

COMPUTER SCIENCE TRIPOS Part IA – 2024 – Paper 3

3 Introduction to Graphics (rkm38)

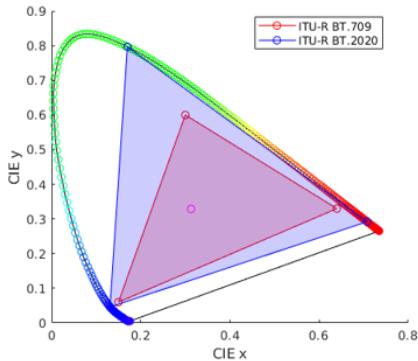
(a) Select the most suitable colour space for the following applications. Justify your choice.

(i) Color picker in painting software. [2 marks]

(ii) An error metric for evaluating colour distortions introduced by a camera. [2 marks]

(iii) Storing high dynamic range textures for real-time rendering. [3 marks]

(b) The diagram below shows a projection of the colour gamut and the primaries of two popular RGB colour spaces.



(i) BT.709 primaries are rather far from the boundary of the visible colour gamut. What motivated that choice of primaries in BT.709? [3 marks]

(ii) Most modern displays do not reproduce all colours from the BT.2020 colour gamut. What motivated that choice of the colour gamut? [3 marks]

(c) You design a colour management system for a new display with atypical primary colours. You measured the spectra of its three primaries and stored measured samples in an $N \times 3$ matrix D , in which the columns correspond to the three primaries and the rows to the spectral samples. Find a transformation matrix from BT.709 RGB to the values of the three native primaries of the display that provide a metameric match. You have an $N \times 3$ matrix S_{XYZ} with the XYZ colour matching functions and a 3×3 matrix $M_{709 \rightarrow XYZ}$ to transform from RGB BT.709 to XYZ. Both input and output colour spaces are linear. You can ignore normalization constants. [7 marks]