

Report from CCPi for the Period 13 December 2013 to 12 May 2014

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<http://www.ccp.ac.uk/>

1. Background

The CCP in Tomographic Imaging is progressing and since the last 6-month report on 12 December 2013 it has built on current activities as well as acted upon the mid-term review findings. The CCPi prioritises the two areas of reconstruction and quantitative analysis. It aims to provide the UK tomography community with a toolbox of algorithms that increases the quality and level of information that can be extracted by computer tomography. Key next components are to increase usage, training and software deposits, as well as integration of iterative methods within the toolkits.

There has been a major change in the core staffing as David Worth has left the project very abruptly, and Srikanth Nagella and Ron Fowler have stepped in to cover this development and porting work.

2. Highlights for the Current Reporting Period

Core highlights within the CCPForge software repository: - *Iterative reconstruction*; development has included; 1. further optimisation of the iterative code for Diamond data sets; and 2. testing of a Matlab interface by HMXIF users that has resulted in the decision to create a version with a native Windows GUI. There is currently a beta testing process undergoing at HMXIF for their XTeK instrument. Next tasks are to tidy up and test the optimised Diamond version on an I13 data set with a reduced number of projections and compare to the back-projection GPU code; and extend the HMXIF interface based on user feedback, which may include support for other instruments.

Quantitative visualisation; Following on from open presentations and meetings, R. Fowler has now taken ownership of this CCPForge archive, and an initial survey of code/updates is ongoing including building, installing and testing. There are a few issues reported by the users regarding certain quantification algorithms not working on large volumes (over 1000³) and from this the code base has been reorganised. A new working relationship with Loic Courtois and Peter Lee (RCaH) has started initially focussing on a new Multi Peak Thresholding routine, as well as finding further challenges from the community.

From the flagship project, two pieces of software are now freely available via the CCP repository within the core work; 1. a novel compressed sensing technique based on non-local regularization that has been successfully applied to simulated and real (neutron) data and 2. a new method for combining multi-modal images, which can be useful for image fusion and also hybrid tomographic reconstruction, such as SPECT/CT, PET/MR etc.

Outreach and networking:

1. The ccpi youtube channel is now operational including five videos, one of them professional;
2. Exhibited at the Materials KTN Materials Research Exchange (24-25 February 2014, Ricoh Arena, Coventry >200 att).

Workshops / Training; We continue to support training courses from the network:

- Diamond Light Source, 15-16 Jan;
- Research Complex at Harwell, 27-28 Jan;
- Manchester X-ray Imaging Facility, 28-29 Jan;
- Diamond Manchester Collaboration, 8-9 Apr;
- STFC Rutherford Appleton Lab. 9 May (att 13).

We have held a new series of social meetings at RAL (coffee-and-tomography; with four sessions att 47). The first developers' workshop occurred in Birmingham in January (att 15) with follow on events now planned for 20 May and then late July.

We also held training course on Digital Volume Correlation in RAL, with Brian Bay from LaVision.

Flagship activities: Related to our CCPForge code, three papers submitted by Daniil Kazantsev;

Report from CCPi to the CCP Steering Panel

1. "A novel technique to incorporate structural prior information into multi-modal tomographic reconstruction" accepted to "inverse Problems",
2. "4D-CT reconstruction with unified spatial-temporal patch-based regularization" on second revision in "inverse Problems and Imaging" and
3. "Multimodal image reconstruction using supplementary structural information in total variation regularization" on second revision in "Sensing and Imaging"

Widening participation: There has been through the RCaH a visiting fellow, Brian Bay, from LaVision Inc., (December 2013 and March 2014 that included a training course and software presentation) and the CCPi fellowship scheme also assisted in promoting the Near-Infrared (NIRFAST) system within the UK (Hamid Dehghani, University of Birmingham).

From the EU involvement. Two short-term scientific missions (STSMs) with iMinds-VisionLab, University of Antwerp, Belgium were funded by COST to work on improvement of spatial-temporal resolution in dynamic applications within the regularization framework of iterative reconstruction algorithms. Geert Van Eindhoven was visiting scientist at Diamond RAL and RCaH for two weeks. D. Kazantsev will be visiting iMinds-Visionlab from 12 May till 23 May. This collaboration will potentially lead to joint publications.

CCP-ASEArch collaboration: Starting in April this work, by Evgueni Ovtchinnikov, involves numerical methods, to apply a multigrid solution to improve the issues caused by gradient based regularization coefficients in order to accelerate and stabilise convergence.

3. Workshops and New Opportunities

New opportunities: 1; A series of developers' community events are now planned (University of Birmingham, 20 May 2014 and Nottingham in July and will continue); 2. supporting the tomography user community with further joint training is ongoing including 7 days of training within the MXIF in June 2014. We will continue to support the European links including code sprints and workshops.

Networking and sustainability opportunities include stronger links with industrial and laboratory based resources. This includes;

1. supporting the next ToScA conference, September 2014 in National History Museum; and a presence at the Eurographics Eurovis conference in 9-13 June 2014;
2. increased presence within the TSB/KTN activities and; 3. links with a newly formed standards supporting panel (NPL/BSI cttee membership).

Nvidia support through SCD has been offered; future opportunity to consider NVidia assistance to look at and improve code bases. This opportunity is being explored during the developer' workshops.

Phil Trans A of the Royal Society: Theme Issue: X-ray Tomographic Reconstruction for Materials Science, has been proposed with favourable comments 'X-ray tomographic reconstruction for materials science is a topic of considerable activity and growing significance in many fields of science'.

From **quantitative visualisation** a preference from the community for which visualisation tool system is preferred; and a possible move away from Volview to say Avizo / Paraview.

4. Issues and Problems

There is a need to foster inter- and intra-networking between the two groups; the developers group and the user community. This requires improved communication across sites and involvement of remote participants. Increased levels of outreach as well as submitting proposal for increased resources; all are needed to gain a higher level of trust across the partners.

Recent progress in certain areas has been seriously hampered by the loss of the STFC staff member supporting the project.

The next CCPi working group meeting is to be held on 17 June 2014.