MECE 6368: Mechanical Engineering Project Design
Fall 2021

Instructor: Dr. Marzia Cescon
Office Room: Room W-206, Engineering Building 2
Online Office Hours: Monday 1:00-2:00 pm or by appointment (please send email). Office hours will be held in Microsoft Teams.
Phone: 713-743-2037
Email: mcescon2@uh.edu

Course format

This course is being offered as a series of face-to-face meetings with a simulated-to-real world transfer practical component in the "Advanced Learning, Artificial Intelligence and Control laboratory". In between face-to-face meetings, there may also be both online synchronous and asynchronous activities to complete (e.g., discussion forums and project check-points).

Face Covering Policy

When you visit the campus, this official face covering policy applies:

> To reduce the spread of COVID-19, the University strongly encourages everyone (vaccinated or not) to wear face coverings indoors on campus including classrooms for both faculty and students.

Presence in classrooms/laboratories

Your presence in the classroom and in the laboratory each session means that you:
- Are NOT exhibiting any Coronavirus Symptoms that makes you think that you may have COVID-19
- Have NOT tested positive or been diagnosed for COVID-19
- Have NOT knowingly been exposed to someone with COVID-19 or suspected/presumed COVID-19

If you are experiencing any COVID-19 symptoms that are not clearly related to a pre-existing medical condition, do not come to class. Please see Student Protocols for what to do if you experience symptoms and Potential Exposure to Coronavirus for what to do if you have potentially been exposed to COVID-19. Consult the (select: Undergraduate Excused Absence Policy or Graduate Excused Absence Policy) for information regarding excused absences due to medical reasons.

COVID-19 Information

Students are encouraged to visit the University's COVID-19 website for important information including on-campus testing, vaccines, diagnosis and symptom protocols, campus cleaning and safety practices, report forms, and positive cases on campus. Please check the website throughout the semester for updates.

Vaccinations

Data suggests that vaccination remains the best intervention for reliable protection against COVID-19. Students are asked to familiarize themselves with pertinent vaccine information, consult with their health care provider. The University strongly encourages all students, faculty and staff to be vaccinated.

Reasonable Academic Adjustments/Auxiliary Aids

The University of Houston complies with Section 504 of the Rehabilitation Act of 1973 and the Americans with

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Disabilities Act of 1990, pertaining to the provision of reasonable academic adjustments/auxiliary aids for disabled students. In accordance with Section 504 and ADA guidelines, UH strives to provide reasonable academic adjustments/auxiliary aids to students who request and require them. If you believe that you have a disability requiring an academic adjustments/auxiliary aid, please contact the Justin Dart Jr. Student Accessibility Center (formerly the Justin Dart, Jr. Center for Students with DisABILITIES).

Excused Absence Policy

Regular class attendance, participation, and engagement in coursework are important contributors to student success. Absences may be excused as provided in the University of Houston Undergraduate Excused Absence Policy and Graduate Excused Absence Policy for reasons including: medical illness of student or close relative, death of a close family member, legal or government proceeding that a student is obligated to attend, recognized professional and educational activities where the student is presenting, and University-sponsored activity or athletic competition. Under these policies, students with excused absences will be provided with an opportunity to make up any quiz, exam or other work that contributes to the course grade or a satisfactory alternative. Please read the full policy for details regarding reasons for excused absences, the approval process, and extended absences. Additional policies address absences related to military service, religious holy days, pregnancy and related conditions, and disability.

Recording of Class

Students may not record all or part of class, livestream all or part of class, or make/distribute screen captures, without advanced written consent of the instructor. If you have or think you may have a disability such that you need to record class-related activities, please contact the Justin Dart, Jr. Student Accessibility Center. If you have an accommodation to record class-related activities, those recordings may not be shared with any other student, whether in this course or not, or with any other person or on any other platform. Classes may be recorded by the instructor. Students may use instructor's recordings for their own studying and notetaking. Instructor's recordings are not authorized to be shared with *anyone* without the prior written approval of the instructor. Failure to comply with requirements regarding recordings will result in a disciplinary referral to the Dean of Students Office and may result in disciplinary action.

Syllabus Changes

Due to the changing nature of the COVID-19 pandemic, please note that the instructor may need to make modifications to the course syllabus and may do so at any time. Notice of such changes will be announced as quickly as possible through email.

Course Description

This Mechanical Engineering Project Design course provides the student with the opportunity to work on a specific topic or issue of interest that might not otherwise be available in a structured course. To plan a project, a one pager proposal that includes the following information should be submitted to the instructor:

1. Statement of purpose – what do you plan to study and why
2. Specific learning objectives you will pursue
3. List of specific texts or other readings you will complete
4. Identify the outcome or product – e.g., data analysis and summary, a video summary, a journal publication, etc.
5. Indicate how often you and the faculty advisor plan to meet over the course of the project

Suggested Topic for Fall 2021: Class activation mapping (CAM) in reinforcement learning (RL)

In the Mechanical Engineering Project Design course students will investigate class activation mapping (CAM) in reinforcement learning (RL) policy network architectures to visualize and understand the behavior of the RL agent. By visualizing and understanding the behavior of the RL agent, methods can then be designed to optimize how the agent

learns by improving its choice of actions. The proposed modifications to the network policy architecture that will initially be investigated for this project are based off the discriminator in U-GAT-IT, an unsupervised image-to-image translation network. Additional research will need to be done to find different methods that can be implemented and compared against this. The findings can then be extended to applications with drones of the "Advanced Learning, Artificial Intelligence and Control laboratory" led by Dr. Cescon, such that the actions of the RL agent can be better understood, visualized with heat maps, and optimized.

Main Parts:
1. Use Class Activation Mapping with Deep Reinforcement Learning to visualize behavior of RL agent
   o Investigate various RL architectures to select the best one for this application
2. Modify the network policy architecture of the Deep RL model (inspired by discriminator network in U-GAT-IT) by incorporating findings from Part 1 to optimize learning of the agent.
3. Extend to drone applications
   o Use findings from above for visualization and optimization of the agent
   o Possible RL-CycleGAN implementation with drones
     ▪ Simulated-to-real world transfer for reinforcement learning

Sources:
- Class Activation Mapping (CAM): http://cnnlocalization.csail.mit.edu/
- Grad-CAM: https://arxiv.org/pdf/1610.02391.pdf
- U-GAT-IT: https://arxiv.org/pdf/1907.10830.pdf
- Grad-CAM in Deep RL: https://ieee-cog.org/2019/papers/paper_241.pdf
- RL-CycleGAN: https://arxiv.org/pdf/2006.09001.pdf

Course evaluation

Students will be evaluated based on the progress, potential innovations and the results obtained. They will be required to submit an end-of project report (8 pages limit, excluding references) and an accompanying slide deck for oral presentation of the project. The final report is meant to mimic a conference setting, and therefore the report should be a self-contained document with an introduction, literature review, problem formulation, main results (and experiments if applicable), and discussion/conclusion sections. Similarly, students will be expected to give a 20 min presentation, where they describe the problem their project addresses, their progress and potential innovations and concluding remarks.

Course Prerequisites

Students are expected to have completed the foundation curriculum, be mathematically mature with a solid background in calculus and probability, and be familiar with basic concepts in dynamics and controls. Knowledge of Matlab/Simulink and/or Python is encouraged.

Resources for Online Learning

The University of Houston is committed to student success, and provides information to optimize the online learning experience through our Power-On website. Please visit this website for a comprehensive set of resources, tools, and tips including: obtaining access to the internet, AccessUH, and Blackboard; requesting a laptop through the Laptop Loaner Program; using your smartphone as a webcam; and downloading Microsoft Office 365 at no cost. For questions or assistance contact UHOnline@uh.edu.

Communication Guidelines and Feedback

Official UH Email Mailbox

All students are provided an *official* UH email mailbox to use during their enrollment at the University of Houston. The email account will be the primary way instructors, UH entities, and support staff communicate with students. The purpose of this action is to: (1) help retain the integrity and privacy of your personal email account by keeping UH related correspondence within its own email mailbox and (2) provide additional course curriculum Office 365 tools and functionality (uh.edu/office365).

Access and Use Your UH Email Mailbox

There are two ways to access and use your official UH email mailbox.
1. Visit AccessUH and click on the "Office 366" icon to gain access to the Outlook web app.
2. Download the free Microsoft Outlook app and follow the appropriate tutorial to check, send, and receive UH emails on mobile devices.
   a. Android Mobile Devices (uofh.sharepoint.com/sites/citelab/SitePages/training-library.aspx)
   b. Apple Mobile Devices (uofh.sharepoint.com/sites/citelab/SitePages/training-library.aspx)

Update Your Destination Email in AccessUH

Manually update your 'destination' email address to redirect to your new official UH email mailbox. Visit the UIT website to learn how to update the destination email within AccessUH (uh.edu/infotech/services/accounts/email/update-student-address).

Reporting Technical Issues

All technical error reports must include screenshot or video proof attached to an email message. Students are encouraged to start assignments early to help reduce last minute technical issues.
- Windows: How to Take a Screenshot tutorial (wikihow.com/Take-a-Screenshot-in-Microsoft-Windows)
- Macintosh: How to Take a Screenshot tutorial (wikihow.com/Take-a-Screenshot-in-Mac-OS-X)

Copyright

Materials in this course may be protected by copyright and should not be redistributed. Visit the UH Library Copyright Resources (guides.lib.uh.edu/copyright) for support resources regarding the basics of copyright, tools, fair use, and copyright law.

Counseling and Psychological Services (CAPS)

Counseling and Psychological Services (CAPS) (uh.edu/caps) can help students who are having difficulties managing stress, adjusting to college, adjusting to the demands of an academic program, or feeling sad and hopeless. You can reach CAPS by calling 713-743-5454 during and after business hours for routine appointments or if you or someone you know is in crisis. No appointment is necessary for the "Let's Talk" program (uh.edu/caps/outreach/lets_talk.html), a drop-in consultation service at convenient locations and hours around campus.

Support Services

Other university support services include:
- Student Resources (uh.edu/students)
- Library (libraries.uh.edu)
- Writing Center (writingcenter.uh.edu)

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- [Online & Special Programs](uh.edu/online) (uh.edu/online)

Emergency Preparedness Information

Emergency Phone Numbers

713-743-3333 UH Police
911 Emergency Dispatch

Security Escort

The Security escort service is designed for the community members who have safety concerns and would like to have a Security Officer walk with them, for their safety, as they make their way across campus. Call **713-743-3333** to make arrangements.

FIRE

Evacuate

> If the fire alarm is not sounding, activate the nearest alarm pull station.
> Call **713-743-3333** or **911** to report the fire.
> Notify and assist people in the immediate area.
> As you leave, close all doors behind you to limit the movement of smoke or flames.
> Do not re-enter the building until authorized to do so by emergency personnel.
> Never assume an alarm is false.
> Do not use elevators.
> If unable to exit the building, go to nearest exit stairwell or safe area of refuge and call **713-743-3333** or **911** to report your location.
> If trained, use a fire extinguisher if the fire is small and contained, and the room is not filled with smoke.

Two emergency exits are located:

1. Farish Hall - Northwest Stairwell (A stairs)
2. Farish Hall - Southeast Stairwell (C stairs)

Primary (Near) Meeting Area:

Green space between Farish Hall and McElhinney Hall.

Secondary (Far) Meeting Area:

Green space at Ezekiel W. Cullen water fountains.

UH Alert

UHALERT

In the event of a campus emergency, the University of Houston will activate the UH ALERT Emergency Notification System to provide critical information. UH ALERT utilizes the following methods to send UH ALERTS:

> UH ALERT Website (alerts.uh.edu)
> Email
> Text Message
> Facebook Alerts (facebook.com/UHAlert)
> Twitter Alerts (twitter.com/UHAlert)
> UH Mobile App (uh.edu/go)
> Digital Signage
> Outdoor Warning Siren

For more information visit the UH ALERT website.

Weather

Shelter-in-Place

> Seek shelter indoors.
> Check uh.edu/emergency for shelter-in-place directive for the UH campus.
> If a Tornado Warning is issued, seek shelter indoors in an interior room away from windows, and on the lowest floor possible.

Active Shooter

Avoid, Deny, Defend

If an active shooter or violent person is in your vicinity, please attempt to take the following steps:

> **AVOID:** If possible, exit the building immediately and call **713-743-3333** to reach UH Police, or dial **911.**
> **DENY:** If you cannot exit, clear the hallway quickly, remain behind closed doors in a locked or barricaded room, if possible, and stay away from interior windows.
> **DEFEND:** Do not attempt to confront or apprehend the shooter, unless it is a last resort.

See **http://uh.edu/police/active_shooter.html** for more information about "Avoid, Deny, Defend."

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