

# IPOL: un journal en ligne pour la recherche reproductible

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Sous la co-tutelle de :

CNRS  
ÉCOLE DES PONTS PARISTECH  
UNIVERSITÉ GUSTAVE EIFFEL



Les Plans de Gestion des Logiciels de la Recherche, UGE, 23-24 mai 2024

### Repeatability and replicability

Capacity to perform the same experiment as many times as needed.

→ **Repeatability**: Same team, same experimental setup

→ **Replicability**: Different team, same experimental setup

**Example:** is distilled water electrically conductive? Is salt water conductive?

We can perform the experiment many times and get results

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### Reproducibility

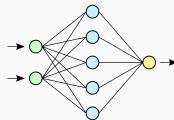
Capacity to obtain the same results when repeating an experiment by following a detailed procedure

→ Different team, different experimental setup

**In computational sciences** (deterministic code, digital data): results obtained by following a detailed and correct pseudo-code description must coincide if the same input data is provided.

## Repeatable

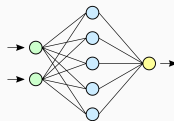
Obtaining the classification results with a **neural network**.  
We can **repeat** the experiment as many times as we want.  
We just need the weights of the network and the input data.



# Repeatability Examples

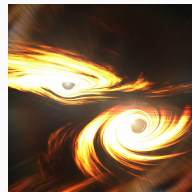
## Repeatable

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## Not repeatable:

Detection of the merger of two black holes from gravitational waves. We can't repeat the experiment as needed.



# Reproducibility Examples

## Reproducible:

Given:

- a detailed pseudo-code (or the source code itself),
- any associated learning or initialization data,
- the input data,

we should obtain exactly the same results each time we run the algorithm.

⇒ Exactly the same denoised image, classification results, etc.

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## Not reproducible

In a paper that shows

- a pseudo-code without all the details, or its initialization,
- the source code is not available,
- neither the learning data,

other researchers can't compare with the proposed method.

⇒ We can't be sure about anything on the method, nor test it with our own data.



# Implementation of Reproducible Research

- **Non-exact sciences** (biology, medicine, . . .): **difficult** (but *desirable*). Hard to have exactly the same **conditions** along experiments.
- Computational sciences: **no excuse!**

Why are we not all doing reproducible research?



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Why are we not all doing reproducible research?

## Several reasons in general:

- Some researchers don't want to **make public working code**
  - doesn't correspond to any version of the pseudo-codes,
  - low software quality,
  - quality software takes more time to produce: testing, documentation, objective quality metrics.
- Results of the method **do not generalize**
- ... (For the discussion later!)

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## Not really considered for career advance

- Classic metrics: “number of high impact-factor classic publications”
- Software is considered as a 2nd class citizen

## Different types of platforms

- Online execution platforms.
- Dissemination platforms.
- Peer-reviewed journals.

- **Galaxy** - <https://galaxyproject.org>
- **IPython** - <https://ipython.org>
- **Jupyter** - <http://jupyter.org>
- **RunMyCode** - <http://www.runmycode.org>
- **Code Ocean** - <https://codeocean.com>
- **DAE** - <http://dae.cse.lehigh.edu/DAE>
- **IPOL** - <https://www.ipol.im>
- **Research Compendia** - [ResearchCompendia.org](http://ResearchCompendia.org)
- **MLOSS** - <https://mloss.org/software>
- **DataHub** - <https://datahub.io/>
- **PaperWithCode** - <https://paperswithcode.com>

- **ReScience Journal** - <http://rescience.github.io>
- **JOSS Journal** - <https://joss.theoj.org>
- **Insight J Journal** - <https://insight-journal.org>

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- **Research Compendia** - [ResearchCompendia.org](http://ResearchCompendia.org)
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- Started in 2009 under the initiative of Nicolas Limare and Jean-Michel Morel (ENS Paris Saclay).
- A journal initially targeting image processing (Image Processing On Line)
- Some other data types were added: video, audio, 3D data...
- Even some articles on SARS-CoV-2 evolution!  
“A Daily Measure of the SARS-CoV-2 Effective Reproduction Number for all Countries” <http://www.ipol.im/pub/art/2020/304/>
- Today it is a general journal on reproducible algorithms  
→ Information Processing On Line

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  - ISSN, DOI, indexed by SCOPUS. Not yet an "Impact Factor".

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Let's have a look!  $\Rightarrow$  <http://www.ipol.im/pub/art/2017/201/>



## Multi-Scale DCT Denoising

Nicola Pierazzo, Jean-Michel Morel, Gabriele Facciolo

article demo archive

published - 2017-10-29

reference - NICOLA PIERAZZO, JEAN-MICHEL MOREL, AND GABRIELE FACCILO, Multi-Scale DCT Denoising, Image Processing On Line, 7 (2017), pp. 288–308. <https://doi.org/10.5201/ipol.2017.201>

BibTeX info

Communicated by Julie Deseon  
Demo edited by Gabriele Facciolo



This IPOL article is related to a companion publication in the SIAM Journal on Imaging Sciences:  
G. Facciolo, N. Pierazzo, J.-M. Morel, "Conservative Scale Reconstruction for Multiscale Denoising (The Devil is in the High Frequency Detail)" SIAM Journal on Imaging Sciences 10(3):1603–1626, 2017. <http://dx.doi.org/10.1137/17M111826>

### Abstract

DCT denoising is a classic low complexity method built in the JPEG compression norm. Once made translation invariant, this algorithm was still proven to be competitive at the beginning of this century. Since then, it has been outperformed by patch based methods, which are far more complex. This paper proposes a two-step multi-scale version of the algorithm that boosts its performance and reduces its artifacts. The multi-scale strategy decomposes the image in a dyadic DCT pyramid, which keeps noise white at all scales. The single scale denoising is then applied to all scales, thus giving multiple denoised versions of the low frequency coefficients of the denoised image. A "multi-scale fusion" of these multiple estimates avoids the ringing artifacts resulting from the pyramid reconstruction. The final algorithm attains a good PSNR and much improved visual image quality. It is shown to have a deficit of only 1dB with respect to state of the art algorithms, but its complexity is two orders of magnitude lower.

### Download

- full text manuscript PDF low-res (1.7M) PDF (15.2M) <sup>(1)</sup>
- source code ZIP BWMF info ZIP

### Preview

Loading takes a few seconds. Images and graphics are displayed here for faster rendering. See the downloadable PDF documents for original high quality versions.

We present an efficient and accurate algorithm for denoising images.

For the hard thresholding pass of the algorithm the aggregation weights are set, as in [3], by counting the number  $N_r$  of nonzero DCT coefficients (excluding the zero frequency) in the patch after thresholding. These aggregation weights are then given by

$$(1 + N_r)^{-1}, \quad (1)$$

where the one is added to prevent the dividing by zero (but it is an arbitrary choice). Indeed, the number of non-zero coefficients will be small for the flat patches, compared to patches containing

290

LOW RESOLUTION PDF: Images may show compression artifacts. A full resolution PDF is available at [www.ipol.im](http://www.ipol.im).

MULTI-SCALE DCT DENOISING

#### Algorithm 2: DCT Denoising - Hard thresholding


1 Function DCTDENOISINGHARD( $\tilde{Y}, \sigma, s$ )  
   input : noisy image  $\tilde{Y}$ , noise level  $\sigma$ , and patch size  $s$   
   output : denoised image  $\hat{Y}$

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## Multi-Scale DCT Denoising

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Experiment #507897.  
2022-05-28 02:50:13 UTC

Parameters


sigma 5  
psr 8  
scales 5  
rectorator 0.4

Files:



[Output text](#)




Original



DCT 1 scale



MS DCT




Noisy


Experiment #507896.  
2022-05-28 02:50:43 UTC

Parameters


sigma 10  
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DCT 1 scale



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Noisy

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Useful to show a landscape of our scientific activity



## Main attention points:

- Consider **source code** as **part of the publication**, not supplementary material
- Different **levels of evaluation**:
  - **Lowest**: **black box** (same inputs → same outputs)
  - ...
  - **Highest**: deep understanding of the method and checking that the source code matches the implementation faithfully.

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## Difficulties

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- Many researchers are not software engineers!

⇒ A possible solution (IPOL): use **at least two reviewers**, one of them being an expert reading source code.

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## Special case of neural networks

Focus on the **architecture**, **training**, **understanding**, and **generalization**.

- Four editors in chief: Luis Alvarez (Univ. Gran Canaria), PM, Jean-Michel Morel (ENS Paris Saclay), Gregory Randall (Univ. Montevideo)
- EiCs decide if the submission looks interesting.
- EiCs name an associate editor for the submission.
- The editor chooses reviewers and a demo editor.
- Reviewers may be asked to check different aspects: article, code, demo.
- After acceptance, an EiC checks the article and plays with the demo, testing with different input data and parameters

## Published articles

Currently about 15–20 accepted submissions per year.



## IPOL CITATIONS

IPOL Journal Image Processing Online  
Adresse e-mail validée de ctim.es - [Page d'accueil](#)  
Image Processing Applied Mathematics

SUIVRE

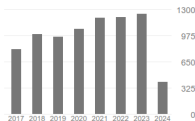
OBTENIR MON PROPRE PROFIL

TITRE	CITÉE PAR	ANNÉE
<b>Non-Local Means Denoising</b> A Buades, B Coll, JM Morel IPOL Journal : Image Processing On Line 1	949	2011
<b>LSD: a line segment detector</b> RG Von Gioi, J Jakubowicz, JM Morel, G Randall IPOL Journal Image Processing On Line 2, 35-55	886	2012
<b>An Analysis of the Viola-Jones Face Detection Algorithm</b> YQ Wang IPOL Journal : Image Processing On Line 4, 128-148	497	2014
<b>TV-L1 Optical Flow Estimation</b> J Sánchez, E Meinhard-Llopis, G Facciolo IPOL Journal : Image Processing On Line. 3, 137-150	475 *	2013
<b>Asift: An algorithm for fully affine invariant comparison</b> G Yu, JM Morel IPOL Journal : Image Processing On Line 1	427 *	2011
<b>An Analysis and Implementation of the BM3D Image Denoising Method</b> M Lebrun IPOL Journal Image Processing On Line 2, 175-213	393	2012
<b>Multiscale Retinex</b> AB Petro, C Sbert, JM Morel IPOL Journal : Image Processing On Line 4, 71-88	353	2014
<b>Rudin-Osher-Fatemi total variation denoising using split Bregman</b> P Getreuer IPOL Journal : Image Processing On Line 2, 79-95	308	2012
<b>Chan-vese segmentation</b> P Getreuer IPOL Journal : Image Processing On Line 2, 214-224	236	2012
<b>Self-similarity Driven Demosaicking</b> A Buades, B Coll, JM Morel, C Sbert IPOL Journal : Image Processing On Line 1	200 *	2011

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Citations	9839	6078
indice h	44	38
Indice i10	117	93



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Thank you for your attention