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FluidImage, a libre framework for scientific treatments of large sets of images

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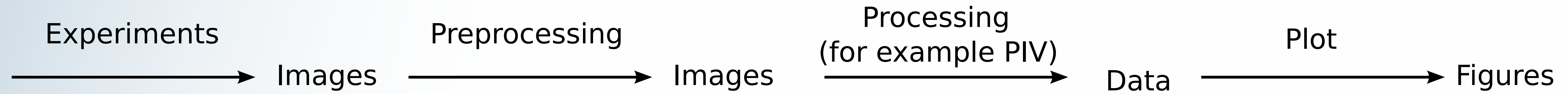
<https://hal.science/hal-01396688v1>

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Motivations



A solution

FluidImage

A software for the fluid dynamic community, by the fluid dynamic community

A libre framework for scientific treatments of large sets of images

Easy, safe and efficient for all users, nice for the developers

New methods of open-source software

- scientific **Python** environment (=>multi-platform)
- **unit tests** (stable, less bugs)
- automatic web **documentation**
- modular, object oriented
- collaborative environment (Mercurial/Bitbucket)

Efficient and multi-architecture (from desktop computer to cluster)

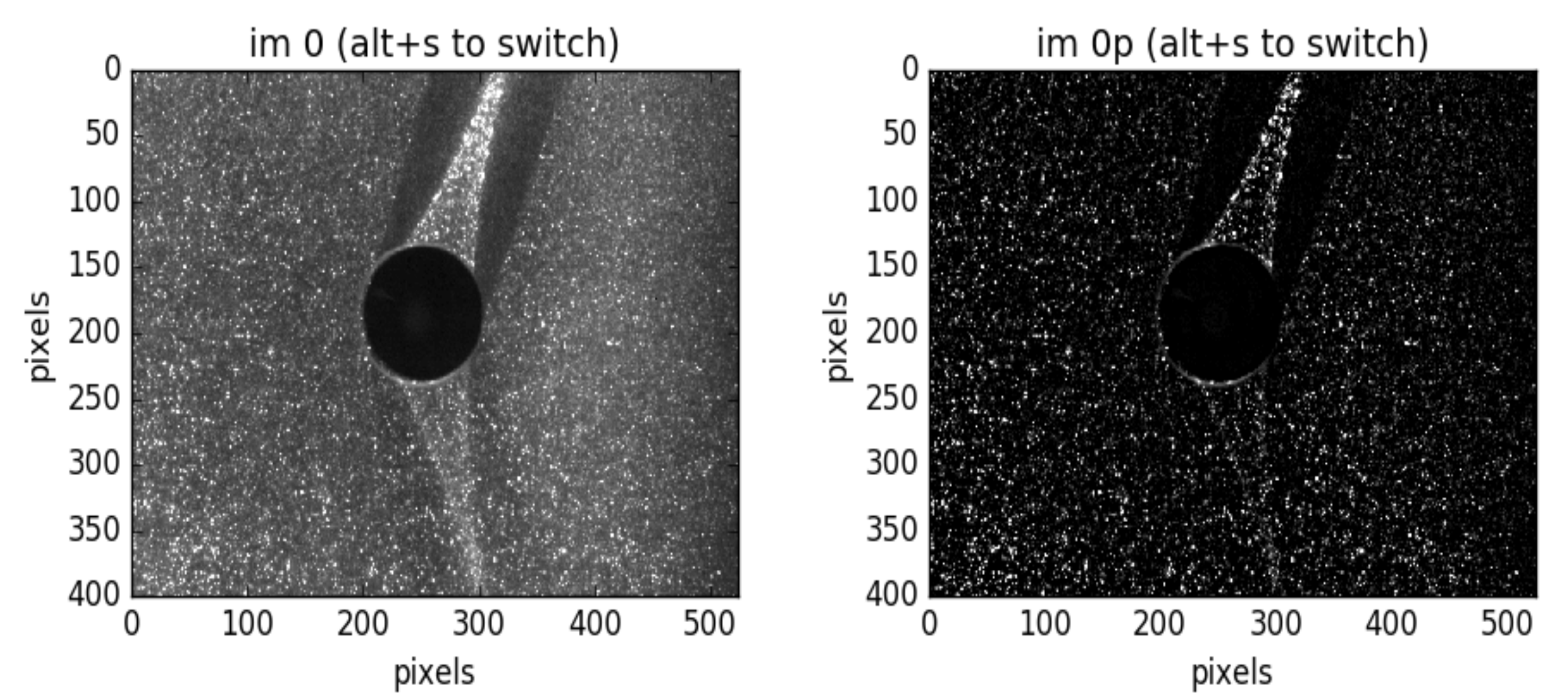
- **asynchronous, distributed** and **parallel** computing
- **hybrid** computation (CPU/GPU)
- unified API for the different schedulers (OAR, Slurm, ...)
- optimized algorithms
- Python/Numpy compiler Pythran (functions as fast as C++ or Fortran)

Doc: <http://fluidimage.readthedocs.io> Code: <https://bitbucket.org/fluiddyn/fluidimage>

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Preprocessing

- Functions of `scipy.ndimage`, `scikit-image` and `OpenCV`
- tools implemented out of the box:
 - spatial and spatio-temporal filters (median, minima, percentile)
 - brightness and contrast tools (global threshold, rescale intensity, histogram equalization)
 - miscellaneous operations (gamma correction, sharpen)
- easy to add user-defined functions operating on a single image



GUI to compare images with and without pre-processing (here, sliding median and global threshold).

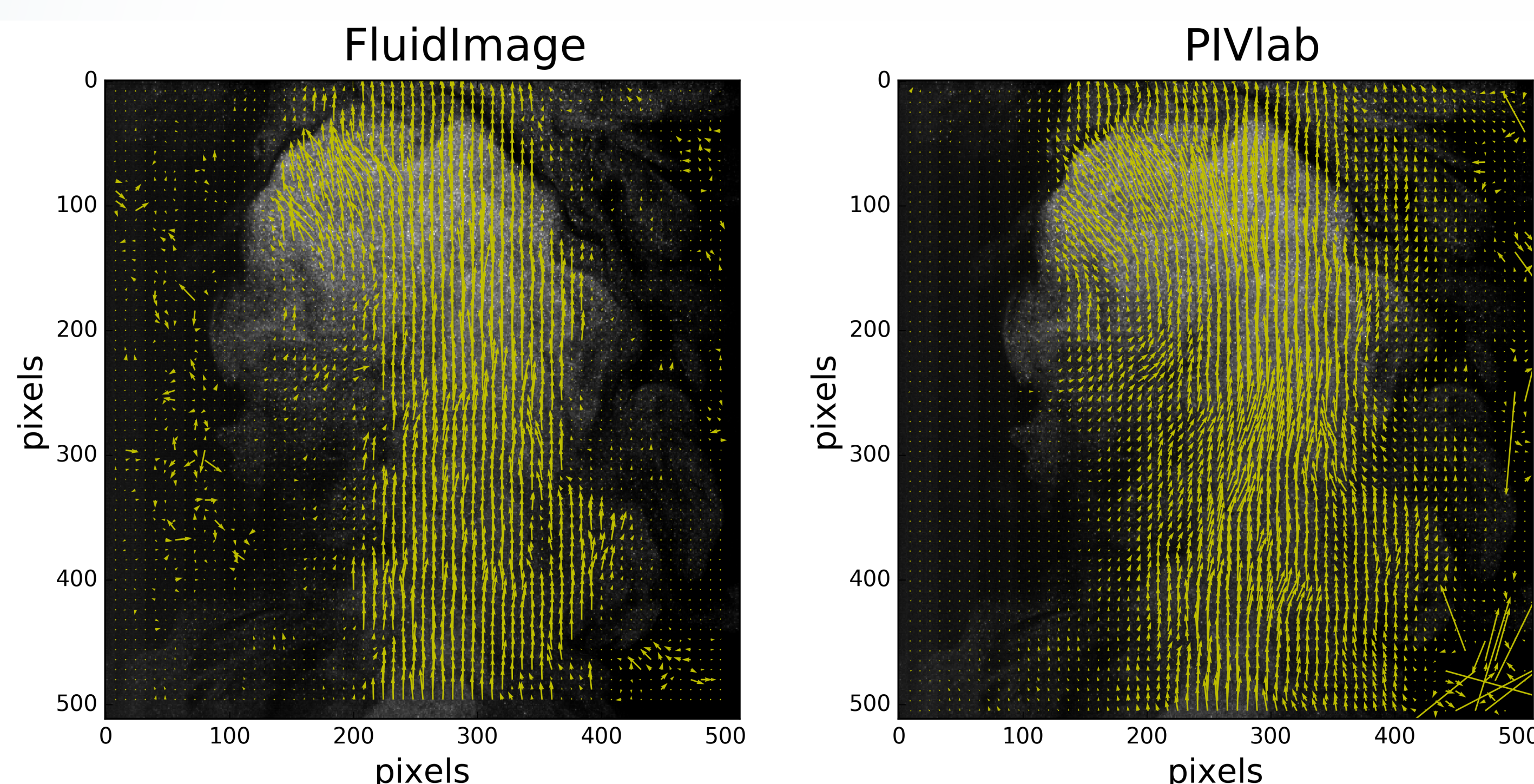
Particle Image Velocimetry - PIV

- Based on 2D correlation
- multiple pass with grid refinement

Several methods (using CPU and/or GPU) for

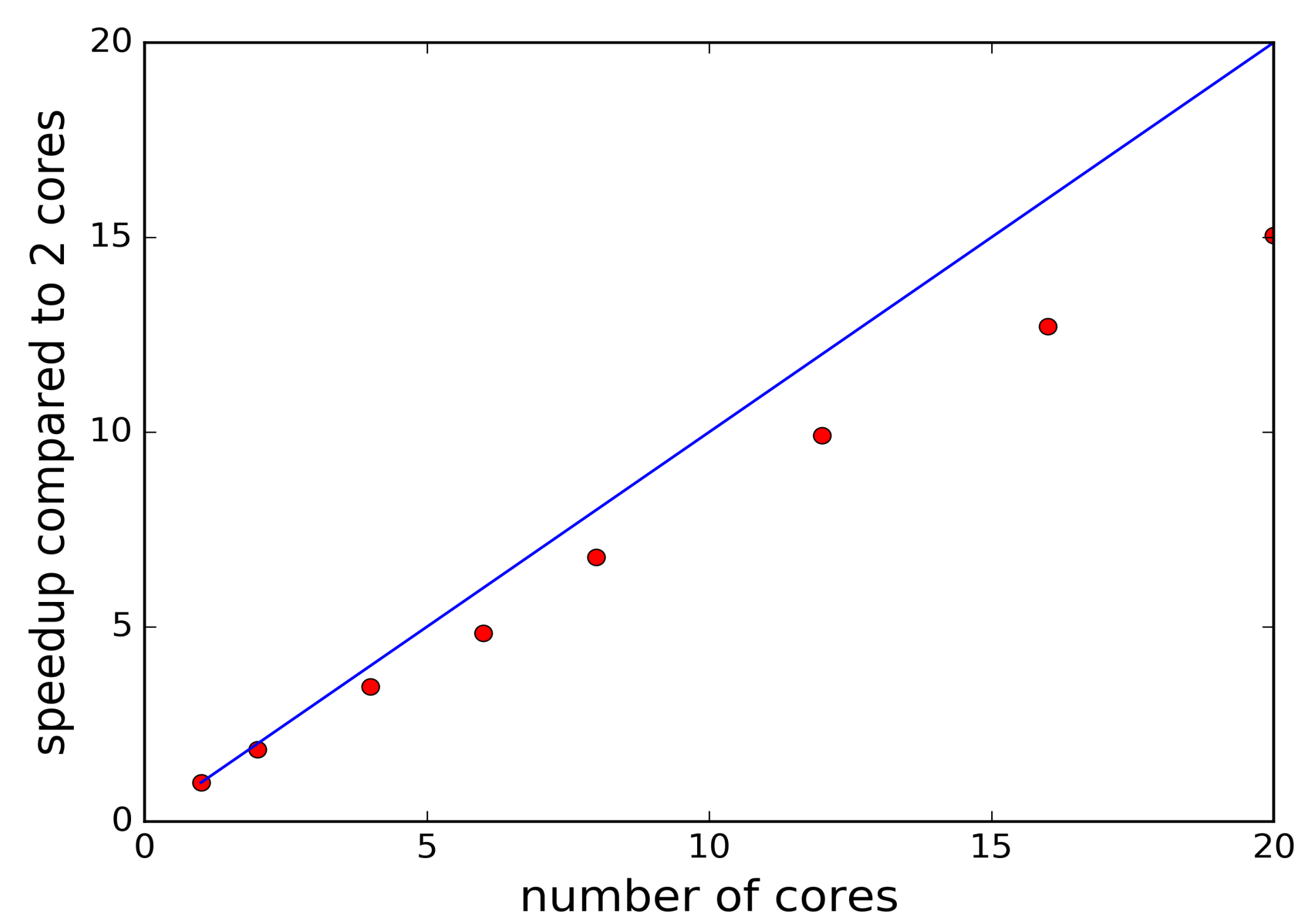
- correlation computation
- interpolation
- sub-pixel peak detection
- detection of wrong vectors

Comparison with PIVlab (Matlab)



Computation of 100 velocity fields from 100 couples of images (example C of PIV challenge 2005) with 3 passes (64x64 → 32x32 → 16x16). FluidImage is slightly faster (58 s vs 69 s).

Speed-up



Benchmark done on one node on a cluster at LEGI for a computation of 100 velocity fields. The deviation from the linear curve is to be due to IO limitations (NFS).