

Report from CCPi for the Period 8 January 2015 to 24 June 2015

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Background

The CCP in Tomographic Imaging is progressing and since the last 6-month report, on 8 January 2015, it has built on current activities to deliver new versions of the core codes; both reconstruction and quantitative analysis. The CCPi prioritises the two areas of reconstruction and quantitative analysis and is currently completing the task list from the original network grant proposal (28 August 2015). 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 components continue to be to increase components, usage, training and software deposits, as well as integration of new iterative methods within the toolkits.

The core team now includes Srikanth Nagella, Barry Searle, Ron Fowler and Evgueni Ovtchinnikov. Evgueni has been brought into the group to assist with CCPi and the follow-on networks; this creates the core 1.5 FTE. For the year until Spring 2015 Martin Turner has had an extra role in the secretariat position and, with Erica Yang, has been developing functionality in collaborating with the new IMAT tomographic beamline on the ISIS neutron spallation source. Erica Yang has been given an extension at 0.1 FTE over the following year to continue this role until Spring 2016.

Formal links are being built with the recently funded CCP PET/MR that employs similar iterative solutions for positron emission tomography (PET) solutions. This has initially involved joint developers' workshops and linking together Working Groups with plans for a shared secretariat role.

Highlights for the Current Reporting Period

Core highlights within the CCPForge software repository:-

- Reconstruction Core algorithms: optimisation work of the iterative code for Diamond data sets is complete and has been tested on a sequence of reduced projection data from I13. Results have been extended for full sequence as well as creating a Windows GUI for the lab based instruments, with licences created for release to the wider community via a ccpforge download.
- Quantitative visualisation algorithms: work in quantification and the new Avizo algorithms have been expended with contributions by Erwan Plougonven, extra code from Robert Bradley (MXIF) and a study on beam hardening code (Queen Mary). Case studies (EPSRC formal) are being planned and produced on quantification codes, beam hardening and the flagship activities.
- Flagship project software outcomes: Daniil Kazantsev reported that 4 papers have been published or in progress (including one in Inverse Problems in Imaging and one on CUDA acceleration) and a final set of code is being developed to compare algorithms for restricted angle reconstruction.
- A new data archive with community space has been setup on the zenodo website <https://zenodo.org/collection/user-ccpi?ln=en> This site includes test data sets from Sophia

Coban; simple model scans and touchtable presentation data sets for science analysis and for public outreach and dissemination.

- The coding work is now producing three different Frameworks for researchers, depending on imaging system used:
 1. Diamond framework Savu: progress has speeded up with the recruitment of Nicola Wadeson to assist Mark Basham and immediate future code will address speed including parallel performance as well as integrated ring artefact codes.
 2. ISIS IMAT framework: Srikanth Nagella built the initial testbed for rendering large data sets (2000^3) and a new setup will be operating in September 2015. The initial IMAT demonstrator has a project page at: <http://stfc.ac.uk/SCD/research/data/44593.aspx> and new publications are planned.
 3. Avizo framework (University of Manchester): a complete framework is being ported within the Avizo visualisation system with interfaces for reconstruction code, segmentation and the beam-hardening sensitivity functions.

Outreach and networking:

Key outcomes:

- Phil Trans Journal special issue with 11 articles was published in May specifically on CCPi activities that were based around reconstruction techniques: with a pull-up poster produced. <http://rsta.royalsocietypublishing.org/content/373/2043> Theme issue 'X-ray tomographic reconstruction for materials science' compiled and edited by Manuchehr Soleimani
- CCPi had a prime location at the Cheltenham Festival of Science in the "Dino zone"; Total public attendance was 12,100 and with schools there were 13,755 attending (plus two evening VIP sessions) over 1-7 June 2015. There were ten demonstrators created and presented (four videos and six 3D exploration models), on the CCPi touch-table, with a total of 699 active explorative viewings covering 2,052 mins (34.2 hours) of use.
- Workshops / Training; We continue to support training courses within the network, from minor software license management to full training provision: four courses occurred during this period - Mantid Training Courses (16-18 February 2015) with a component of tomography vis; Diamond and ISIS CDT doctoral training working shop (9-13 March 2015) with early imaging and visualisation; (16-17 April 2015) Diamond Manchester Collaboration, CCPi and HIP, the University of Manchester and Diamond Light Source training on the visualisation and quantification of tomographic data; and a University of Manchester Avizo training session (9 June 2015).
- The series of social meetings at RAL (coffee-and-tomography) has now hosted its 23rd monthly meeting (total attendance is at 318). There was also an extra Lunch and Learn seminar, on Friday 27 February, by Dr Martin Turner on "Visualisation Matters - the need to put the human back in the imaging-capture-and-computational loop". The first two video recorded seminars have now been viewed 66 times.
- Developer workshops occur each quarter considering a specific focus;
 1. An extended four day Avizo framework developers meeting was held at Manchester hosted by Ali Chirazi (17-20 February 2015).

2. Touchscreen day at Reading University with NHM (Natural History Museum) was very useful and formed a sub-group (IVG – Interactive Visualisation Group) to promote touch screens for outreach (24 March 2015).
 3. A Manchester Workshop focused on iterative solutions for the XTek machines (such as the released CGLS code) and planned the requirements to get them into regular usage in the labs that use these machines (28 April 2015).
- Fellowships: Manuch Solemani has have some time to edit the Royal Society Phil Trans A special edition that is now published; Brian Bay, from LaVision Inc., continued his tour in the UK; the scheme will assist the Drishti volume visualiser author Ajay Limaye, visit in September 2015; two members from the University of Bordeaux, Erwan Plougonven (Dec 2014) and Dominique Bernard (February 2015), visited the UK to exchange experiences on source code integration for quantification visualisation; and Nicola Wadeson updated work for source code to make the Rapiscan RTT x-ray CT Machine usable as an experimental system (Feb-May 2015). Also Daniil Kazantsev has agreed to extend his fellowship until the end of August 2015.
 - EU involvement: There has been exchanges with the EU e-COST programme (EXTREME) with collaborating through workshops and conferences (links through Bill Lionheart, Mark Basham and Daniil Kazantsev). Formal meetings have occurred at the Applied Inverse Problems 2015 conference.

CCP Cross-collaborations:

CCP-ASEArch collaboration: Starting in April 2014 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 is complete with a a publication submitted (collaboration with Daniil Kazantsev - CCPi Flagship Fellow).

The SLA EPSRC funded survey: the results for CCP visualisation user needs has been analysed to consider the long tail of products that the global community uses (>100 responses) and focus our CCPi core development effort on certain products. Launched on 2 February 2015:

http://www.vizmatters.cs.manchester.ac.uk/index.php/Main_Page

Cross-funded links with the HIP (Harwell Imaging Partnership) have provided momentum for the visualisation facilities within the new ICAL (Interdisciplinary Centre for Ancient Life) with the Manchester Museum.

Industrial Projects:

- The TSB (UK Innovate) project (code 37972-241197) for Towards Zero Prototyping programme. Titled 'In silico evaluation of manufacturing concepts for non-Newtonian products' is a collaborates with Prof Rob Prosser (University of Manchester), Drs Charles Moulinec and Rob Allan (STFC/SCD), Prof Adam Kowalski (Unilever) and CDDMtec aim to integrate computer CFD simulation, with tomographic 3D image capture; that will add the human-in-the-loop with EIT (Electrical Impedance Tomography).
- New discussions have occurred with the Avizo developers (FEI) to see about integration of code within their system. Next workshop is planned for September 2015.

Workshops and New Opportunities

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

- September 2015 Our third annual co-sponsored symposium on tomography (ToScA) will hopefully attract even more attendees than the 100 last year. Besides numerous academic sessions our involvement will include further CCPi activities including two fellowships for software developers' to attend (ToScA 2015 will be in Manchester and 2016 will be in Bath). Partnership status has been applied for and advertisement including leaflets and a stand are being prepared including links with the CCP PET/MR. We will be sponsoring student travel grants.
- July 8-11, 2015 Harwell Open Days including Tomography vis tools from CCPi and CCP PET/MR will be demonstrated over the days at the Atlas Visualisation Facility
- 30 June-1 July 2015 EMIIT held at University of Manchester: the EMIIT (EMerging Technology) conference series brings together experts from all areas of computing to examine how to best take advantage of the changing landscape of computer hardware that includes GUI based touchable interactions that CCPi will be presenting. <http://emit.manchester.ac.uk/>
- Open session for analysis of CLF Vulcan data from recent imaging capture industrial exploitation days is planned for June/July 2015
- Continual links with the tomography standards panel (NPL/BSI cttee membership).
- Training and developer's days are to continue as normal but other items also under consideration:
- The next "away-day" developers' day is proposed to be at the Warwick University Manufacturing group: and future software show-and-tell events will be based on the three Frameworks.
- NVidia support through SCD has been offered and will be exploited in a forthcoming the developer' workshops.
- A touchable volume visualisation content discussion mini workshop is planned to coincide with the ToScA event .
- A ParaView training day and software show-and-tell Kitware Inc (Marcus Hanwell) when author of TomView visits in September 2015

The CCPi is in constant negotiations with a new CCP (MR/PET) and both proposals been successful for future funding in the next round of EPSRC networks.

Issues and Problems

There is a still need to foster inter- and intra-networking between the two groups; the developers group and the user community. We have increased levels of outreach but more project and research proposals need to be submitted.

- Applications for 'good' new Fellowships and exchange visits are difficult to attract.
- CCP website consistency could be improved across CCPs and further advertisement.
- Inner-core level SLA support for follow-on phase needs clarification.
- Software licences are an issue including the Avizo Harwell Campus site license that expires in 2016.

The next CCPi Working Group meeting is planned to be held in December 2015; with a mini-session planned during the change of phase around August 28 2015.