Image bilinear interpolation

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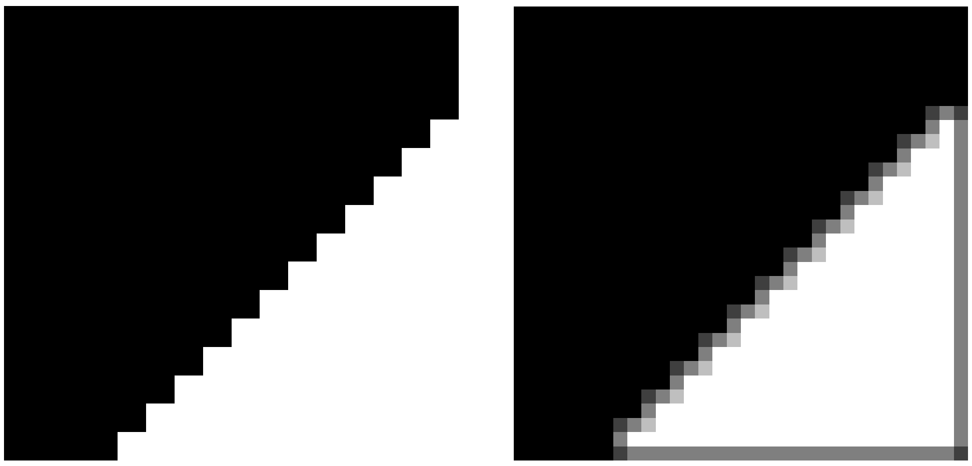

Figure 1. Applying bilinear filter to input image (on the left) and the output image (on the right).

1. Abstract

Image interpolation is used in numerous applications, from photos browsers to latest computer games. The most common interpolation methods are: bilinear [2], bicubic [1], gradient [3] and spline [4].

Furthermore there are some adaptive algorithms, which take into account different issues of interpolation and reduce such visual defects as jaggies, blur and halo.

The main issue of doubling image size with bilinear or bicubic interpolation is a lack of data to compute last rows and columns. By interpolating $M \times N$ image it is only possible to produce an $(2M-1) \times (2N-1)$ version. Two standard solutions are: either copy nearest pixels (clamping) or wrap them from the opposite edge of image.

Nowadays NVIDIA GPUs have hardware implementation of bilinear interpolation using texture processors, supporting both clamping and wrapping modes.

2. Problem definition

Given:

- Source image of $M \times N$;

Produce $2M \times 2N$ image using hardware implementation of bilinear interpolation. Take missing pixels of last row and column from the opposite edge.

3. Proposed method

The following method is proposed to implement bilinear interpolation:

1. Copy data to device memory;
2. Bind them to a texture link;
3. Using special function, extract data from texture memory and place them to result array in global memory.

4. Implementation requirements

4.1. Input data

- path to a source image file (image shall be read from file);

4.2. Output data

- running time using GPU;
- running time without GPU;
- result – output image.

4.3. Implementation

It is required to use texture memory and hardware texture filtering.

5. The expected result

1. Getting familiar with methods of image interpolation;
2. Improve CUDA programming skills, get experience using textures.

References

[1] Bicubic interpolation – http://en.wikipedia.org/wiki/Bicubic_interpolation.

[2] Bilinear interpolation – http://en.wikipedia.org/wiki/Bilinear_interpolation.

[3] Jinyu Chu, Ju Liu, Jianping Qiao, Xiaoling Wang, and Yujun Li. Gradient-based adaptive interpolation in super-resolution image restoration.

[4] Sky McKinley and Megan Levine. Cubic spline interpolation.