Processing of 2D Signals (Images)

Lab 10, DSP

Objective

Students should be able to implement basic low-pass and high-pass filters for 2D data (images).

Exercises

1. Load the `Lena` image (use `imread()`) and display it (use `imshow()`).
2. Apply the system $y[n] = \frac{1}{4}x[n-1] + \frac{2}{4}x[n] + \frac{1}{4}x[n+1]$ to **every row** of the Lena image, and then to **every column** of the image. Ignore the first and last row/column.
   a. What type of filter is this? Find $H(z)$, find the poles and the zeros, and deduce the type of filter.
   b. Display the resulting image. How did it change?
3. Repeat the same operation further 9 times. Display a $2x2$ figure and display the original image, the image filtered once, the image filtered 5 times, and the image filtered 10 times.
4. Apply the following 2D system on the Lena image. Display the resulting image. What has changed? What type of 2D filter is this?

$$\begin{aligned} y[i,j] = \frac{1}{16}x[i-1,j-1] - \frac{2}{16}x[i-1,j] + \frac{1}{16}x[i-1,j+1] \\ -\frac{2}{16}x[i,j-1] + \frac{4}{16}x[i,j] - \frac{2}{16}x[i,j+1] \\ +\frac{1}{16}x[i+1,j-1] - \frac{2}{16}x[i+1,j] + \frac{1}{16}x[i+1,j+1] \end{aligned}$$

5. Repeat the same operation 3 times. Display the resulting image. What has changed?

Final questions

1. TBD