

Computer Graphics 1

Project 1

Subject: Image filtering

The goal of this project is to implement application with graphical user interface allowing image filtering using functional and convolution filters.

Common part (10 points)

Requirements

- loading of a selected image file and displaying it in the application window,
- applying selected filters to the loaded image and displaying result beside or in place of original image (displaying both images is not required, but recommended),
- combining multiple filters on top of each other,
- saving result image to a file,
- returning filtered image back to its original state without reloading the file (optional, but recommended),
- implementation of following function filters - with fixed parameters easily modifiable from the source code:
 - inversion,
 - brightness correction,
 - contrast enhancement,
 - gamma correction.
- implementation of following convolution filters - with fixed coefficients and 3x3 kernel size, with both size and coefficients easily modifiable from the source code:
 - blur,

- Gaussian blur (Gaussian smoothing),
- sharpen,
- edge detection (one, selected variant),
- emboss (one, selected variant).

Remarks

Image file loading and displaying may be handled by an external library, but implementation of the required filters must be done using only operations on single pixels.

It is forbidden to use any scripting programming language due to performance reasons. Recommended languages are **C**, **C++**, **C#**, **Java**.

Interaction with the application may be handled mainly by the graphical user interface. All actions performed with keyboard shortcuts should be possible to do using application GUI.

Application should load color images and correctly apply filters to them. Every color channel should be processed independently at the same time.

Special care should be taken applying convolution filters near the edges of an image.

Application will be used in the next project (color conversion and quantization), and it will also be required during the laboratory part of this project.

Additional functionality (5 points)

Only one of the following tasks needs to be implemented. The task will be assigned by a teacher running the laboratories.

Task 1

Graphical user interface for functional filter editing.

Requirements

- separate area with size 256x256 pixels for displaying and editing functional filters,
- displaying function graph using polylines,

- creating new functional filters (starting as identity filter, which is a straight line from lower left corner to upper right corner).
- adding, moving and deleting points of a graph polyline
- leftmost and rightmost points cannot be removed and can only move up or down
- polyline represents valid function (for each color value input from 0 to 255 there is only one output value),
- editing existing functional filters (also predefined, specified above, except for gamma correction),
- saving created or modified filters in an application and applying them to the image.

Taks 2

Graphical user interface for convolution filter editing.

Requirements

- separate area displaying rectangular table with convolution filter kernel coefficients,
- independently selecting number of columns and rows of a kernel (values can be limited to an odd numbers from range $[1, 9]$),
- editing coefficients of a kernel in the table,
- editable field with filter divisor,
- option to automatically compute divisor,
- editable field with filter offset value,
- editable field with kernel anchor point (which element of a table overlaps with currently processed pixel),
- loading and editing existing filters (also predefined, specified above),
- saving created or modified filters in an application and applying them to the image.