

imager: an R package for image processing based on CImg

Simon Barthelmé¹ and David Tschumperlé²

¹ CNRS, Gipsa-lab, Grenoble INP, France ² CNRS, Greyc, ENSICAen, France

DOI: [10.21105/joss.01012](https://doi.org/10.21105/joss.01012)

Software

- [Review](#) ↗
- [Repository](#) ↗
- [Archive](#) ↗

Submitted: 28 August 2018

Published: 11 June 2019

License

Authors of papers retain copyright and release the work under a Creative Commons Attribution 4.0 International License ([CC-BY](#)).

Summary

R is a language designed for the processing of (numerical) data, and images are just numerical data. The original motivation for developing *imager* was that existing image processing facilities in R were at the time rather limited, and that R had the potential to be a great environment for processing image data. Many scientists now use R as their primary computing environment, and some amount of image processing is a requirement in fields like biology (when microscopy is used), or astronomy.

Because R already provides a lot of generic data processing tools, *imager* was designed to be “idiomatic”, so that native R tools could be used easily on image data. On the other hand, because R is also slow, and ill-adapted to many image processing algorithms that involve looping over each pixel in an image, *imager* was designed to provide easy access to a C++ image processing library as a fall-back option (using Rcpp (Eddelbuettel et al., 2011) as glue).

There are many C++ libraries for image processing, and among them [OpenCV](#) is arguably dominant. However, its API is quite complex and targets computer vision rather than image processing *per se*. A popular alternative is the [CImg](#) library developed by the second author (Tschumperlé, 2012). *CImg* provides an elegant API, and is easy to learn. In addition, *CImg* is fast, parallel (using OpenMP), and supports image data in up to four dimensions, meaning that it can process hyperspectral or video data. It is already used in many OSS applications [partial list here](#). Notably, *CImg* is the back-end for [G'MIC](#), a popular command-line tool and Gimp/Krita plugin for image processing.

imager is based on *CImg* but is not a simple wrapper. It is organised around two main types of objects: raster images (with *cimg* type), and pixel sets (with *pixset* type). The first are meant to represent images, while the second represent regions of interest, such as foreground pixels, cells, etc. Both come with standard R generics, like `print`, `plot`, or `as.data.frame`. Internally, they are nothing more than 4D arrays, of numeric or logical type, that *CImg* can directly work with.

imager provides all classical image processing operations (filtering, morphology, etc.), along with more advanced functionality. It integrates well with packages from the tidyverse such as [purrr](#). It is extensively documented, with two vignettes ([getting started](#), and [pixsets](#)), and many worked-out examples on the [website](#).

Current status, and plans for the future

The package is now relatively mature (over 3 years old). As a testament to its usefulness, we note that *imager* is used by several other OSS projects: as of Aug. 2018, 18 dependencies are listed on [CRAN](#). The package contains at this stage far more functions than its author

can remember, so the current focus for development is on enhancing documentation and “discoverability” of imager’s content, and consistency of the API. Another interesting area is support for missing values: this is generally a strong point of R, and a weak point of image processing libraries. *imager* provides limited support for missing values, but future versions should increase the level of support.

Acknowledgements

Simon Barthelmé is supported by a grant from the French National Agency for Research (ANR GenGP, ANR-16-CE23-0008).

References

- Eddelbuettel, D., François, R., Allaire, J., Ushey, K., Kou, Q., Russel, N., Chambers, J., et al. (2011). Rcpp: Seamless r and c++ integration. *Journal of Statistical Software*, 40(8), 1–18.
- Tschumperlé, D. (2012). The CImg Library. In *IPOL 2012 Meeting on Image Processing Libraries* (p. 4 pp). Cachan, France. Retrieved from <https://hal.archives-ouvertes.fr/hal-00927458>