Computer Vision

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M2R IVR First Semester 2005/2006

Working Conditions: You are authorised to use your class notes, as well as any text book or research article. Your handwriting must be readable! Illegible text will be ignored.
Duration 3 hours.

Illustrations for questions 1, 2 and 3:

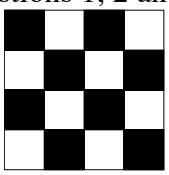
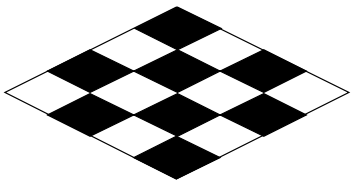


Image s : Calibration Pattern

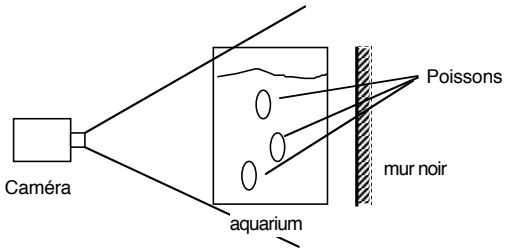


The image i : Image as seen from Camera

1) (4 points) A checkerboard pattern can be used as a calibration grid for estimating an homography. Explain how to use the Sobel edge detector and the Hough transform to determine the image possitions of the corners of the squares of the calibration pattern, as seen from the camera (image i).

2) (4 points) Explain how to estimate the homographic transform $\mathbf{H}_s^i$ from the image (s) to the image (i) given the image position of the corners in image (i).

3) (4 points) Explain how to use $\mathbf{H}_s^i$ to transform the image (i) into the image (s) as seen from above.



4) You are asked to design a system to detect and follow tropical fish in an acquarium. The Aquarium is well illuminated by several spotlights with a white spectrum. The back wall of the acquarium is matte black. A color camera is placed such that the acquarium is entirely within the visual field of the camera. The fish have unique colors. You are requested to estimate the position of each fish in each image.

a) (4 points) Explain how to use a histograms of colors to detect the position of each fish. How do you comput the probability that a pixel is projected from each of the fish? How do you initialise your histograms? How can you determine the size of the histograms (how many bins) that can be used?

b) (2 points) How can you calculate the position of each fish from the image of probabilities?

c) (2 points) How can you use the histograms to determine the probability that one fish might be mistaken for another?