

Computer Vision

CAP 5416 Section 09E9

Class Periods: TTH, 7, 7-8, 1.55pm-2.45pm, 1.55-3.50pm

Location: Online Class via Zoom

Academic Term: Fall 2020

Instructor:

Name : Baba C. Vemuri

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Office Phone Number : 352-294-6675

Office Hours: Tuesdays 3-5pm, online

Teaching Assistant/Peer Mentor/Supervised Teaching Student: TBA

Please contact through the Canvas website

- Name, email address, office location, office hours

Course Description

Introduction to image formation and analysis. Monocular imaging system projections, camera model calibration, and binocular imaging. Low-level vision techniques (denoising etc.), segmentation and representation techniques, and high-level vision (classification/recognition).

Course Pre-Requisites / Co-Requisites

MAC 2312 or Equivalent, COT 4501 or equivalent and Proficiency in MATLAB or Paython. Course instructor will determine Equivalency.

Course Objectives

Students will learn and become proficient in many fundamental processing methods in computer vision including the geometry of 2-dimensional image formation namely, projective geometry; sampling theorem and image spatial resolution; image filtering and edge and corner detection (also data driven features as in deep networks); image denoising and restoration; variational framework and regularization for solving low-level vision problems; image segmentation techniques (active contours, and deep-active contours, K-means clustering, graph cuts, mean-shift, deep neural networks); Stereo image formation and matching, and surface reconstruction using variational splines; motion fields and optical flow with applications to image panorama formation; linear-subspaces learning with applications to image and shape recognition; deep learning (CNNs) for image classification.

Students will be assigned written and programming assignments on all of the above topics on a regular basis to test their understanding as well as to gain a hands on experience with camera calibration, camera intrinsic and extrinsic parameter estimation, image stitching to create panoramas, image in-painting to restore poor quality images, extracting shapes of objects from images and recognizing objects from images.

Required Textbooks and Software

- **Title** : Computer Vision, Algorithms and Applications
- **Author**: Richard Szeliski
- **Publication date and edition** : 2011, First edition.
ISBN number: 978-1-84882-935-0

Recommended Materials

- **Title** : Multiview Geometry
- **Author**: Richard Hartely and Andrew Zisserman
- **Publication date and edition** : 2004, Second Edition
- **ISBN number** : 0521540518

Course Schedule

- Week 1: Introduction to Computer Vision
- Week 2: Projective Geometry in 2D and Homographies
- Week 3: Projective Geometry in 3D, Homographies and Camera Calibration
- Week 4: Fourier Transforms and Convolution
- Week 5: Sampling Theorem, Edge Detection
- Week 6: Features and Feature Detection, Multi-resolution pyramids
- Week 7: Image Denoising and Restoration
- Week 8: Variational Calculus +Regularization; Midterm-1 (on the Thursday of the week)
- Week 9: Image Segmentation
- Week 10: Image Segmentation (continued)
- Week 11: Stereo and Surface reconstruction
- Week 12: Texture and texture segmentation
- Week 13: Motion fields and Optical Flow
- Week 14: Deep Learning and Image classification
- Week 15: Wrap up and Midterm-2

Online Course Recording

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance Policy, Class Expectations, and Make-Up Policy

Class attendance is highly recommended since I will only use the text book as a guide but will be covering material drawn from research papers and other references, most of which will be posted on the class website. **Cell phones must be in silent mode** during class hours. Late homeworks will not be accepted. For programming assignments, one day late will be allowed at a penalty of 15% of the grade and two days at 30% of the grade. No programming assignments will be accepted later than two days beyond the deadline. Make up exams will only be permitted in cases of illness or family emergencies but will require documented proof.

Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (4)	100 each	20%
Programs (4)	100 each	30%
Midterm Exam (2)	100 each	50%
		100%

Grading Policy

Final letter grades will be relative and on a curve.

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

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

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.ua.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.ua.ufl.edu/public-results/>.

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/policies/student-honor-code-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 broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

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
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@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: <http://www.counseling.ufl.edu/cwc>, 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 Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.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://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.