

Software Methodologies COMP2231

2019/2020

Image processing assignment

Submit your work on **DUO** before **17 January 2020, 14:00**. For any questions, contact the setter of the assignment Dr Ioannis Ivrissimtzis: ioannis.ivrissimtzis@durham.ac.uk

What to submit

Submit your **report** as a single pdf file.

Your report should be no more than **4 pages** long (in **11 font size**), including a list of references at the end of the main document. It can have one appendix, which will not count towards the 4 page limit, and which can only contain higher resolutions of images that are already in the main report.

Non-Local Means Denoising

The non-local means algorithm was proposed in [1], as a simple yet effective image denoising method based on the principle of replacing the colour of a pixel with an average of the colours of 'similar' pixels.

Based on independent literature research, and experimentation with the OpenCV implementation of non-local means denoising *fastNlMeansDenoisingColored()*, write a report containing:

1. A description of the non-local means denoising algorithm.
2. Discussion of the various proposed implementations of the algorithm and discussion of their efficiency. You can start your research on implementation issues from [2].
3. Demonstration of the influence of the algorithmic parameters on the output.
4. Discussion of the strengths and limitations of non-local means compared to other denoising algorithms.
5. Description and discussion of modifications and extensions of the algorithm that have been proposed in the literature.
6. Description and discussion of applications of the original algorithm and its extensions.

The report should contain examples of images denoised by the OpenCV implementation of the algorithm. You can use the Python program uploaded on DUO and fine-tune its parameters.

Images with various levels of added noise have also been uploaded on DUO, together with the corresponding originals. You can use some, or all of them to produce your examples. But if you think that a property of the algorithm, or the effect of a parameter, can be better illustrated on some other image, you can use that image instead.

References

[1] Buades, Antoni, Bartomeu Coll, and J-M. Morel. "A non-local algorithm for image denoising." *2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'05)*. Vol. 2. IEEE, 2005.

[2] Buades, Antoni, Bartomeu Coll, and Jean-Michel Morel. "Non-local means denoising." *Image Processing On Line* 1 (2011): 208-212.

Marking scheme

D1	Description of the non-local means denoising algorithm.	15%
D2	Discussion of implementation issues and of the algorithmic efficiency.	15%
D3	Description of the influence of the algorithmic parameters on the output.	20%
D4	Discussion of strengths and limitations.	20%
D5	Description and discussion of modifications and extensions of the main algorithm.	10%
D6	Description and discussion of applications.	10%
W	Writing skills.	10%

Marks will be awarded based on the:

D1: Clarity and completeness of the description, which should be supported by appropriate references to the literature.

D2: Clarity and breadth of the discussion, which should be supported by appropriate references to the literature. Evidence of your own, independent literature research beyond [1] and [2] will be appreciated.

D3: Clarity of the description, which should be supported by appropriate examples of denoised images generated by you, and by appropriate references to the literature. Evidence of independent literature research will be appreciated.

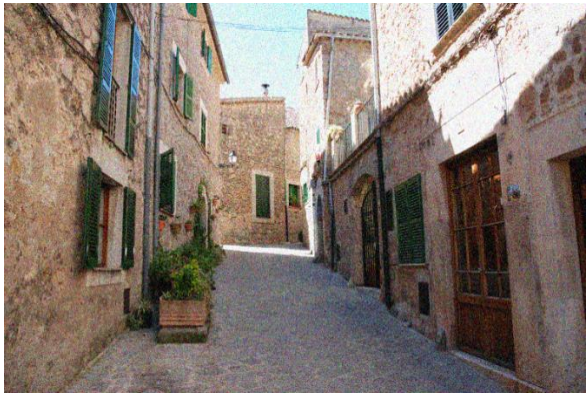
D4: Clarity, breadth and depth of the discussion, which should be supported by appropriate examples of denoised images generated by you, and by appropriate references to the literature. Evidence of independent literature research will be appreciated.

D5: Clarity and breadth of the discussion which should be supported by independent literature research.

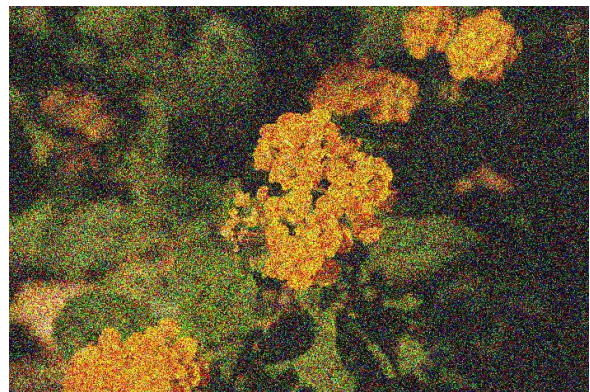
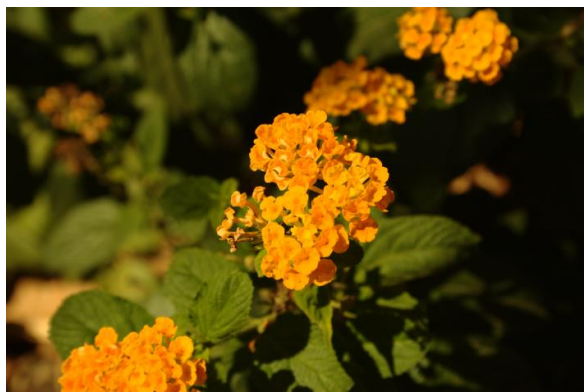
D6: Clarity and breadth of the discussion which should be supported by independent literature research.

D1-D6: Marks will be awarded based on the quality and relevance of the cited papers, and the integration of the references in to the main report, i.e., appropriate papers should be cited at appropriate places.

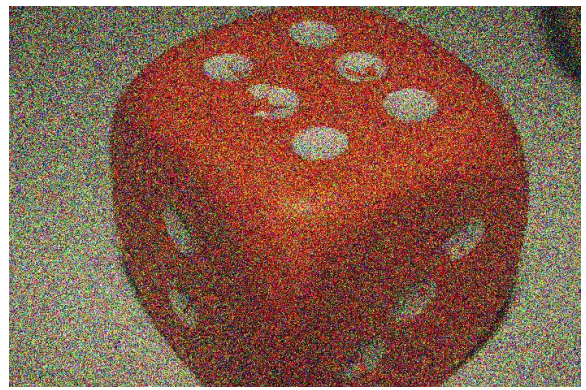
W: Appropriate formatting, quality of the report's art, grammar and syntax, and maturity of the technical writing style.



From Top-Left and clockwise: original image, noisy image, high noise, extreme noise.



From Top-Left and clockwise: original image, noisy image, high noise, extreme noise.



From Top-Left and clockwise: original image, noisy image, high noise, extreme noise.