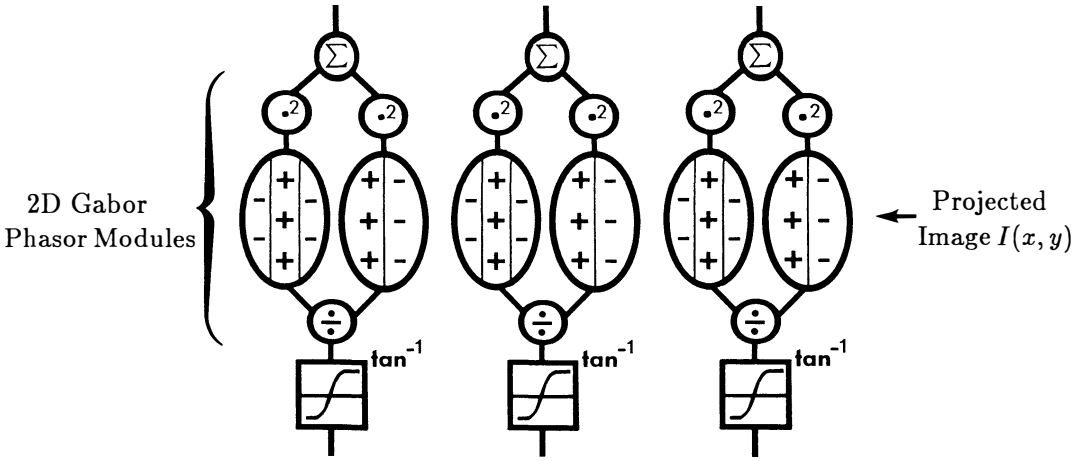
COMPUTER SCIENCE TRIPOS Part II – 2020 – Paper 8

4 Computer Vision (jgd1000)

(*a*) Neural receptive fields used in early stages of vision can be regarded as linear integro-differential operators of the first- and second-orders, represented by the elongated ovals within the diagram below. Explain how they can be used for oriented edge detection, and also state the basis for a Fourier interpretation of them as anisotropic bandpass filters. Explain how combining their outputs by the nonlinear operations depicted in the rest of this diagram (sum-of-squares, and response ratio) can be used for higher-level feature detection. [8 marks]



(*b*) In self-driving cars, the following acronyms are names for automated vision systems. Define them and briefly describe how they work.

(*i*) LIDAR [3 marks]

(*ii*) SLAM [3 marks]

(*c*) Discuss the use of texture gradients as a depth cue in computer vision. How can texture gradients be measured? What prior assumptions are needed to make computations about depth and shape possible? You may find it helpful to refer to the following texture examples. [6 marks]