COMPUTER SCIENCE TRIPOS Part II – 2013 – Paper 9

3   Computer Vision (JGD)

(*a*) Explain why inferring object surface properties from image properties is an ill-posed problem in general. In the case of inferring the colours of objects from images of the objects, how does knowledge of the properties of the illuminant affect the status of the problem and its solubility?   [4 marks]

(*b*) What surface properties can cause a human face to form either a Lambertian image or a specular image, or an image lying anywhere on a continuum between those two extremes? In terms of geometry and angles, what defines these two extremes of image formation? What difficulties do these factors create for efforts to extract facial structure from facial images using "shape-from-shading" inference techniques?   [4 marks]

(*c*) Explain and illustrate the "Paradox of Cognitive Penetrance" as it relates to computer vision algorithms that we know how to construct, compared with the algorithms underlying human visual competence. Discuss how human visual illusions may relate to this paradox. Comment on the significance of this paradox for computer vision research.   [4 marks]

(*d*) Define the "Correspondence Problem", detailing the different forms that it takes in stereo vision and in motion vision, and discuss its complexity. In both cases, explain why the computation is necessary. What are the roles of space and time in the two cases, and what symmetries exist between the stereo and motion vision versions of the Correspondence Problem?   [4 marks]

(*e*) When defining and selecting which features to extract in a pattern classification system, what is the goal for the statistical clustering behaviour of the data in terms of the variances within and amongst the different classes?   [4 marks]