The University of Nottingham Ningbo China

SCHOOL OF COMPUTER SCIENCE

A LEVEL 3 MODULE, SPRING SEMESTER 2017-2018

COMPUTER VISION

Time allowed: 2 hours

Candidates may complete the front cover of their answer book and sign their desk card but must NOT write anything else until the start of the examination period is announced

Answer Any THREE Questions

Each question carries 33 marks

Only silent, self contained calculators with a Single-Line Display or Dual-Line Display are permitted in this examination.

Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted.

No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used.

DO NOT turn examination paper over until instructed to do so

1. Feature Detection and Segmentation

(a)   Briefly describe what image segmentation is and show which tasks/applications that image segmentation are helpful.

[8 marks]

(b)   Briefly describe what image features are, list and explain three types of features are commonly used in computer vision algorithms.

[10 marks]

(c)   Briefly describe the main steps to extract SIFT features and explain what are the purposes or benefits of those steps.

[15 marks]

2. Stereo Correspondence

(a)   Rectification is important in binocular stereo. Explain what is rectification, and how rectification simplifies the stereo correspondence problem.

[8 marks]

(b)   Correlation is often used to find the matching patch in stereo vision. Show the formula of correlation and briefly describe what is the advantage and disadvantage of correlation based correspondence compared with feature-based correspondence.

[8 marks]

(c)   Camera calibration is necessary for calculating depth in stereo vision. Explain what camera parameters are recovered through camera calibration.

[7 marks]

(d)   Although methods and processes vary widely in stereo vision, the same pipeline is followed. Briefly describe the main steps in stereo pipeline.

[10 marks]

3. Optic Flow and Tracking

(a)   In many algorithms, there exists the issue of motion boundaries. For example, optic flow at object boundaries is often inconsistent and contains lots of errors. Explain why such issue occurs.

[8 marks]

(b)   Briefly describe the main differences between Horn-Shunk and Lucas Kanade algorithms.

[9 marks]

(c)   It is well-known that the aperture problem causes problem in optic flow calculation. Explain what is the aperture problem and why it occurs.

[8 marks]

(d)   Particle filters are often used in single object tracking. Explain the potential problems if particle filters are applied in the context of multi-object tracking.

[8 marks]

4. Object Detection and Recognition

(a)   Viola-Jones method learns from a large set of images. One of the core techniques in this method is the integral image. Briefly describe what integral image is and what are the advantages of using integral image.

[8 marks]

(b)   Bag-of-features is often used in object recognition algorithms. Briefly describe the idea of bag-of-features and how it is used to represent a given image.

[10 marks]

(c)   Convolutional Neural Network (CNN) has been proven to be very effective in object recognition lately. Briefly describe the main components of CNN.

[15 marks]