

## Advanced Image Processing Lab.

### Lab. 1 Image Digitization: Discretization.

#### 1.1 Image discrete representation in different discretization bases

Investigate how the accuracy of image discrete representation in different discretization bases depends on the representation volume and on the type of the discretization transform.

For Discrete Fourier Transform (function **fft2.m**), Discrete Cosine Transform (function **dct2.m**), Walsh Transform (function **walsh2.m**), Haar Transform bases (functions **haar2.m**, **ihaar2.m**), set to zero transform coefficients whose magnitude is lower than a certain threshold. Use the threshold as a varying parameter. Write the required programs.

Measure total energy of the zeroed coefficients relative to the entire energy of the coefficients and their percentage with respect to all coefficients and observe how quality of the reconstructed image depends on this percentage and on the discretization basis. Compare image reconstruction RMS error for different bases given the same percentage of the zeroed coefficients. Observe also the shape of the image spectra after the coefficient zeroing.

#### 1.2 Image Sampling

Observe and explain discretization aliasing effects on sinusoidal signals of different frequency (program **aliasing.m**).

Generate a test image of “Fresnel rings” (program **radius.m** can be used) and observe visually aliasing effects for different frequency modulation index. Suggest your method for illustrating aliasing in image and video sampling.

Compare sampling with the ideal low-pass filtering and simple decimation without low pass filtering. Observe differences between optimally sampled and decimated images (program **sampling.m**). Determine the minimal bandwidth required to maintain the readability of the test text image (**text256**).

Recommended images: **lenna**; **brain**; **jerus**; **text256**.

#### Submit

1. Programs for the task 1.1.
2. Examples of images reconstructed, for different discretization bases, after zeroing image spectral representation
3. Results of comparison of the bases in terms of the image reconstruction RMS error after zeroing the same percentage of spectral coefficients.
4. Your suggestion to demonstrate aliasing effects in image and video sampling
5. Your evaluation of the bandwidth required to to maintain the readability of the test text image