

## POWER-UP YOUR MICROSCOPE.

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We report about a software package, named "Power-up your Microscope" designed and realized for the optimization of three-dimensional optical microscopy image quality using the Internet<sup>1</sup> and inverse problems computational approaches<sup>2</sup>. The package is mainly devoted to Confocal microscope users also providing tools for wide-field computational optical sectioning microscopy and two-photon excitation microscopy imaging<sup>3,4</sup>.

So far, The main goal of our project is to provide the microscopy community with an extremely easy and comparatively powerful access to some advanced image restoration methods<sup>2,4</sup>: such methods are usually hardly usable by microscopists, in that they require a mathematical, physical and often also computeristic knowledge that goes beyond their scientific background and research interests.

"Power-up your microscope" has been realized using JSP (Java Server Page) technology accordingly to the scheme outlined in figure 1. It is accessible from a website and the only pieces of information required to run the algorithms are the names of the images to be restored and a few parameters related to the specific optical device with which the data was collected, figure 2. These parameters are usually well known by the microscopist. No data related to the reconstruction method is required at all, because this is a choice and decision of the service provider. The optical system is modelled in terms of space-invariant linear system. This means that the optical system is completely described by its point spread function that is computed by the service provider accordingly to the optical data given by the utilizer. The inversion algorithm software implements three different approaches, namely: Thikonv, Landweber and EM<sup>2,4</sup>. The first one is used to produce a fast preview.

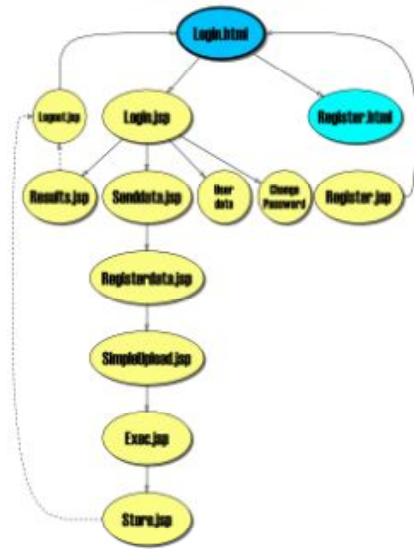
Figure 3 shows an example of image enhancement using the three different approaches. Time and memory requirements have been evaluated.

"Power-up your Microscope" presents the following characteristics: ease of use, compatibility (web => multi-platform), transparent software and hardware update, personalized access (database, session, etc...).

We think that "Power-up your Microscope" can successfully contribute to microscopy utilisation exploiting the culturally and technologically mature technology of the Internet.

### References

- 1) C.Eberhardt, Proc.Royal Microsc.Soc. 36(3), p.217 (2001).
- 2) M. Bertero, P. Boccacci, Introduction to inverse problems in imaging, Institute of Physics Publishing, Bristol and Philadelphia (1998)
- 3) K.R. Castleman Digital image processing. Prentice-Hall, Englewood Cliffs, NJ (1996).
- 4) A.Diaspro (ed.), Confocal and Two-photon microscopy: Foundations, Applications and Advances, Wiley-Liss, New York (2002)
- 5) <http://www.svi.nl>



**Figure 1 : Website Structure**

**Send Data Page**

Microscope Parameters

Numerical Aperture :

Immersion Medium Refractive Index :

Emission WaveLength :

Excitation WaveLength :

Image Parameters

X Axis Pixels :

Y Axis Pixels :

Planes Number :

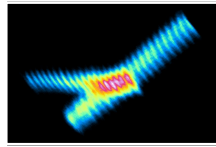
Field of View (micron) :

Slice Spacing (micron) :

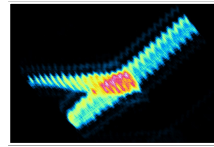
Image Format :

Image Reconstruction Type

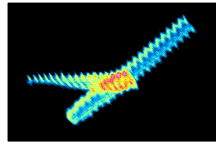
Type :



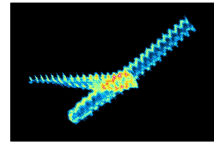
Original



Tikhonov



Landweber



EM

**Figure 2 :User interface example**

**Figure 3 : Octopus sperm head PSF-deconvolution results**