Advanced Image Processing Lab.

Lab. 2 Image Digitization: Quantization

2.1 Image element-wise quantization

2.1.1 Generate a step-wedge test image (*STW*) and an image of a rectangle stimulus on the uniform background (*STIM*). Form an image *STW+gSTIM*. Obtain threshold visibility contrast of the stimulus as a function of the stimulus's size and of the stimulus contrast parameter *g*.

2.1.2 Write a program for uniform image quantization. Test uniform quantization of images to 2-64 levels. Observe false contours. Find number of quantization levels that do not produce visible false contours. Compare the obtained result with the threshold visibility contrast found in the task 2.1.1. Test quantization with additive noise. Find a relationship between the number of quantization levels, intensity of noise and visibility of false contours.

2.1.3 Write a program for image quantization in the dynamic range defined by the image mean and standard deviation.

2.2 Uniform and nonuniform quantization

2.2.1 Generate, for ***x***=1:512, a signal ***sgn=1-abs(sin(pi*x/128))***; Apply to this signal uniform (program **quantize.m**) and nonuniform (program **nlquantz.m** with ***P***<1) quantization and observe quantization effects (to display graphs, use program **stairs.m**). Suggest another example of a signal that requires non-uniform quantization.

2.2.2 Compare uniform and nonuniform ***P***-th law quantization of a test-signal (signals **ecg1.mat**, **ecg256.mat** may be used). Find, for a given number of quantization levels, optimal nonlinearity index that minimizes RMS error of signal reconstruction

2.3 Image quantization in spectral domain

2.3.1 Test nonuniform P-th law quantization of image Fourier spectrum magnitude and uniform quantization of image spectrum phase (program **quanamph.m**). Observe image reconstruction quality for different quantization levels of quantization of magnitude and phase. Determine optimal nonlinearity index ***P*** in the nonlinear ***P***-th law quantization of spectrum magnitude, that minimizes RMS error of signal reconstruction.

2.3.2 Test nonuniform ***P***-th law quantization of spectrum orthogonal components (**quanspec.m**). Observe image reconstruction quality for different quantization parameters. Determine optimal nonlinearity index **P**, that minimizes RMS error of signal reconstruction.

Submit:

1. Threshold visibility contrast curves you obtained.
2. Results of the comparison of the threshold visibility of false contours in image quantization and those obtained for a rectangular stimulus on a uniform background..
3. Plot of the number of admissible image quantization levels as a function of the additive noise standard deviation
4. Program for task 2.1.3
5. Plot of the optimal nonlinearity index for ***P***-th law nonuniform quantization of a test signal as a function of the number of quantization levels
6. Plot of the optimal nonlinearity index for ***P***-th law nonuniform quantization of image spectrum magnitude.
7. Plot of the optimal nonlinearity index for ***P***-th law nonuniform quantization of image spectrum orthogonal component