

Artifact-Free JPEG Decompression with Total Generalized Variation

Martin Holler and Kristian Bredies

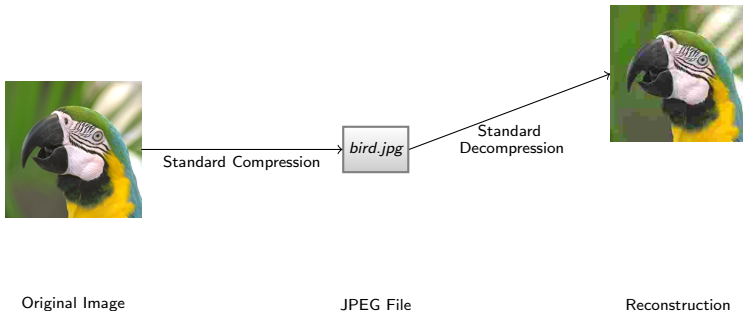
Institute for Mathematics and Scientific Computing
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JPEG Compression/Decompression

The JPEG standard:

- JPEG is the most common lossy compression standard for digital images.
- It allows a high compression rate but leads to artifacts (noise) in the standard reconstruction due to **loss of image data**.



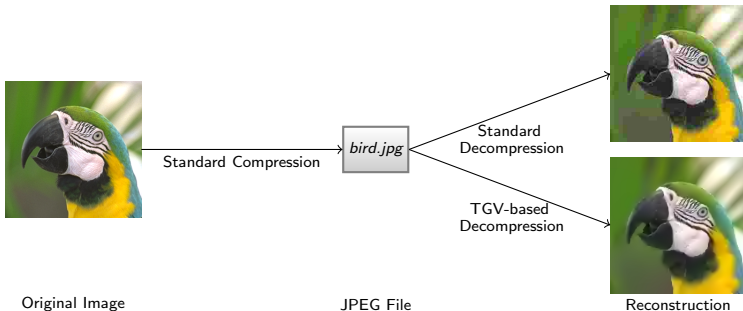
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TGV-based reconstruction of JPEG compressed images:

- The method uses any given JPEG file to uniquely determine the **set of all possible source images**.
- It then applies the TGV functional to **particularly choose one** of these possible source images and with that obtain a highly improved reconstruction. This is realized by an iterative process. The reconstructed image can then be displayed or saved to hard disk in higher quality.



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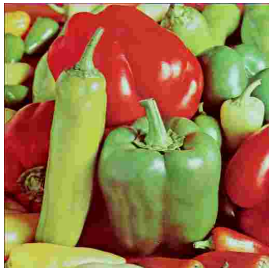
Standard reconstruction.



TGV-based reconstruction.

Advantages of the TGV-Based Method

- It allows to obtain a **highly improved** reconstruction of any given JPEG compressed image.
- It **removes noise** and yields a clean image without over-smoothing sharp edges.
- It is ensured that the reconstruction **always fits to the given data**, no data modifications take place.
- **No user input** is necessary, the standard settings are suitable for any kind of image.
- It directly operates on the JPEG source data, standard JPEG compressed data can be used.
- It is an iterative process that can be **stopped at any time**.
- Is not a filter-type method, higher iteration numbers do not over-smooth the image.
- Is a fast reconstruction method that has already been implemented in parallel for the GPU.



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TGV-based reconstruction after
0.06 Seconds, 50 Iterations (GPU).



TGV-based reconstruction after
0.6 Seconds, 500 Iterations (GPU).

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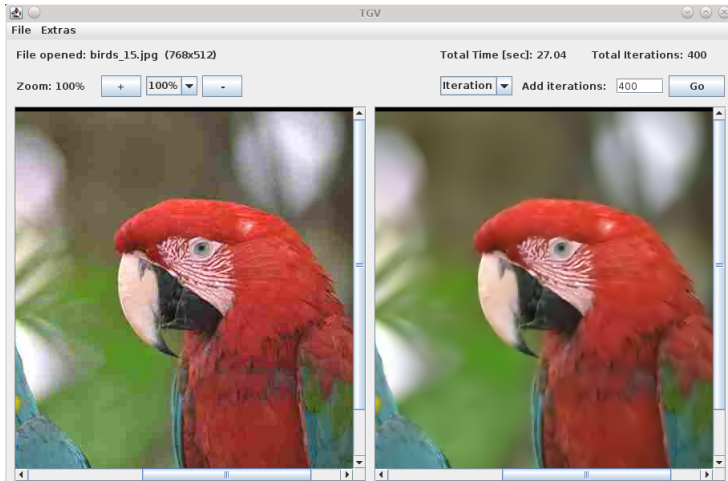
Computation times of the TGV-based reconstruction method. Time in seconds for 500 iterations and different image sizes:

Device	512 × 512	1600 × 1200	3200 × 2400
CPU AMD Phenom 9950	14.16	131.85	406.09
GPU Quadro FX 3700	2.46	17.76	--- ¹
GPU Nvidia GTX 280	1.1	5.11	--- ¹
GPU Nvidia GTX 580	0.6	3.3	12.85

¹Insufficient GPU memory.

A Test-Applet for the TGV-Based Method

- An interactive applet to test the TGV-based reconstruction method is available.
- It uses multi-core CPU and GPU implementations to obtain the reconstruction.
- It allows to save the improved reconstruction and to compare it with the standard reconstruction.





Standard decompression (Image from <http://topbrasilturismo.wordpress.com/>)



TGV-based decompression (Image from <http://topbrasilturismo.wordpress.com/>)



Standard decompression



TGV-based decompression

Contact and Patent Information

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- Applied for European patent 2011

Cooperation Options:

- Licence agreement, assignment

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