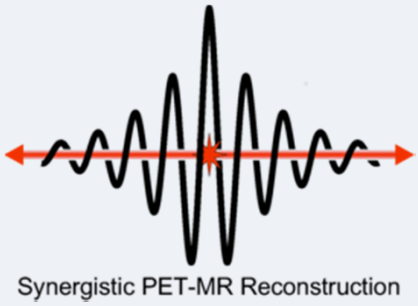
A Proposal for an Open Source Framework for Synergistic Image Reconstruction of PET-MR Data

E. Ovtchinnikov[1], D. Atkinson[2], R. Fowler[1], C. Kolbitsch[3], J. Matthews[4], C. Prieto[5], A. Reader[5], C. Tsoumpas[6], M. Turner[1], K. Thielemans[2]

1. STFC, 2. UCL, 3. PTB,4. Univ Manchester,5. KCL,6. Univ. Leeds

On behalf of CCP PETMR

http://www.ccppetmr.ac.uk



Software Aims

- ***Framework*** for 3D and 4D reconstruction of PET-MR data
- ***Python*** and ***MATLAB*** interface
- ***Simple enough*** for education and teaching
- ***Powerful enough*** for processing of real data in a research context
- ***Open Source*** Apache 2.0 License
- ***Easy installation*** via installation script, virtual machine, …

What is CCP PET-MR?

- ***Computational Collaborative Project for Synergistic PET-MR Reconstruction***
- UK Network (EPSRC funding 2015-2020)
- **… open for anyone**

Aims

- ***Network formation: bringing together expertise***
  - advancing understanding of PET-MR
  - enhancing understanding of the algorithms used for each modality
- ***Developing software infrastructure***
  - creating an Open Source software platform for integrated PET-MR image reconstruction
  - standardisation of data formats
  - database with test cases

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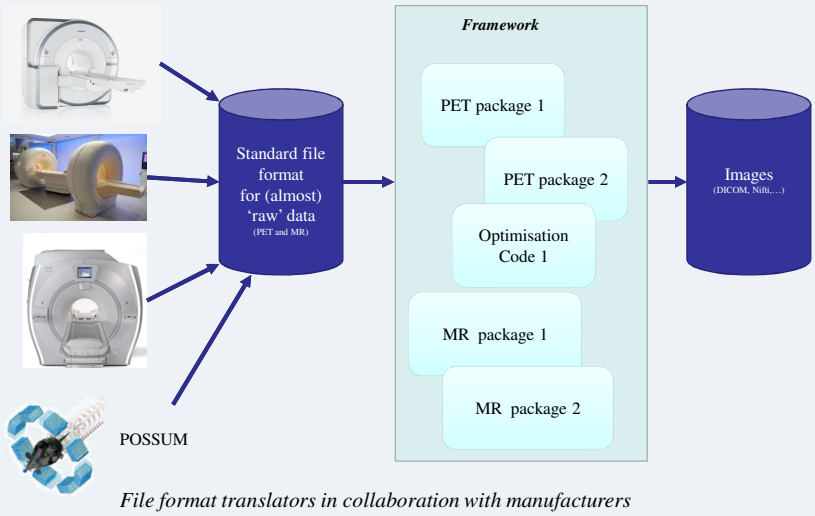
File formats and software from:
Siemens Healthineers and GE Healthcare

Software Architecture



File format translators in collaboration with manufacturers

- *ISMRM Raw data format: A proposed standard for MRI raw datasets Magnetic Resonance in Medicine* (2016) Inati et al DOI: 10.1002/mrm.26089
- *A proposed extension to Interfile for PET* Thielemans et al http://stir.sourceforge.net/links/petinterfile03.pdf

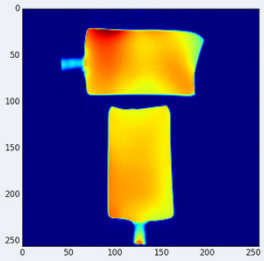
Current status

- ***Design documents***
  - Software Specification
  - initial User Specification (library and pseudo-code)
  - established via collaborative process
- ***Underlying packages***

- ***Basic MATLAB/Python interfaces***
  - prototype for independent PET and MR reconstruction
  - basic examples
- ***Scanner support***
  - Siemens mMR
  - GE Signa information received
- ***Software distribution***
  - Virtual Machine
  - source code via **https://github.com/CCPPETMR**

Example PET Reconstruction

```
# initialise reconstruction object
recon =OSMAPOSLReconstruction('settings.par')
obj = recon.get_objective_function()
prior = obj.get_prior()
prior.set_penalisation_factor(0.001)
# read an initial estimate
image =Image('my_image0.hv')
# run reconstruction
recon.set_up(image)
recon.proces(image)
# display reconstructed images
image = recon.get_output()
data = image.as_array()
figure()
imshow(data[20,:,:])
```



Example MR Reconstruction

```
# preprocess data
input_data = MR_Acquisitions(file)
prep_gadgets = ['NoiseAdjustGadget', 'AsymmetricEchoGadget',
'RemoveROOversamplingGadget']
acq_proc = AcquisitionsProcessor(prep_gadgets)
preprocessed_data = acq_proc.process(input_data)
# initialise reconstruction object
recon = MR_BasicGRAPPAReconstruction()
recon.set_input(preprocessed_data)
# run reconstruction
recon.process()
# display reconstructed images
images = MR_extract_real_images(recon.get_output())
data = images.image_as_array(i)
figure()
imshow(data[0,0,:,:])
```

Want to know more join at: http://www.ccppetmr.ac.uk/contacts.html

UCL · King's College London · The University of Manchester · Science & Technology Facilities Council · University of Leeds