23r^d Software Framework Meeting

15 February 2019, UCL

Attendees

- Local
    - Kris Thielemans (UCL)
    - Richard Brown (UCL)
    - Evgueni Ovtchinnikov (STFC)
    - Casper da Costa Luis (KCL)
    - Andrew Reader (KCL)
    - David Atkinson (UCL)
    - Alex Whitehead (UCL)
    - Ben Thomas (UCL)
    - Will Hallett (Invicro)
- Remote
    - Edoardo Pasca (STFC)
    - XXX (STFC, CCPi)   **Commented [KT1]:** Edo
    - Christoph Kolbitsch (PTB)
    - Gemma Poulter (STFC)
    - Jakob Jorgensen (Manchester)
    - Martin Turner (Manchester)
    - Nikos Efthimiou (Hull)
    - Claudia Prieto (KCL)

CIL – Edo

CIL does many things including: beam hardening, iterative reconstruction algorithms for CT in C++, segmentation and visualisation

Examples were shown for Norm2sq objective function for MR (Shepp-Logan):

1. gradient descent
2. FISTA ("smooth" objective function and "non-smooth" regulariser)
    a. With regulariser (FGP-TV)
    b. Without regulariser

Showed that convergence was quickest with regularised FISTA

Questions

- Question on "what is in the Shepp-Logan MR simulation" – **EO to include this info in a README in the repo**
- Could we use CIL algorithms with Poisson Loglikelihood? Answer: FISTA could implement unregularised (using the positivity constraint as a regulariser). Work-in-progress to implement primal-dual algorithm with multiple regularisers (e.g. one for positivity constraint, other for another regulariser)
- Is this going in a paper? Daniil submitted paper on CIL for regularisation to Fully3D. Suggestion to mention and illustrate in SIRF paper. **Jakob** to let us know what to do for referencing etc.

SIRFReg- Richard

Richard gave an overview of the new capabilities of SIRF since the SIRFReg branch has been merged into master. See the slides for more info.

Clarification on

- which registration capability is there? Answer: exposed all in NiftyReg: rigid, affine, B-splines non-rigid

- Can do resampling, with "chaining up" of different transformations

Some discussion on including other registration packages. This should be a lot easier now, but probably still sizeable amount of work to wrap another package. It will clearly depend on what that package provides, which file formats it supports etc. Interest in ITK etc but this is currently not planned by us due to available resources.

Discussion on forward and transpose transformations. Transpose is currently not available. It is probably buried in NiftyReg. UCL will dig into this and try to expose it, in collaboration with Jamie McClelland (UCL CMIC). Help very welcome!

GE SIGNA - Kris on behalf of Palak

- Histogrammed LM data in STIR (both LM-TOF-OSEM and TOF-OSEM)
- STIR and vendor reconstructions look similar
- Still need to take into account VQC offsets (1-2mm)
- Future work: ToF scatter and randoms correction

Next steps for synergistic reconstructions - Kris

- KT: alignment between PET and MR (esp. in Gantry coordinates) is still missing. In the meantime, you can register images to know transformation between different image sources
- DA: would be better to know geometry, but in meantime OK to register
- AR: Abi's algorithm can simply use resampling (after registration) as regulariser needs the prior image in the same space, but not more.
- KT: transpose resampler needed for joint optimisation
- KT: SIRF missing MR objective function, but for the moment can use from CIL.
- AR: Are we really interested in PET-MR synergistic reconstruction? KT: yes. Many algorithms of interest, e.g. for multi-modal MR. Dynamics are interesting - motion modelling required.
- AR: which algorithms should we have for synergy? KT: MAPEM, Matthias' alternating PLS, joint objective function (CIL?)

Anvil - Gemma

- what is it?
    - Continuous integration service, based on Jenkins
    - STFC-led (EPSRC funding)
    - Supported OS's are linux (scientific and ubuntu) and OSX
- Can we use Docker? Matlab? **Gemma to check**. Gemma asks if we need any Matlab toolboxes. KT says not for testing at present (we probably use the optimisation toolbox in one of the demos)

- Gemma/Edo mention a potential problem reporting for PRs from different forks. **Gemma to investigate**.

SIRF v2- Kris
- Plan to get v2 out before SIRF paper submitted in March
- Features not to be included yet:
    - non-TOF scatter (v2.1)
    - GE Signa (2.1)
    - Windows (2.1?). If no Windows, need to remove from SIRF paper
    - Using SWIG for creating Python/MATLAB interfaces (3.0?)
- Continue to improved C++ interface
- **KT/RB/EO need to update SIRF LongTermPlan** (e.g Geom info, common image objects done)
- For GE to ISMRMRD: GE are willing to help if anyone is interested in progressing with MR for GE. (Needs Orchestra)
- Extensive discussion about extra MR sequences to support in AcquisitionModel and how to do this:
    - CK and CP: Gadgetron maybe not so useful for this. Main Gadgetron functionality that we should use in this context is all the data preparation (sorting etc).
    - Other tools exist (e.g. BART). Should we use/incorporate them? DA mentions BART uses a lot of memory in his experience and had to be dropped. CP and CK suggest that we should implement simple forward models ourselves in SIRF ("not too hard"). Leave it to the researcher to add their own.
    - Which sequences? CP: Non-cartesian is research-based. 3D cartesian is more relevant. Conclusion: fully-sampled 3D cartesian is most important. Possible implementations from Johannes, Gadgetron, or KCL.

Future events
- PSMR course: depends on MR people. Gastau? Johannes & Camila?
- ISMRMR demo: still pending
- 24th SM. Where and when? Hull, 1st week of May? discuss SIRF and machine learning. **EO organise Doodle**
- Next hackathon:
    - o potential hackathon topic to implement recent paper's CNN inside of reconstruction iteration loop
    - o Summer? Leeds? (Involve MR team there)
- MIC course and workshop still under discussion

ACTIONS are listed in **bold**