THE UNIVERSITY OF WESTERN ONTARIO
FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECE 9992A –TELEROBOTICS

COURSE OUTLINE – Fall 2017
(M.ENG. ONLY)

OBJECTIVE: This graduate course presents an introduction to telerobotics, with special emphasis on haptic teleoperation. Teleoperator systems with haptic interfaces allow human to feel and physically manipulate virtual or remote environment. These systems have applications in many areas, including computer-assisted and simulated surgery, exploration of hazardous or remote environments, micro/nano manipulation, education and entertainment. The objective of this course is to give an overview of the field, provide students with the necessary theoretical background, and prepare them for research work in the area of haptic teleoperation.

CONTACT HOURS: 3 lecture hours per week, half course

PREREQUISITES: a) An undergraduate course in systems and control is required.
b) An undergraduate/graduate preparation in robotics and some knowledge of communication networks are highly recommended.

COURSE CONTENT:

1. Introduction: telerobotics, teleoperation, haptics.
2. Applications: minimally-invasive surgery, surgical simulators, exoskeletons and assistive devices, computer-aided design, space teleoperation, entertainment.
3. Telerobotic systems architectures.
4. Human haptics, haptic devices and interfaces.
5. Mathematics of the teleoperation and haptics: mathematical models, passivity, stability and control, transparency, wave variables, issues related to communication delays and quantization.
6. Internet-based teleoperation.

SPECIFIC LEARNING OBJECTIVES:

1. To gain general knowledge of telerobotics and haptic teleoperation, including main application areas.
2. To understand the theoretical framework for teleoperation and haptics, including basic mathematical models of teleoperators and haptic systems, notions of stability, passivity, transparency and wave variables.
3. To learn main properties of the human haptics and construction of haptic devices/interfaces.
4. To understand basic issues and challenges related to communication aspects of Internet-based teleoperation.

TEXTBOOK: There is no assigned textbook for this course. Full set of lecture slides and the reading list will be provided.

REFERENCES:

1. G. Niemeyer, C. Preusche, and G. Hirzinger, ``Telerobotics'', in Springer Handbook of Robotics, Bruno Siciliano, Oussama Khatib (Eds.), Springer, 2008, pp. 741-757.
2. B. Hannaford and A. M. Okamura, ``Haptics'', in Springer Handbook of Robotics, Bruno Siciliano, Oussama Khatib (Eds.), Springer, 2008, pp. 719-739.
3. T. B. Sheridan ``Telerobotics, Automation, and Human Supervisory Control'', MIT Press, 1992.
4. ``Advances in Telerobotics'', M. Ferre, M. Buss, R. Aracil, C. Melchiorri, C. Balaguer (Eds.), Springer, 2007

A more detailed reading list will be provided.

PROJECT: The students can choose any related topic for the course project. It can be a literature survey, development of new algorithms, devices or applications, simulations, implementation, comparison of existing algorithms, etc. Students are encouraged to consult with the instructor regarding the choice of the topic.

PAPER PRESENTATION: Each student is required to present (15 to 20 minutes) one research paper selected from the reading list.

FINAL EXAM: 3-hours in-class final examination.

EVALUATION: The final course grade will be determined from students' performance in the paper presentation, the course project, and the final exam (in-class). The weighting of each of these components will be as follows:

		Maximum Penalties*	
Component	Value	English	Presentation
Paper presentation	10%		
Course Project	50%	10%	10%
Final Examination	40%	5%	5%

*In accordance with the policy of the University, the grade assigned to all written and oral work presented in English shall take into account syntax, diction, grammar and spelling. In the professional life of an engineer, the manner in which oral and written communications are presented is extremely important. An engineering student must develop these skills as an integral part of the undergraduate program. To encourage the student to do so, the grades assigned to all written and oral work will take into account all aspects of presentation including conciseness, organization, neatness, use of headings, and the preparation and use of tables and figures. All work will be

marked first for content after which a penalty not to exceed the maximum shown above may be applied for lack of proficiency in English and/or presentation.

ATTENDANCE: Any student, who in the opinion of the instructor is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

CHEATING: University policy states that cheating is a scholastic offense. The commission of a scholastic offense is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

PLAGIARISM: Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offense (see Scholastic Offense Policy in the Western Academic Calendar). The following web site provides some clear examples that will help avoid plagiarism: http://www.hamilton.edu/academics/resource/wc/usingsources.html

ACCESSIBILITY: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x82147 for any specific question regarding an accommodation. Students that are in emotional/mental distress should refer to MentalHealth@Western, http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

INTERNET AND ELECTRONIC MAIL: Students are responsible for regularly checking their Western email and the course web site (https://owl.uwo.ca/portal/) and making themselves aware of any information that is posted about the course.

COURSE INSTRUCTOR: Ilia G. Polushin, Office: TEB 357. Phone 661-2111, ext. 88575. E-mail: ipolushi@uwo.ca