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Image Interpolation

Digital Image Processing and Analysis

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1. Project Summary

Image interpolation refers to the process of estimating the values of pixels at unknown locations within an image based on the values of surrounding pixels. It is often used in digital image processing when images are resized, rotated or transformed in other ways, which can cause the loss of some of the original image information. Interpolation algorithms work by examining neighbouring pixels of a given pixel and using that information to calculate an estimate of the pixel value at a new location.

The basic idea of interpolation is quite simple: first, reconstruct a “continuous” image from the discrete input image, then sample this image onto the grid of the output image. Interpolation methods differ from the way the “continuous” image is reconstructed.

Interpolation can be used to improve the visual appearance of an image after it has been resized, rotated, or transformed in some way. It can also be used to fill in missing or damaged areas of an image, such as when restoring old photographs. However, it is important to note that interpolation can also introduce artifacts and distortions in the image, particularly when it is used to increase the size of an image beyond its original resolution.

2. Tasks

2.1. Neural networks

The main objective of this project is to investigate image interpolation by use of flexible adaptive non-linear model (neural networks). Neural network-based methods often require large amounts of training data and computational resources, but they can produce high-quality results with fewer artifacts and better visual quality.

The main task of neural networks in image analysis is the convolutional neural network and it consists of three important parts:

- The input layer (a grayscale image).
- The output layer (a binary or multi-class label).
- Hidden layers consisting of convolution layers.

For training, we will use variety of high-resolution images (Note, that the images which we will evaluate will not be included in the training dataset). For our task, we plan on developing a model with one hidden layer with multiple hidden neurons.

2.2. Non-neural networks

There are various interpolation methods available, such as nearest neighbour interpolation, bilinear interpolation, bicubic interpolation, and Lanczos interpolation.

Each method has its own advantages and disadvantages in terms of image quality, speed, and computational complexity. Our way of work will be subdivided in several tasks:

- Study and search for the most known non neural networks image interpolation algorithms.
- Use these different algorithms to interpolate the images.
- Compare the results (check if there are differences between the images) and check the differences between the algorithms in terms of time and memory.

3. Expected results

We will compare all the interpolations done with non-neural and neural algorithms. An expected result will be that the images will be more or less the same, but there will be differences in terms of memory used and time between all the algorithms. We expect that the interpolation done with neural networks will be more precise, using less memory and doing it faster than the non-neural networks algorithms.

4. Work schedule

We will divide our work in two parallel teams; one of them will develop the neural networks method, and the other will be focused on all the non-neural network algorithms. A possible work schedule should be divided the following one, starting from 27.03:

- Week 1-3: analyse algorithms individually.
- Week 4-7: Implementation of Neural and non-neural networks.
- Week 8-9: compare results between different algorithms.

Meanwhile we will be taking data obtained from the results we obtain and writing the final report.