ELG 5163 - Machine Vision
Course Outline
Winter 2019

Professor: Pierre Payeur, SITE 5066
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WEB Page: www.eecs.uottawa.ca/~ppayeur/ELG5163
Lectures: Tuesday, 4:00 to 5:30 PM, LPR 155
          Thursday, 2:30 to 4:00 PM, FSS 1030
Consultation: on appointment
Course Notes:
  • Course notes - will be available on Virtual Campus.
  • Selected research papers - will be available online.
Reference Manuals (optional):
  • “Introductory Techniques for 3-D Computer Vision”,
    by E. Trucco & A. Verri, Prentice Hall, 1998
  • “Machine Vision”,
  • “Computer Vision, A Modern Approach”,
  • “Computer Vision: Principles, Algorithms, Applications,
  • “Learning OpenCV”,

Overview:
Machine vision is the area of engineering and computer science concerned with the use of
artificial vision tools to collect and process information in order to provide automatic
systems with some autonomy. The objective of this course is to present an insight into the
world of machine vision that goes beyond image processing algorithms and traditional
computer vision approaches. Students will acquire a knowledge and an understanding of
artificial vision from a practical implementation perspective and gain the capability to
design physical vision systems. Various aspects will be examined, as time permits, and
some of the main approaches currently found in the literature will be discussed, opening
the door to many research themes.

Prerequisites:
Preliminary exposure to computer vision or image processing may be helpful but not
mandatory. However, preliminary exposure to the advanced concepts of spatial
transformations in 3-D space is essential. Some programming experience in high-level
languages (C/C++, Java, Python, or Matlab) is required to implement existing
algorithms in computer vision and image processing.
Course Content:
The following list of topics will potentially be covered but may be modified according to the size of the class and resulting time available.

Basics of computer vision
- Nature of images, homogeneous transformations, image acquisition, geometrical and optical image formation, perspective projection, camera technologies and vision systems design.

Basics of image processing
- Filtering, edge detection, features detection, contours, segmentation, morphological operators.

Calibration
- Camera model, intrinsic and extrinsic camera parameters, camera calibration.

Motion
- Motion detection, optical flow, object tracking, motion capture.

Three-dimensional imaging
- Epipolar geometry, stereoscopic vision, active range imaging, structured lighting.

Modeling and registration
- Modeling techniques for autonomous systems, data fusion, uncertainty mapping, registration, pose estimation.

Applications
- Quality control, visual feedback, mapping and robot guidance, activity monitoring, motion estimation, autonomous systems, biomedical imaging devices.

Evaluation:
Distribution: [Ph.D.; M.A.Sc.; M.Sc. students], [M.Eng. students]

Project proposal / Techno-blog abstract: [5%], [5%]
A research project proposal or techno-blog abstract will be submitted early in the term. It will identify a topic relevant to machine vision that you will explore further. Techno-blog topics will be assigned. A research project proposal will include a number of sources of documentation from the literature, and present a framework and timeline that will guide your project over the term. Tentative date: 24 January 2019.

Assignments: [25%], [25%]
A series of assignments will be written on selected topics. These will involve some programming and evaluation of algorithms in machine vision. Dates to be determined.

Presentation: [20%], [0%]
In the final month of the semester, Ph.D., M.A.Sc. and M.Sc. students will present their research project in class. Dates to be determined according to size of group.

Documentation: [25%], [15%]
A final research project report taking the form of a condensed formal scientific paper, or a short synthesis document, will be submitted at the end of the term. Scientific papers will include
a literature review, details on the implementation of solutions to a given problem, and some experimental testing and analysis. The originality of the treatment of the approach and the analytical content, as well as the presentation style and format, will be considered and graded. Techno-blog synthesis documents will efficiently and attractively present the state-of-the-art concepts and operational principles about an assigned topic in machine vision. Conciseness, clarity, efficiency, and accessibility will be considered and graded. Specific formats to be determined. Tentative date: 8 April 2019.

Midterm quiz: [25%], {25%}  A midterm quiz will be written by all in class by midterm. Tentative date: 26 February 2019.

Final quiz: [0%], {30%}  A final quiz will be written by M.Eng. students in class at the end of the term. Tentative date: 4 April 2019.

***Please take note that due to the nature of this graduate course, it may not be possible to evaluate and return work pertinent to this course that is worth at least 25% of the final course mark no later than one week prior to the deadline for withdrawal without academic penalty.***

Note: Plagiarism and academic fraud will not be tolerated under any form and on any component of the course. Any such situation (copying, cheating, infringement of copyrighted materials, improper referencing or citations, etc) will be brought to the attention of the faculty and disciplinary procedures will follow. The University of Ottawa’s regulation on academic integrity which addresses plagiarism and academic fraud can be found here: http://web5.uottawa.ca/mcs-smc/academicintegrity/regulation.php.

Note: Reuse of former work, of work prepared for other courses, or duplicate submission of work to more than one course is prohibited, and will result in a 0 mark for that work.

Note: The use of electronic devices such as a cellphone, tablet, or camera for the purpose of taking pictures or recording videos or audio of any part of lectures is strictly prohibited. Anybody not observing this rule will be expelled from class. Recording lectures in any way, including the taking of photographs, is prohibited in this course. The educational materials developed for this course, including, but not limited to, lecture notes and slides, handout materials, examinations and assignments, and any materials posted to Brightspace, are the intellectual property of the professor. These materials have been developed for student use only and are not intended for wider dissemination and/or communication outside of a given course. Participation in this course constitutes an agreement by all parties to abide by the relevant University Policies, and to respect the intellectual property of others during and after their association with the University of Ottawa. Students creating unauthorized audio and/or video recordings of lectures, and/or redistributing or providing unauthorized audio, video, photographic or textual material of lecture content violates the professor’s intellectual property rights, and the Canadian Copyright Act.

Update: January 4th, 2019