Report from CCP-PETMR for the Period 06/06/2015 to 07/12/2015

Kris Thielemans, CCP Chair
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1. Background

The recent integration of positron emission tomography (PET) and magnetic resonance (MR) imaging into a single simultaneous imaging system opens up an exciting potential for synergistic imaging. This CCP aims to bring together the best of the UK's PET and MR image reconstruction expertise to capitalise on this unique opportunity. We have two primary aims: **PET-MR networking** (bringing researchers and groups together towards the goal of synergistic PET-MR image reconstruction and analysis, by advancing understanding of PET-MR and the algorithms used for each modality) and **developing PET-MR software infrastructure** (development and promotion of a common software framework to tackle the specific challenges of PET-MR imaging).

Our CCP started on the 1st of April 2015.

2. Main Activities during the Current Reporting Period

- **Growing of website content** and transition to a Drupal-based Content Managing System (CMS) for easier access and maintenance.
- **Creation of 2 additional mailing lists** for more targeted communication. We now have 3 JISCMAIL lists: a low-volume announcement list (68 subscribers), a user's list (55 subscribers) and a developer's list (9 subscribers, the list is not yet used).
- **Announcement of Researcher Exchange Programme.**
- **Progress on data formats**:
    - Contributions to specification and publication of ISMRM Raw Data Format for MR (https://github.com/ismrmrd/ismrmrd-paper).
      Converters for Siemens and Philips MR raw data to this format are now available (non-CCP effort). This will need additional work for supporting more data acquisition types etc.
    - Discussions with GE and Siemens on making their PET data formats more open and/or providing converters. A prototype implementation for Siemens PET data was constructed in STIR (http://stir.sourceforge.net).
- **Organised open discussion on the Software Framework** via 2 online editable documents, email list and meetings (see also next item).
  We have created a User Specification 4 page document (finalised on 21/9/2015) and are still working on a pseudo-code document that is intended to
    - get community input on what the software in the Framework needs to "look like" and what they want to achieve with the CCP software
    - agree on the MATLAB/Python interface to the software by distilling a "library" out of the pseudo-code
- **Four Software Framework design meetings** (7/6, 7/9, 6/10 and 20/11/2015) with attendance of around 20 people (minimum 16, maximum 24), of which ~1/5 attended remotely.
  These meetings have mostly consisted of discussions on the Software Framework design.

- **Creation of prototype implementations.** Most advanced is the PET implementation of a small subset of the Software Framework for PET in both MATLAB and Python (based on using STIR for the PET image reconstruction). We have experimental code for communicating with the Gadgetron (http://gadgetron.github.io/) for MR reconstruction.
- **Creation of Virtual Machine image** (using VirtualBox) with installation of STIR, data and exercises for PET and SPECT reconstruction. This VM is freely downloadable and was used at the Short Course on Image Reconstruction for PET/SPECT and CT at the IEEE Medical Imaging Conference, San Diego, USA.
- **STIR User's Meeting** 5/11/2015 at the IEEE Medical Imaging Conference, San Diego, USA (co-sponsored by the CCP PETMR and GE Research) with attendance of ~40 people.
  http://stir.sourceforge.net/MIC2015UsersMeeting/
  As the CCP-PETMR Software will initially rely on STIR for PET reconstruction, the STIR user's community and their contributions are very relevant to us.
  We have also advertised the CCP-PETMR at this meeting.
- **Satellite Workshop on Open Source Software for Image Reconstruction** 7/11/2015 at the IEEE Medical Imaging Conference, San Diego, USA (co-sponsored by the CCP PETMR and GE Research) with attendance of ~55 people.
  http://stir.sourceforge.net/MIC2015SatelliteWorkshop/
  This Workshop had 6 speakers representing 6 different Open Source projects for image reconstruction in PET, SPECT, CT and/or MR. The presentations were followed by a discussion on future collaborations and establishment of interfaces. There was no final consensus on how to achieve this but most groups showed willingness for future discussions.
  We have also advertised the CCP-PETMR at this meeting.
- **Working Group Meeting** 7/12/2015.

STFC effort over the first eight months (beginning of April - end of November) has been 4.97 man months (MM) (14MM per year funded, but can be carried over).

3. Workshops and New Opportunities

Precise dates are yet to be finalised. The preliminary schedule is as follows:

Software releases:

This is only an approximate schedule

- end January 2016: a first release for developers
- February 2016: first release of Virtual Machine for developers with pre-installed software
- Q2 2016: first release for users

UK workshops:

- Q1 2016: half-day workshop jointly organised with CCPi:
  Synergistic Reconstruction of Multi-modality and/or Multi-spectral data
- Q3 2016: 2-day workshop:
  Issues in PET-MR Reconstruction and Quantification
  (educative sessions, software training, research presentations)

Developers' Meetings:

In the current reporting period, we had ~6 weekly meetings to get the project started. We will probably decrease the frequency once an initial version is released, but this will depend on input from the community

- Jan 2016: framework update and first release preparation, git training
- Mar 2016: framework update and consolidation of user feedback on first release

International activities:

- Sep 2016: Pre-meeting Workshop on PET-MR Image Reconstruction at the British Chapter ISMRM meeting (Leeds).
- Nov 2016: STIR User's Meeting at IEEE Medical Imaging Conference (Strasbourg, France)
- Nov 2016: Satellite Workshop at IEEE Medical Imaging Conference, possibly in collaboration with the EU COST EXTREME project. (Strasbourg, France)
  Open Source Software in Medical Imaging

4. Issues and Problems

We found expectations of what this CCP can (or would like to) achieve were high. We will need to balance this with the available resources but are actively trying to collaborate with others.

The management of the web-site http://www.ccppetmr.ac.uk/ continued to create considerable delays in external communication (and a waste of STFC core support time). However, the website has now been transferred to a Drupal-based CMS which hopefully will alleviate some of these issues.

Assigned STFC staff have limited knowledge about PET and MR, but have some familiarity with X-ray CT. To alleviate this, Ron Fowler attended the PET-MR training school in Leeds in the previous period and Evgueni Ovtchinnikov is now spending occasional days at UCL. Another issue is that our WG has decided to target MATLAB and Python, where MATLAB is not an area of expertise for Ron and Evgueni. There were also some issues with availability of MATLAB licenses at STFC but this has now been resolved.

We have routinely provided WebEx video conferencing facilities but there have been on-going problems with audio quality and signal drop out. We are investigating alternative suppliers.