

3D Image Processing

Lab Assignment 2

Image Resampling

Due: 18 November 2014, 9:30am

The goal of this lab assignment is that you get some idea about lattice structures, frequency bandwidth of signals, and filtering. You can use Matlab/Octave or any programming or scripting language. You can use *Matlab Image Processing Toolbox* or *Octave Image Package* in this assignment. A good documentation for them can be found here:

<http://www.mathworks.de/de/help/images/functionlist.html>

Any other Matlab/Octave toolbox, or C/C++/Java/etc libraries have to be confirmed by us before being used for this assignment. For tasks (a) to (f), you are not allowed to use `imresize`, `imrotate`, and `imtransform` in Matlab/Octave.

If you are using Octave, Octave Image Package can be downloaded from:

<http://octave.sourceforge.net/image/>

and it is installed inside Octave by the following command:

```
cd download_folder
pkg install image-2.2.2.tar.gz
```

Or if you use **MacPort**:

```
port install octave octave-image
```

To use it, you have to load the package using the following command in Octave:

```
pkg load image
```

For each task, explain how you solve the problem and why you are doing it this way. Explain each operation, what it does and why it is used.

- Download the `Universität_Wien.JPG` file which is a high quality JPEG image with the size of 5184×3456 from this link:
http://upload.wikimedia.org/wikipedia/commons/7/7d/20120401_Universit%C3%A4t_Wien_15.JPG
- (15 Points) Resize the image to 648×432 which is $\frac{1}{8} \times \frac{1}{8}$ of the original size.
- (18 Points) Resize the image to 500×500 . Since it changes the aspect ratio of the image, your final image would look stretched vertically.

- (d) (20 Points) Assume that all images are black outside their borders. Rotate the 500×500 image for 20 degrees. To include all the input image, your final image would be 641×641 .
- (e) (20 Points) Generate the 641×641 , 20 degree rotated image in the last section from the original image. It means starting from the original high quality image, downsampling would be the last operation applied to it.
- (f) (15 Points) Which one has higher quality? (d) or (e)? Use the higher accuracy as the ground truth and calculate the Mean-Squared-Error(MSE) for the second one.
- (g) (12 Points) How would you solve the above tasks if you could use `imresize`, `imrotate`, and `imtransform` as well?
- (h) (*OPTIONAL*) [+15 Points] Repeat task (b) using FFT transform:
http://spiedigitallibrary.org/data/journals/appres/929364/JARS_8_1_083683.pdf
- (i) (*OPTIONAL*) [+15 Points] Create a "Blur-Aware Downsampled Image" in $\frac{1}{32} \times \frac{1}{32}$ of the original size
<http://www.cs.ubc.ca/~heidrich/Papers/EG.11.pdf>

Submission

You need to submit a pdf report, and one Matlab/Octave function for each task all in the same folder. Please write your name and student ID on top of each Matlab file as well as the pdf report. Feel free to define other auxiliary functions. I should be able to test your code with the following sequence of commands:

```

Img = imread('Universitaet_Wien.JPG');
ImgB = taskB(Img);
ImgC = taskC(Img);
ImgD = taskD(Img);
ImgE = taskE(Img);
ImgMSE = taskF(ImgC, ImgD);
ImgFB = taskGB(Img);
ImgFC = taskGC(Img);
ImgFD = taskGD(Img);
ImgFE = taskGE(Img);
ImgIB = taskIC(Img);

```

```
ImgJB = taskJC(Img);
```

If you are using other programming/scripting languages: please provide similar functions. Your code should also include a Makefile to compile and a README.txt explaining the procedure I can follow to test your code and call the functions listed above.