CpE 462 Introduction to Image Processing and Coding

Department of Electrical and Computer Engineering
Spring 2021

Instructor:	Hong Man
Course Website:	stevens.edu/canvas
Meeting Times:	Thursday 6:30PM to 9:20PM
Classroom Location:	McLean 119, Canvas and Zoom
Contact Info:	hman@stevens.edu, Canvas Inbox
Office Hours:	Thursday 2:00PM to 4:00PM, or by appointment https://stevens.zoom.us/j/2078654249
Prerequisite(s):	E 245
Corequisite(s):	none
Cross-listed with:	EE 462

COURSE DESCRIPTION

Image acquisition, storage, image formation, sampling, basic relationship between pixels, imaging geometry, segmentation: edge detection, edge linking and boundary detection, Hough transform, region growing, thresholding, split and merge, histogram matching, representation: chain code, polygonal approximation and skeletonization, thinning algorithms, texture, image compression: elementary discussion of motion vectors for compression, discussion of industry standards such as JPEG and MPEG.

STUDENT LEARNING OUTCOMES

After successful completion of this course,

- Students will be able to calculate 1-D and 2-D convolutions and data transforms (e.g. DTFT, DFT, DCT), and understand frequency domain signal and system representations.
- Students will be able to understand the underlying principles of image enhancement, analysis and compression techniques.
- Students will be able to design image enhancement, analysis and compression techniques to solve specific problems
- Students will be able to implement image processing designs using computer language (e.g. C/C++) or software package (e.g. Matlab).
- Students will be able to use computer hardware/software and digital devices to acquire, display and process images.

COURSE FORMAT AND STRUCTURE

- This is a regular lecture based course. Class will meet once per week.

TENTATIVE COURSE SCHEDULE

Class Date	Topic(s)	Readings	Assignment (assigning dates)
Sep 2	Introduction	IPintro CPE462-1	
Sep 9	Signals and Systems 1	CPE462-2	HW 1
Sep 16	Signals and Systems 2	CPE462-2	
Sep 23	Fourier Transform	CPE462-3	HW 2
Sep 30	2-D Signals and Systems	CPE462-4	HW 3
Oct 7	Image Perception	CPE462-5	HW 4
Oct 14	Image Enhancement I	CPE462-6	
Oct 21	Midterm Exam		
Oct 28	Image Enhancement 2	CPE462-7	HW 5
Nov 4	Image Analysis	CPE462-8	HW 6
Nov 11	Information Theory and Coding 1	CPE462-9	
Nov 18	Coding 2	CPE462-10	HW 7
Dec 2	Geometric Processing	Cpe462-11	HW 8
Dec 9	Review / Project Presentation		

COURSE MATERIALS

Textbook(s):

Digital Image Processing, 4th edition, by Rafael C. Gonzalez, Richard E. Woods, Pearson 2017; ISBN-10: 9780133356724; ISBN-13: 978-0133356724. http://www.imageprocessingplace.com

Other Readings:

"DSP First, a Multimedia Approach", 2nd edition, J.H. McClellan, R.W. Schafer and M.A. Yoder, Pearson 2015, ISBN-10: 0136019250

Materials:

Comprehensive lecture notes will be provided on Canvas

COURSE REQUIREMENTS

Attendance Attendance is required and will be recorded. Excused absences (religious or medical, noted in via email to the professor prior to the absence occurring) accompanied by proper documentation can be granted.

Homework Homework will be assigned periodically. All problem sets are expected to be completed according to the instructions, and they are usually due in one week after the assignment. Discussion of homework problems among students is permitted, but each student must finish his/her homework independently. Homework submissions are expected to be in a neat and complete form, showing all major steps towards the solutions.

Project The term project is to provide you an opportunity to investigate a specific topic in the area of image processing and coding. The projects are to be conducted in groups, each with 2~3 students. A list of suggested project topics will be provided around the third week. Each group will select its topic, and some creativity and imagination are encouraged. Each term project will be concluded with a 5-page report which describes the nature of your work, and a 10-15 min. computer demo to show your results.

Exams There will be a midterm exam and a final exam. They are both open-book-open-notes exams. No communication is allowed among students in this class during the exams.

GRADING PROCEDURES

Grades will be based on:

Homework	(20 %)
Team Project	(20 %)
Exam I (midterm)	(30 %)
Exam II (final)	(30 %)

Late Policy:

To encourage you to stay on schedule, due dates have been established for each assignment; 20% of the total points will be deducted for assignments received 1-6 days late; assignments received more than 1 week late will receive 0 points. Extensions and exceptions can be granted for appropriate reasons.

ACADEMIC INTEGRITY

Students in undergraduate courses (100-400 level) are bound by the Honor System.
Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"*I pledge my honor that I have abided by the Stevens Honor System*."

Reporting Honor System Violations
Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

EXAM ROOM CONDITIONS

The following procedures apply to exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Room Conditions on the quiz or exam.

1. Students may use the following devices during exams. Any electronic devices that are not mentioned in the list below are not permitted.

Device	**Permitted?**	
	Yes	No
Laptops	X	
Cell Phones		X
Tablets	X	
Smart Watches		X
Google Glass		X
Other (specify)		X

2. Students may use the following materials during exams. Any materials that are not mentioned in the list below are not permitted.

Material	**Permitted ?**	
	Yes	No
Handwritten Notes *Conditions*: no restriction	X	

Typed Notes *Conditions*: no restriction	X	
Textbooks *Conditions*: no restriction	X	
Readings *Conditions*: lecture notes and homework solutions	X	
Other (specify)		X

3. Students <u>are not</u> allowed to work with or talk to other students during exams.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/office-disability-services. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone (201) 216-3748.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and in-class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations,

disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are strongly encouraged and can be made by phone (201-216-5177) or in-person (on the 7th floor of the Howe Center). CAPS is open from 9:00 am – 5:00 pm Mondays, Wednesdays, Thursdays and Fridays and from 9:00 am – 7:00 pm on Tuesdays during the Fall and Spring semesters.

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. Other 24/7 resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.