

## Minutes of the 4<sup>th</sup> Cosmic Meeting - 03/07/2017@NeuroSpin

**Participants:** Carole Lazarus (2<sup>nd</sup> year PhD student NeuroSpin), Loubna El Gueddari (1<sup>st</sup> year PhD student in MR image reconstruction, NeuroSpin), Ming Jiang (3<sup>rd</sup> year PhD student, Cosmostat), Antoine Grigis (Research engineer, NeuroSpin), Fabrice Poupon (), Christine Doublé (Communication staff at NeuroSpin), Alexandre Vignaud (MR Physicist at NeuroSpin), Philippe Ciuciu (Nsp group leader) and Jean-Luc Starck (Cosmostat leader).

**Absents:** Florent Sureau (CosmoStat).

For the next one: invite Samuel Farrens from CosmoStat (<http://www.cosmostat.org/people/samuel-farrens/>)

**Writer:** Philippe CIUCIU

**Version:** 1.0

### Objectives:

1. Discuss communication plan for the next coming months
2. Make a point on recent technical (reconstruction algos, software) progresses and ongoing works between the two teams.
3. Prepare the mid-term evaluation of the DRF Impulsion staff on the 19<sup>th</sup> of April 2017 at NeuroSpin.
4. Discuss the working plan of our next intern, Hamza Cherkaoui
5. Outline short term perspectives (up to the end of the funding, Sept. 2017) and mid-term ones that allows us to ask for a 1 year extension
6. Discussion interactions with the BrainAMP DRF Impulsion project led by Bertrand Thirion.

### 1. Communication Plan

- **Philippe:** introduced **Christine Doublé** who will help us for improving the website and communicate through all social networks (Twitter, @CEA\_Cosmic)
- The cosmic website is there: <https://cosmic.cosmostat.org>. Now we should think of what putting there. Of course, we should communicate on our actions: conferences, publications, regular meetings but also explain the project to a large audience!
- To go beyond, we should make short videos explaining why Astrophysics and MRI people may work together, why the COSMIC project makes sense and to which extent we can expect cross-fertilizing interactions ie more than  $1+1=2!$  Then, we should illustrate our interactions on a few reconstructed images.
- Also Project videos: PhD students in both teams might present their PhD thesis in 180s.
- Think of specific communication actions in line with the delivery of the 11.7 T magnet on late May.
- CEA News article (Disseminate our illustration on “Les Defis du CEA”).
- Think of a specific place in Github to give access to our source code in Python.
- **Philippe** will contact **Samuel Farrens** soon to improve the design of our website, especially as regards the News section. Mimic that of the DEDALE website!

### 2. Technical advances

- **Loubna & Philippe:** Condat-Vu reconstruction algo implemented in the complex-valued

image case. But results suffered from the use of the Starlet decomposition which is not optimal for MRI in contrast to asptrophysics.

- Work-in-progress by Antoine himself: Make Python wrappers around the different multi-resolution decompositions (e.g., starlets but also undecimated 7/9 wavelets). Noticeably, he used a wavelet tree data structure as used in the **pywavelet package**.
- **Antoine** also implemented a small visualizer based on **pyqtgraph** for **Ming** to get across a series of images.
- Significant advances from **Antoine & Loubna** on the pISAP package in Python based on Samuel Farrens' code. The goal of this package is to process fairly well both astrophysics data sets and MR images.
- **Fabrice** is ready to start C++ code optimization to speed up the `mr_transform`. He only needs input data and command line (or `main.cpp`) to launch the original code and compare it to its optimized version. This optimization will start by the decomposition (transform & reconstruction) before looking at filtering and denoising (iterative process). The first ingredient for optimization: multi-threading, before possibly changing the data structure.

### 3. Prepare mid-term evaluation

- Of course, we should communicate on our actions: conferences, publications, regular meetings but also explain the project to a large audience!
- We should obtain improved MR reconstruction results based on the use of undecimated 7/9 biorthogonal wavelets and show them at the mid-term evaluation.
- We should also make a demo based on our ipython **notebook**.
- Organize a specific meeting on April, 5<sup>th</sup> with a slide set already built up to rehearse our project presentation. What to show?
  - 1 slide on project management with objective view of the project life (people involved, meetings, website, ...);
  - 2<sup>nd</sup> technical aspects: Scientific objectives, Current results in 2D, Joint python Toolbox, Code optimization
  - Perspectives
    - Short term (6 months → end of the project)
    - Longer term (ie 18 months, ask for one more year of funding)

### 4. Working plan for our next intern Hamza Cherckaoui (postponed arrival)

- Arrival of an intern, **Hamza Cherckaoui**, on the 1<sup>st</sup> of May up to the 30th of September at NeuroSpin (extended delay because of the 3-lasting months security investigation). He will be working on the 3D CS-reconstruction framework (if the steps described afterwards are already completed and the milestones achieved. If not, the intern will start with some specific aspects on 2D reconstruction).

### 5. Perspectives

- **Short term**: Single python toolbox, called pISAP, that allows us to reconstruct galaxy and MR 2D images using the same Python code & algorithms. First accelerations based on C++ multithreadings. Good illustration of the success of our interactions
- **Mid term**: extend the formalism to 3D reconstruction either to the fMRI (functional MRI) setting which might be appealing for the BrainAMP project or for high resolution 3S anatomical imaging. In the first case, Ming's code based on 2D in space + 1D in time wavelet decompositions could be used directly. In the second situation, we should think of actual 3D wavelet decompositions.

### 6. Discussion with BrainAMP (DRF Impulsion 2016 project led by Bertrand Thirion at NeuroSpin)

- Discussion with Bertrand either to organize a meeting between the 2 projects or to plan to collaborate in a second step typically for asking a 1 year funding extension.