

Lec 6: Reflectance: algorithms and measurements

Lec 7: Camera calibration

Lec 8: Image Warping and morphing

Week 4:

Lec 9: Lighting and shadows

Lec 10: Programmable imaging

Lec 11: Human head rendering

Week 5:

Lec 12: Interreflections

Lec 13: Structured light

Lec 14: Image pyramids, retargeting and fusing images

Week 6:

Lec 15: Reflection and refraction

Lec 16: Superresolution

Lec 17: Mosaicing images

Week 7:

Lec 18: Caustics of cameras and reflections

Lec 19: Flutter shutter and temporal coding

Week 8: (Midterm)

Lec 20: Light polarization

Lec 21: Camera arrays - 1

Lec 22: Optical flow and motion

Week 9:

Lec 23: Basic principles of scattering

Lec 24: Camera arrays - 2

Lec 25: Spatial textures

Week 10:

Lec 26: Advanced scattering in vision and graphics

Lec 27: Catadioptric cameras

Lec 28: Temporal textures

Week 11:

Lec 29: Modeling fluids

Lec 30: Stereo with planar mirrors

Lec 31: Create digital mattes

Week 12:

Lec 32: Optical processing with diffraction

Lec 33: Deblurring

Lec 34: HDR images

Week 13:

Lec 35: Interference and angle sensitive pixels

Lec 36: Polarization imaging

Lec 37: Geometry from a single image

Week 14:

Lec 38: High-speed flash photography

Week 15:

Lec 39: Photo tourism

Lec 40: Image-based rendering

Lec 41: Transient imaging

Week 16:

Lec 42: Presentations (Graduate student's report due)

Lec 43: Presentations (Graduate student's report due)

Attendance Policy, Class Expectations, and Make-Up Policy

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Assignment	Total Points	Percentage of Final Grade
In class projects (~10)	100 each	15%
Participation in class and Assigned paper discussion	100 each	20%
Midterm Exam	100	35%
Final Exam	100	15%
Presentation (Graduate student's report is part of the presentation)	100	15%
		100%

Grading Policy

The following is given as an example only.

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
70.0 - 80.9	B-	2.67
65.0 - 70	C+	2.33
50.0 - 64.9	C	2.00
45.0 - 50	C-	1.67
40.0 - 44.9	D+	1.33
30.0 - 39.9	D	1.00
20.0 - 29.9	D-	0.67
0 - 19.9	E	0.00

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)
[Grades and Grading Policies](#)

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Course Title, Prefix, and Number
Course Instructor and Academic Term

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- HWCHE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu

- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>;<https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.