Module Specification

Machine Vision

Version: 2022-23, v2.0, 21 Nov 2022

Contents

Part 1: Information

Module title: Machine Vision

Module code: UFMFRR-15-M

Level: Level 7

For implementation from: 2022-23

UWE credit rating: 15

ECTS credit rating: 7.5

Faculty: Faculty of Environment & Technology

Department: FET Dept of Engineering Design & Mathematics

Partner institutions: None

Delivery locations: Frenchay Campus

Field: Engineering, Design and Mathematics

Module type: Standard

Pre-requisites: None

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: The definition and scope of what is meant by the term 'machine vision' is changing rapidly as, via increasing capabilities often enabled through innovation in machine learning, new and exciting contributions are being made in applications across a wide variety of disciplines - such as robot navigation, human-robot interaction, healthcare technologies and in precision agriculture. Given the ubiquity of camera equipped smartphones and the wide availability and variety of alternative

imaging devices (e.g. thermal and RGB-D cameras), one should not be surprised to notice that machine vision technology is increasingly becoming a part of everyday life. Just as how a visual sense is important to human beings, it is arguably just as important to new forms of AI enabled systems. Therefore, the ability to "observe" the world with visual sensors, to "describe" the world from pictures or sequences of pictures, and to use this information to make useful decisions, is core to machine vision applications today.

This module provides an introduction to machine vision including the fundamentals of image formation and image processing as well as state-of-the-art feature extraction and image-based machine learning techniques. The course content is research-informed and practice-led, and as such, aims to provide students with the key skills that meet the needs of industry. The core syllabus is outlined below (note this is by no means an exhaustive list), where all elements are, where possible, supported using example case study materials drawn from current research and practical application.

Features: Not applicable

Educational aims: This module aims to introduce to students machine vision methods and their applications in differing domains including robot navigation, human-robot interaction and healthcare technologies. Students will be able to gain an understanding of the key issues of the state-of-the-art machine vision research as well as knowledge of designing and implementing machine vision solutions to real-world problems.

Outline syllabus: Syllabus Outline

1. Basic concepts:

- What is machine vision/computer vision/robotic vision?
- Machine vision vs. human vision
- Machine vision applications across disciplines (e.g. healthcare, agriculture, security, robot navigation, etc.)
- Core stages of the machine vision process

2. Image formation and representation

- Camera model

- Hardware elements: lighting, camera, optical configuration, etc.
- Different types of projection
- Binary, greyscale and colour image representations

3. Basic image processing techniques
- Convolution
- Filtering
- Segmentation

4. Feature extraction
- Edges, corners and gradients
- Invariant features
- Feature detectors and descriptors

5. 3D imaging
- Applications
- Laser triangulation
- Stereo triangulation
- Structured light
- Photometric stereo

6. Machine learning (deep learning) in machine vision
- Machine learning models for image/video analysis (e.g. recognition/classification tasks)
- Data preparation and model validation

7. Generating machine vision code

Part 3: Teaching and learning methods

Teaching and learning methods: Scheduled Learning includes lectures and laboratory sessions.

Independent learning includes hours engaged with essential reading, coding and testing, assignment completion and exam preparation, etc.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Appraise use of machine vision systems in differing domains.

MO2 Interpret the current key research issues in machine vision.

MO3 Identify requirements of an application task; formulate and constrain a machine vision problem.

MO4 Design and implement machine vision solutions to real-world problems and evaluate algorithm performance.

MO5 Explain, compare and contrast machine vision techniques including image acquisition, feature extraction and machine learning.

Hours to be allocated: 150

Contact hours:

Independent study/self-guided study = 114 hours

Face-to-face learning = 36 hours

Total = 150

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://rl.talis.com/3/uwe/lists/A1B547D8-85D2-BFCD-9029-443E63D59E22.html

Part 4: Assessment

Assessment strategy: First Sit

Component A
Written Examination (50%): this is an end-of-semester Exam (with a 4-hour submission window) to assess student's understanding of machine vision concepts and techniques.

Component B
Written Group Project Report (50%): this is approximately a 5000-word group report that proposes and evaluates machine vision solutions to a given real-world problem. A group mark will be awarded to each group by tutors based on the quality of the Group Project Report. To reflect individual contribution to the group-based activity, peer assessment will be used in line with the EDM group work policy.

Resit:

Component A
Written Examination (50%): this is an Exam (with a 4-hour submission window) in controlled conditions to assess student's understanding of machine vision concepts and techniques.

Component B
Individual Project Report (50%): this is a 2000-word individual report that proposes and evaluates machine vision solutions to a given real-world problem.

No further attendance at lectures nor labs is required.

Assessment components:

Examination (Online) - Component A (First Sit)
Description: Online Written Examination (50%): this is an end-of-semester Exam (with a 4-hour submission window) in controlled conditions to assess student's understanding of machine vision concepts and techniques.
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2, MO5

Report - Component B (First Sit)

Description: Written Group Project Report (50%): this is a 5000-word group report that proposes and evaluates machine vision solutions to a given real-world problem. A group mark will be awarded to each group by tutors based on the quality of the Group Project Report. To reflect individual contribution to the group-based activity, peer assessment will be used which may allocate a positive or a negative mark to each group member, in addition to the group mark one will receive.
Weighting: 50 %
Final assessment: Yes
Group work: Yes
Learning outcomes tested: MO2, MO3, MO4, MO5

Examination (Online) - Component A (Resit)
Description: Online Written Examination (50%): this is an Exam (with a 4-hour submission window) in controlled conditions to assess student's understanding of machine vision concepts and techniques.
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2, MO5

Report - Component B (Resit)
Description: Individual Project Report (50%): this is a 2000-word individual report that proposes and evaluates machine vision solutions to a given real-world problem.
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO2, MO3, MO4, MO5

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Robotics {Joint Award}[Sep][FT][Frenchay][1yr] MSc 2022-23

Robotics {Joint Award}[Frenchay] MSc 2022-23

Robotics and Autonomous Systems {Joint Award}[Sep][FT][Frenchay][1yr] PhD 2022-23

Robotics and Autonomous Systems {Joint Award}[Frenchay] PhD 2022-23