

MENG 4308/5308 – Robotic Vision and Control
Course Syllabus

Semester / Year	Spring 2021
Catalog Description	This course focuses on the application of machine vision and robot learning in robotics, specifically for the vision-guided control in arm-type robots. A software package will be selected for use a learning support tool. The course includes a project and computer programming as a major component. Conduct a major project leading to a draft of a publishable level paper for graduates only.
Prerequisites	MENG 3303 or Graduate student standing
Section number	MENG 4308 – 001 / 040, MENG 5308 – 001 / 040
Instructor name	Dr. Chung Hyun Goh
Contact info	Email: cgoh@uttyler.edu Voice: 903-566-6125 Office: RBN 3007
Class Type / Location	Hybrid (Face-to-face / RBS 2029 & HEC B210 and Zoom Synchronous)
Class Time	Mon / Wed: 2:30 PM – 3:50 PM
Office Hours	Mon / Wed: 10:00 AM – 11:30 AM
Credits	3 credits
Required Textbook	Robotics, Vision and Control: Fundamental Algorithm in MATLAB – Peter Corke. 2 nd Ed., 2016, Springer
Optional References	Computer & Machine Vision: Theory, Algorithms, and Practicalities – E. R. Davies, 4 th Ed., 2012, AP (Academic Press)
Additional requirements	Programming skills with MATLAB / Simulink or Python (or other computer languages)
Evaluation Method	Project Report / Video Presentations 20% Mid-term Exam 20% / Final Exam 25% Homework (including Computer Programming) / Quizzes 20% Design Workshop for Ideation 10 % Course Participation 5%
Grading Policy / Scale	Letter grades / A=>90, B=>80, C=>70, D=>60, F<60
Important events / dates	Census date: January 25, 2021 Exam date: TBD Final date: Per published schedule by the registrar – TBD
Attendance / Makeup policy	Regular attendance is imperative if you want to do well in this course. Therefore, <u>regular attendance is required</u> . In case you have to miss a class, it is your responsibility to keep up with the class work and be informed of all announcements made in the class on homeworks, tests etc. <u>No makeup</u> .
Course Learning Outcomes / ABET & PEOs relation	1. Demonstrate an understanding of basic knowledge for position and orientation representation and navigation process in robotics. (SO 1) 2. Apply machine vision and robot learning techniques to analyze forward and inverse kinematics in arm-type robots. (SO 1)

	<ol style="list-style-type: none"> 3. Utilize computer programming using MATLAB to perform vision-guided motion control in robotics. (SO 1) 4. Demonstrate the ability to be an effective team member on a group project to apply robot vision concepts for real-world problems. (SO 3) 5. For Graduate Student Only: Conduct a major project leading to a draft of a publishable level paper. (SO 3)
Tentative Topics	<ol style="list-style-type: none"> 1. Representation of position and orientation in robotics 2. Navigation and localization in robotics 3. Robot arm kinematics 4. Image formation, processing, and feature extraction in machine vision 5. Vision-guided control in robots 6. Robot learning combined with motion control in robotics
Other	N/A

University Policies:

UT Tyler Honor Code

Every member of the UT Tyler community joins together to embrace: Honor and integrity that will not allow me to lie, cheat, or steal, nor to accept the actions of those who do.

Student Standards of Academic Conduct

Disciplinary proceedings may be initiated against any student who engages in scholastic dishonesty, including, but not limited to, cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, or material which has been submitted within a different course without explicit approval of the instructor, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.

- i. “Cheating” includes, but is not limited to:
 - copying from another student’s test paper;
 - using, during a test, materials not authorized by the person giving the test;
 - failure to comply with instructions given by the person administering the test;
 - possession during a test of materials, or devices and instruments allowing access to materials, which are not authorized by the person giving the test, such as class notes or specifically designed “crib notes” as well as cell phones, to name a few. The presence of textbooks constitutes a violation if they have been specifically prohibited by the person administering the test;
 - using, buying, stealing, transporting, or soliciting in whole or part the contents of an unadministered test, test key, homework solution, or computer program;
 - collaborating with or seeking aid from another student or person during a test or other assignment without explicit authorization;
 - discussing the contents of an examination with another student who will take the examination;
 - divulging the contents of an examination, for the purpose of preserving questions for use by another, or removing material from the exam location, when the instructors has designated that the examination is not to be removed from the examination room or not to be returned or to be kept by the student;
 - substituting for another person, or permitting another person to substitute for oneself to take a course, a test, or any course-related assignment;

- paying or offering money or other valuable thing to, or coercing another person to obtain an unadministered test, test key, homework solution, or computer program or information about an unadministered test, test key, home solution or computer program;
 - falsifying research data, laboratory reports, and/or other academic work offered for credit;
 - taking, keeping, misplacing, or damaging the property of The University of Texas at Tyler, or of another, if the student knows or reasonably should know that an unfair academic advantage would be gained by such conduct; and
 - misrepresenting facts, including providing false grades or resumes, for the purpose of obtaining an academic or financial benefit or injuring another student academically or financially.
- ii. “Plagiarism” includes, but is not limited to, the appropriation, buying, receiving as a gift, or obtaining by any means another’s work and the submission of it as one’s own academic work offered for credit.
 - iii. “Collusion” includes, but is not limited to, the unauthorized collaboration with another person in preparing academic assignments offered for credit or collaboration with another person to commit a violation of any section of the rules on scholastic dishonesty.
 - iv. All written work that is submitted will be subject to review by plagiarism software.
 - v. Penalty for any related infractions will be decided at the discretion of the instructor including, but not limited to, granting of a failing grade in part or the course or in the entire course.

Students Rights and Responsibilities

To know and understand the policies that affect your rights and responsibilities as a student at UT Tyler, please follow this link: <http://www.uttyler.edu/wellness/rightsresponsibilities.php>

Important Covid-19 Information for Classrooms and Laboratories

Students are required to wear face masks covering their nose and mouth, and follow social distancing guidelines, at all times in public settings (including classrooms and laboratories), as specified by [Procedures for Fall 2020 Return to Normal Operations](#). The UT Tyler community of Patriots views adoption of these practices consistent with its [Honor Code](#) and a sign of good citizenship and respectful care of fellow classmates, faculty, and staff.

Students who are feeling ill or experiencing symptoms such as sneezing, coughing, or a higher than normal temperature will be excused from class and should stay at home and may join the class remotely. Students who have difficulty adhering to the Covid-19 safety policies for health reasons are also encouraged to join the class remotely. Students needing additional accommodations may contact the Office of Student Accessibility and Resources at University Center 3150, or call (903) 566-7079 or email saroffice@uttyler.edu.

Recording of Class Sessions

Class sessions may be recorded by the instructor for use by students enrolled in this course. Recordings that contain personally identifiable information or other information subject to FERPA shall not be shared with individuals not enrolled in this course unless appropriate consent is obtained from all relevant students. Class recordings are reserved only for the use of students enrolled in the course and only for educational purposes. Course recordings should not be shared outside of the course in any form without express permission.

Campus Carry

We respect the right and privacy of students 21 and over who are duly licensed to carry concealed weapons in this class. License holders are expected to behave responsibly and keep a handgun secure and concealed. More information is available at <http://www.utyler.edu/about/campus-carry/index.php>

UT Tyler a Tobacco-Free University

All forms of tobacco will not be permitted on the UT Tyler main campus, branch campuses, and any property owned by UT Tyler. This applies to all members of the University community, including students, faculty, staff, University affiliates, contractors, and visitors.

Forms of tobacco not permitted include cigarettes, cigars, pipes, water pipes (hookah), bidis, kreteks, electronic cigarettes, smokeless

tobacco, snuff, chewing tobacco, and all other tobacco products.

There are several cessation programs available to students looking to quit smoking, including counseling, quitlines, and group support.

For more information on cessation programs please visit www.utyler.edu/tobacco-free.

Grade Replacement/Forgiveness and Census Date Policies

Students repeating a course for grade forgiveness (grade replacement) must file a Grade Replacement Contract with the Enrollment Services Center (ADM 230) on or before the Census Date of the semester in which the course will be repeated. Grade Replacement Contracts are available in the Enrollment Services Center or at <http://www.utyler.edu/registrar>. Each semester's Census Date can be found on the Contract itself, on the Academic Calendar, or in the information pamphlets published each semester by the Office of the Registrar.

Failure to file a Grade Replacement Contract will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates are eligible to exercise grade replacement for only three course repeats during their career at UT Tyler; graduates are eligible for two grade replacements. Full policy details are printed on each Grade Replacement Contract.

The Census Date is the deadline for many forms and enrollment actions of which students need to be aware. These include:

- Submitting Grade Replacement Contracts, Transient Forms, requests to withhold directory information, approvals for taking courses as Audit, Pass/Fail or Credit/No Credit.
- Receiving 100% refunds for partial withdrawals. (There is no refund for these after the Census Date)
- Schedule adjustments (section changes, adding a new class, dropping without a "W" grade)
- Being reinstated or re-enrolled in classes after being dropped for non-payment
- Completing the process for tuition exemptions or waivers through Financial Aid

State-Mandated Course Drop Policy

Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2-year or 4-year Texas public college or university. For purposes of this rule, a dropped course is any course that is dropped after the census date (See Academic Calendar for the specific date).

Exceptions to the 6-drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Enrollment Services Center and must be accompanied by documentation of the extenuating circumstance. Please contact the Enrollment Services Center if you have any questions.

Disability/Accessibility Services

In accordance with Section 504 of the Rehabilitation Act, Americans with Disabilities Act (ADA) and the ADA Amendments Act (ADAAA) the University of Texas at Tyler offers accommodations to students with learning, physical and/or psychological disabilities. If you have a disability, including a non-visible diagnosis such as a learning disorder, chronic illness, TBI, PTSD, ADHD, or you have a history of modifications or accommodations in a previous educational environment, you are encouraged to visit <https://hood.accessiblelearning.com/UTTyler> and fill out the New Student application. The Student Accessibility and Resources (SAR) office will contact you when your application has been submitted and an appointment with Cynthia Lowery, Assistant Director of Student Services/ADA Coordinator. For more information, including filling out an application for services, please visit the SAR webpage at <http://www.uttyler.edu/disabilityservices>, the SAR office located in the University Center, # 3150 or call 903.566.7079.

Student Absence due to Religious Observance

Students who anticipate being absent from class due to a religious observance are requested to inform the instructor of such absences by the second class meeting of the semester.

Student Absence for University-Sponsored Events and Activities

If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify the instructor at least two weeks prior to the date of the planned absence. At that time the instructor will set a date and time when make-up assignments will be completed.

Social Security and FERPA Statement

It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

Emergency Exits and Evacuation

Everyone is required to exit the building when a fire alarm goes off. Follow your instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do not re-enter the building unless given permission by University Police, Fire department, or Fire Prevention Services.

UT Tyler Resources for Students

- UT Tyler Writing Center (903.565.5995), writingcenter@uttyler.edu
- UT Tyler Tutoring Center (903.565.5964), tutoring@uttyler.edu
- The Mathematics Learning Center, RBN 4021, this is the open access computer lab for math students, with tutors on duty to assist students who are enrolled in early-career courses.
- UT Tyler Counseling Center (903.566.7254)

Course Outline

MENG 4308-001 / 040 & MENG 5308-001 / 040: Robotic Vision and Control

Spring Semester, 2021

MW 02:30 PM - 03:50 PM

RBS 2029 / HEC B210

Instructor: Chung Hyun Goh, Ph.D. (Office: RBN 3007, 903-566-6125, cgoh@uttyler.edu)

Text: Peter Corke, *Robotics, Vision and Control*, 2nd ed, Springer, 2016

Mtg.	Day	Date	Topic	Reading*
1	M	1/11	Introduction to the course / Chap 1 – Introduction 1	1.2
2	W	1/13	Chap 1 – Introduction 2	1.1
3	M	1/18	No Class (Martin Luther King Jr. Birthday)	
4	W	1/20	Chap 2 – Representing Position and Orientation I	2. 1
5	M	1/25	Chap 2 – Representing Position and Orientation II	2.2 – 2.3
6	W	1/27	Chap 3 – Time and Motion	3.1 – 3.3
7	M	2/01	Chap 4 – Mobile Robot Vehicles	4.1 – 4.2
8	W	2/03	Chap 10 – Computer Vision I: Introduction to CV & Light and Color 1	10.1
9	M	2/08	Chap 10 – Computer Vision II: Light and Color 2	10.2 – 10.4
10	W	2/10	Chap 11 – Computer Vision III: Image Formation 1	11.1 – 11.2
11	M	2/15	Chap 11 – Computer Vision IV: Image Formation 2	11.3 – 11.4
12	W	2/17	Chap 12 – Computer Vision V: Image Processing 1	12.1 – 12.2
13	M	2/22	Chap 12 – Computer Vision VI: Image Processing 2	12.3 – 12.5
14	W	2/24	Chap 13 – Computer Vision VII: Image Feature Extraction 1	13.1 – 13.2
15	M	3/01	Chap 13 – Computer Vision VIII: Image Feature Extraction 2	13.3 – 13.4
16	W	3/03	Review for Mid-term Exam	
Spring Break (3/08 – 3/13)				
17	M	3/15	Mid-term Exam	
18	W	3/17	Design Workshop (Detailed Guideline will be provided)	
19	M	3/22	Chap 5 – Navigation & Chap 6 – Localization	5.1 – 5.2 & 6.1 – 6.8
20	W	3/24	Chap 7 – Robotic Arm Kinematics I	7.1 & 7.4
21	M	3/29	Chap 7 – Robotic Arm Kinematics II	7.2 – 7.5
22	W	3/31	Chap 7 – Robotic Arm Kinematics III (MATLAB)	7.1 – 7.5
23	M	4/05	Chap 8 – Manipulator Velocity I	8.1 – 8.3
24	W	4/07	Chap 8 – Manipulator Velocity II	8.4 – 8.6
25	M	4/12	Chap 9 – Dynamics and Control	9.1 – 9.3
26	W	4/14	Chap 15 – Vision-based Control	15.1 – 15.2
27	M	4/19	Review for Final Exam	
28	W	4/21	Project Video Presentations & Discussion	
		TBD	Final Exam – Comprehensive	

Course Grading (Total 100%)

Mid-term Exam (80 minutes):	20 %	Final Exam – Comprehensive (2 hours):	25 %
Design Workshop**:	10 %	Homework Assignments / Quizzes:	20 %
Design Project Report*** / Video Presentations:	20 %	Course Participation:	5 %

Note:

* Reading assignment to be completed BEFORE coming to class on the day it is assigned

** The design workshop (flipped class) is scheduled on March 15 (Mon).

*** The deadline of the final report of the design project is 5 pm on April 23 (Fri).

Grading Policies

Assessment and Measurement:

The students will be evaluated on the basis of performance on periodic four examinations, weekly face-to-face quizzes and online quizzes and class participation. A percentage of total points possible determine the course grade.

90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
0 – 59	F

Course Structure:

20 points	Mid-term Exam (80 minutes)
25 points	Final Exam (2 hours)
20 points	Design Project Report
20 points	Homework Assignments / Quizzes
10 points	Design Workshop for Ideation
5 points	Course Participation (in-class examples, small group work, discussion, etc.)
Total Possible Points: 100 points	

Classroom Participation / Attendance:

Students must actively participate in in-class activities and attend the class on time for full points. The following rubric will be employed to assign participation points. They will be added up in the final and the accumulated points will be converted into total 5 points out of 100 points for the final grade consideration.

Preferred (5 pts)	Acceptable (4 pts)	Won't ask you to leave (2-3 pts)	May ask you to leave (1 pt)	Will ask you to leave (0 pt)
Arrives on time	Arrives no more than 5 min. late	Arrives no more than 10 min. late	Arrives more than 10 min. late	Absent
Comments are relevant and reflect understanding and good participation	Comments are mostly relevant, but understanding may be slightly lacking	Comments are minimal and demonstrate poor preparation	No comments are made	Disruptive or rude comments are made
Clear enthusiasm	Not overly enthusiastic, but positive	Demeanor is sluggish	Sleeping, texting, disengaged	Drawing others into disrespectful behaviors (showing texts, passing notes, hanging around during the class, etc.)

Design Project Report:

Students will be organized by project teams (3-5 members), and each team must submit the design project report by the assigned deadline. The guideline for writing the project report will be provided by the instructor, in the similar manner to the template provided by the professional journal (or conference) committee. The rubric below will be used to assess the final report. The final points will be converted into 25 points (out of 100 points) for the final grade consideration as aforementioned.

Excellent (8 -10 pts)	Good (5 – 7 pts)	Fair (2 – 4 pts)	Poor (0 – 1 pt)
Includes analysis or synthesis of course materials, personal	Usually includes analysis or synthesis of course materials, personal	Significant amount of course material copied or repeated from the course	No evidence of cognitive processing of course material or analyzing own

experiences, and/or scholarly works. Includes citations to external materials of high academic quality (e.g., peer-reviewed). Thoughtful, academic, stimulating. Pertinent to the course	experiences, and/or scholarly works. Citations are of mixed quality (some academic, some less academic). Pertinent to the course	OR copied from external sources without considering through analysis or synthesis. Citations are of mixed quality-high dependence on corporate websites or the like. Loosely pertinent to the course	experience through the lens of the course content. Not directly relevant to the course. Poorly organized. Poor or no citations given.
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No Make-Up Exams:

THERE WILL BE NO MAKE-UP EXAMS. The percentage of any exam missed by a student will be added to his/her final exam only if prior approval is granted. The student is responsible to contact me at least a week before the scheduled exam date to get an excuse from the exam. If you have to miss an exam due to emergencies (such as medical and other emergencies) please inform me as soon as possible before or immediately after the exam. If you miss any exam without getting prior approval from me at least a week before the exam date, it will be counted as zero in the calculation of your final course grade. If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify me at least a week prior to the date of the planned absence. Just to remember, quizzes and all exams, including the final, are to be taken at the assigned time. **There will be no exceptions!**

Academic Dishonesty:

Academic or scholastic dishonesty includes cheating, plagiarism, collusion and/or falsifying academic records. University policy prohibits these acts and students suspected of academic dishonesty are subject to disciplinary proceedings. Therefore, no cheating of any kind will be tolerated. If you try to cheat, your course grade will be "F" and the incident will be reported to the University.

"Cheating" includes:

1. Copying from the paper of another student, engaging in written, oral or any other means of communication with another student, or giving aid to or seeking aid from another student when not permitted by the instructor;
2. Using material during an examination or when completing an assignment that is not authorized by the person giving the examination or making the work assignment;
3. Taking or attempting to take an examination for another student, or allowing another student to take an examination for oneself;
4. Using, obtaining, or attempting to obtain by any means, the whole or any part of an unadministered examination or work assignment.

"Plagiarism" includes the unacknowledged incorporation of the work of another person in work that a student offers for credit.

"Collusion" includes the unauthorized collaboration with another person in preparing written work that a student offers for credit.

Grade Appeal Procedure

A student who wishes to contest a grade given by an instructor must initiate the procedure by contacting the instructor who assigned the grade. The instructor and the student should informally review the criteria for assignment of grades and the student's performance. The instructor may affirm the grade or revise the grade.

If the student is not satisfied after the informal discussion with the instructor, then the student may initiate a formal grade appeal by completing a Grade Appeal Form that may be obtained from the Office of Student Records. Normal grade appeals should be filed at the earliest date possible, but no later than six months from the final date of assignment. The instructor and the student should complete the appropriate parts of the form clearly indicating the instructor's rationale for the grade given and the student's basis for the grade appeal.

At each administrative level of the appeal process, an attempt will be made to resolve the issue. If the instructor holds one of the administrative positions used in the appeal process, then that level is omitted. If no resolution is reached at a particular level, then the appeal is forwarded with the recommendation of the administrator at that level with all documentation.

If the appeal is to be considered by the vice president for academic affairs, then a copy of the Grade Appeal Form shall be forwarded by the academic dean of the students. The Office of the President is the final step in the appeal process at The University of Texas at Tyler.

Food and Drink in Classrooms

Consumption of food and drink in university classrooms is prohibited.

Note: This course outline is subject to change based on the needs of the class.