

ELG 5163 - Machine Vision

Course Outline

Winter 2011

- Professor:** Pierre Payeur, SITE 5066
- Email:** ppayeur@site.uottawa.ca
- WEB Page:** www.site.uottawa.ca/~ppayeur/ELG5163
- Lectures:** Monday, 11:30 AM to 1:00 PM, MRN 226
Wednesday, 11:30 AM to 1:00 PM, MRN 226
- Consultation:** Wednesday, 2:30 PM to 4:00 PM, SITE 5066
- Reference Manual:**
- “*Introductory Techniques for 3-D Computer Vision*”, by E. Trucco & A. Verri, Prentice Hall, 1998
 - Course notes - will be available online.
 - Selected research papers - will be available online.
- Other references (optional):**
- “*Machine Vision*”, by R. Jain, R. Kasturi, B. G. Schunck, McGraw Hill, 1995.
 - “*Computer Vision, A Modern Approach*”, by D.A. Forsyth & J. Ponce, Prentice Hall, 2003.
 - “*Learning OpenCV*”, by G. Bradski & A. Kaehler, O’Reilly, 2008.

Overview:

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

Prerequisites:

It is not mandatory for students to be already familiar with the basic concepts of computer vision or image processing. However, some preliminary exposure to the concepts of spatial transformations in 3-D space will be helpful. Some programming experience in high-level languages (*C/C++*, *Java* or *Matlab*) is required to be able to implement existing algorithms in computer vision. Some preliminary exposure to computer vision or image processing might be helpful but the course will also review the basic concepts.

Course Content:

The following list of topics will be covered but will likely evolve.

Basics of computer vision

Nature of images, homogeneous transformations, quaternions, 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.

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:

Project proposal:	5%	A project proposal will be submitted early in the term. It will identify a topic relevant to machine vision that you wish to explore further, as well as a number of sources of documentation from the literature, and present a high level framework that will guide your project over the term.
Assignments:	20%	Two or three assignments will be given on selected topics. These will involve some programming and evaluation of algorithms in machine vision.
Presentation:	20%	Toward the end of the term, every student will present his/her project work, including the literature review and the experimental component.
Project paper:	20%	A final project report taking the form of a formal scientific paper will be submitted at the end of the term. It 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.
Exam:	35%	A final exam will be written in class. Date to be determined.