Carleton University
Department of Systems and Computer Engineering
SYSC5303/BIOM5402 Interactive Networked Systems and Telemedicine – Winter 2022
Course Outline

Instructor Information and Office Hours

Name	E-Mail	Telephone	Office	Office Hours
Dr. Xiaoping Liu	xpliu@sce.carleton.ca	(613)5202600 Ext.1774	Online	Thu 11:30 ~ 12:30

Calendar Information

Course Number: SYSC5303/BIOM5402
Course Title: Interactive Networked Systems and Telemedicine
Calendar description: http://calendar.carleton.ca/grad
telemanipulator, networked mobile robot, human motoring and sensory capability, typical interface device, visual and haptic rendering, remote control scheme, predictive technique, delay compensation, force feedback, stability and transparency, fusion of human and machine intelligence, real-time protocols and networking, data transmission and compression, history and challenges of telemedicine, and telemedicine applications: telesurgery, tele-monitoring, tele-diagnosis and tele-homecare.
Lectures: three hours a week.

Course Objectives

The objective of this course is to provide students an introduction to some advanced topics about interactive networked (IN) systems, such as teleoperation, tele-haptic and tele-robotic systems. Students will learn fundamental concepts about IN systems including human factors, interfacing, modelling, control, data transmission and applications to telemedicine. Students will also be trained on doing research through completing a course project, making presentation and writing a paper-style project report.

Learning Outcomes

After successful completion of this course, the students will:

1. Understand the basic elements of an interactive networked (IN) system and its application in the medical domain;

2. Develop a good understanding of human-machine interfaces for IN systems (e.g. human factors, force and tactile feedback, visual feedback devices, haptic interfaces and auditory devices);

3. Be able to analyze the kinematics of haptic interfaces; understand force propagation and haptic rendering in an IN system as well as the fundamental issues and challenges in the design of the interfacing devices;

4. Be able to formulate and model a master-slave teleoperator using two-port network models;

5. Develop a good understanding of various control schemes for master-slave teleoperators and appreciate the trade-off between stability, transparency and tracking accuracy; recognize and appreciate the difficulties due to time delay and unreliable data transmission;

6. Understand the current technologies, challenges and obstacles about telemedicine;

7. Develop basic skills in writing a technical paper style project report.

Course Website

We will use Brightspace for the course website.

All course materials, such as slides and recordings, will be posted in the Brightspace course website.

Both midterm and final exams will be hosted by Brightspace and students are required to sign in your Brightspace account to access the exam.

All the submissions (such as project report, midterm exam and final exam) will be accepted ONLY through Brightspace. Submission to your professor via email will be automatically discarded.

Textbook and References

There is no assigned textbook for this course. Lecture notes and other materials will be provided posted on the course website.

Lectures

This course is an online course where there is a mixture of synchronous meetings and asynchronous activities. This means students need to be prepared to meet some of the time online via web conferencing tools at scheduled days and times.

More specifically, **all the lectures will be LIVE unless an asynchronous event is announced in advance.**

The asynchronous activities are intended to provide flexibility to students when the class is not meeting synchronously. Students are expected to remain up to date with the deadlines and due dates provided by the instructor.

This course requires reliable high-speed Internet access, a computer (ideally with a webcam), a camera or scanner and a headset with a microphone. You also need software to convert pictures taken of your answers into one single PDF or word file.

Session Recording

Web conferencing sessions of lectures in this course may be recorded and made available only to those within the class. Sessions may be recorded to enable access to students with internet connectivity problems, who are based in different time zone, and/or who have conflicting commitments. If students wish not to be recorded, they need to leave your camera and microphone turned off.

You will be notified at the start of the session when the recording will start, and Zoom will always notify meeting participants that a meeting is being recorded. It is not possible to disable this notification.

You may be expected to use the video and/or audio and/or chat during web conferencing sessions for participation and collaboration. If you have concerns about being recorded, please email me directly so we can discuss these.

Please note that recordings as well as all other course materials are protected by copyright. These recordings and materials are for your own educational use, but you are not permitted to publish to third party sites, such as social media sites and course materials sites.

Evaluation and Grading Scheme

Midterm Exam	Project Presentation	Project Report	Final Exam
30%	10%	20%	40%

Project

The course project is a significant piece of term work, and **each student is required to complete a project individually**.

Ideally, you are expected to apply knowledge learned in class to solve a research or technical problem within the relevant field. However, the possible topic is open and you are free to choose any topic relevant to the content of this course. For instance, you can develop a new image foveation algorithm for streaming real-time data over the Internet; you can design a new haptic device or sensory-substitution application; you can analyze, compare and evaluate different teleoperation control algorithms; you can implement and assess an existing networking protocol for interactive networked systems; or you can perform a thorough literature survey about a specific (not too broad) topic.

In terms of deliverables, you are required to make a presentation to the class and submit a final project report.

Each project presentation is 15 minutes (the maximum) including your presentation and the Q&A period. While the presentation of the entire class may span several weeks, all projects are required to be ready for presentation at the first week of prestation. The specific schedule of each project will be announced at the due time. You need to upload your presentation slides to Brightspace preferably before your presentation date/time, but no later than the last day of the class.

You are required to submit a final project report of the IEEE conference paper style. While most project reports have approximately 6 pages, there is no limit on the number of pages. In general, a project report should include an abstract, the background and motivation, a clear statement of the problem, the current state-of-art and relevant work, the main body of the project (development, design, assessment, comparison, critical review, etc), discussion, conclusion, future work, and a list of references.

Exams

There are two exams: a midterm exam and a take-home final exam.

The final examination is for evaluation purposes only and will not be returned to students. You will be able to make arrangements with the instructor or with the department office to see your marked final examination after the final grades have been made available.

Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed the midterm exam must inform the professor and provide a valid report (proof) no later than three (3.0) working days after the test date; otherwise, a zero mark will be assigned for the midterm exam.

Important Notes on the Submissions of Exams and Project Report

Due to COVID-19, both the midterm and final exams will be held on-line through BrightSpace. After completing the exam, you must scan (or take photo of) your answers into your computer, make them into one single file (preferably PDF or Word format), and upload it on-line in BrightSpace before the stipulated deadline.

1) It is your sole responsibility to prepare and familiarize yourself with your equipment (e.g. scanner, camera and software) and the entire submission process (such as how to scan and convert scanned images into one single PDF or Word formatted file) well in advance.
2) It is your sole responsibility to make sure that you complete the submission process and that your submitted file is complete, can be opened and is readable. If your file cannot be opened or your answers are unreadable (e.g. because of bad image quality), the entire exam or the relevant part will be marked as zero.
3) All submissions that fall outside the given deadline will NOT be accepted and will NOT be marked.
4) DO NOT email your answers to the professor's personal email accounts. All submissions through emails will not be graded and will be automatically discarded and deleted.

Important Dates

- **Midterm Exam: 8:30am to 11:30am Thursday March 3rd (Week 7)**
- **Project Presentation: ~~Week 8~~ Week 9 to ~~Week 11~~ Week 12**
- **Project Report Due: 11:59pm Tuesday April 12th (Last Day of University Class)**

- **Final Exam Due: 11:59pm Thursday April 28th (Note: Take-home Final Exam will be available in Brightspace at 11:30am Thursday April 7th (Last Day of Class).**

Week-by-Week Breakdown

Introduction (Week 1)
History of interactive networked and telemedicine systems; teleoperators and telehaptics, current research status and challenges

Human-Machine Interface (Week 2 and Week 3)

Human factors: perception and motoring capabilities; command generation techniques; cross-modal interactions and sensory substitution; visual and haptic rendering; force-reflection and haptic interface devices; requirements on haptic interfaces and design challenges

Kinematics of Haptic Interfaces and Haptic Rendering (Week 4 and Week 5)

Spatial descriptions; mappings; translation, rotation and transformations; Static force and moments propagation from link to link; haptic rendering through manipulator

Master-Slave Teleoperator Modelling and Control (Week 6 and Week12)
Two-port network model; force and tactile feedback; time delay and discretization issues; wave-variables and passivity theorem; Stability and transparency; impedance control; optimization for haptic feedback fidelity.

In-class Midterm Exam: Thursday March 3rd (Week 7)

Project Presentation (Weeks 8 - 11)

Telemedicine Applications (Week 12)
Technologies, challenges and obstacles; on-going telemedicine projects; robotic surgery; minimally invasive surgery; telesurgery.

General Regulations

Student Responsibility: It is the student's responsibility to remain informed of all rules, regulations and procedures required by their program and by the Faculty of Graduate and Postdoctoral Affairs. Ignorance of regulations will not be accepted as a justification for waiving such regulations and procedures.

Academic Integrity: Students should be aware of their obligations with regards to academic integrity. Please review the information about academic integrity at: https://carleton.ca/registrar/academic-integrity/. This site also contains a link to the complete Academic Integrity Policy that was approved by the University's Senate.

Plagiarism: Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated.

Deferred Term Work : Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases this must occur no later than three (3.0) working days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. For more information, see the current *Graduate Calendar, Academic Regulations of the University, Section 9.3.*

Academic Accommodation: You may need special arrangements to meet your academic obligations during the term. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www.carleton.ca/equity/ For an accommodation request, the processes are as follows:

- **Pregnancy or Religious obligation**: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf
- **Academic Accommodations for Students with Disabilities**: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your ***Letter of Accommodation*** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (*if applicable*). **Requests made within two weeks will be reviewed on a case-by-case basis**. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (*if applicable*).
- **Survivors of Sexual Violence:** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/sexual-violence-support/.
- **Accommodation for Student Activities:** Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience.

Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf

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Health and Safety: Every student should have a copy of our Health and Safety Manual. A PDF copy of this manual is available online: http://sce.carleton.ca/courses/health-and-safety.pdf

Students from the University of Ottawa: You can request to have access to cuLearn: please see http://gradstudents.carleton.ca/forms-policies/