Supporting documents

Testimonies

1. Dr Jean Michel Létang, INSA de Lyon (France) (Page 2);
2. Dr Amin Garbout, the University of Manchester (Page 3);
3. Dr Llion Evans, Swansea Univeristy (Pages 4 & 5);
4. Dr Franck Vidal & Prof Simon Middleburg, Bangor University (Pages 6 & 7).

Email

Invitation from Dr Edo Pasca, STFC, to give a talk to CCPi members (Page 8).

Agenda

CCPi Working Group Meeting agenda (Pages 9 to 12).

Award

Best poster certificate, dXCT 2022 (Page 13).

Lyon (France), the 12th of July 2023

Lyon (France), the 12th of July 2023

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UNIVERSITÉ JEAN MONNET
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DE LYON

Testimonial for Iwan Mitchell:
Application for CoSeC Impact Award 2023
by Jean Michel Létang

I hereby submit my testimonial and wholehearted recommendation of Iwan Mitchell for his application for the CoSeC Impact Award 2023. Iwan is currently undertaking a PhD under the guidance of Dr Frank P. Vidal at Bangor University. Thanks to a successful application for a visiting grant, Iwan joined our research group for a month. His objective during his tenure was to contribute to the development of a *digital shadow* of our state-of-the-art dual high-energy CBCT (cone-beam computed tomography).

The integration of our tomographic setup's *digital shadow* into our engineering course focused on Non-Destructive Testing (NDT) using x-ray radiation is of great importance. It opens up the possibility of incorporating a feedback loop with mechanical CAD design and modeling of industrial components. This also has a significant societal value as it enables students to learn and gain hands-on experience with imaging devices that are typically too costly to obtain. There is also an economic interest in this development: it allows for feasibility tests to be conducted before data acquisition, facilitating optimization of device settings such as amperage, voltage, filtration, and geometry. The *digital shadow* is highly valuable in comprehending and minimizing imaging artifacts that occur in actual acquisition images. Consequently, it saves both acquisition time and the amount of unusable data, ultimately resulting in cost savings.

The advancements Iwan is working on are applicable and versatile, benefiting any tomographic platform. Iwan has remarkable abilities and proved to be a very efficient and motivated computer science researcher.

Sincerely yours,

JEAN MICHEL LÉTANG
Senior Associate Professor
jean.letang@creatis.insa-lyon.fr

The University of Manchester,
Henry Moseley X-ray Imaging Facility (HMXIF),
Photon Science Institute,
Alan Turing Building,
The University of Manchester,
Manchester
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Email: amin.garbout@manchester.ac.uk

For the attention of the CoSeC Impact award committee

My name is Amin Garbout and work as Senior Experimental officer at the Henry Moseley X-Ray imaging Facility at the University of Manchester, which is part of the National X-ray CT facility. I am supporting researchers and industry to use X-ray CT.

Having a digital twin created for some of our X-ray CT instrument on WebCT will offer the possibility to assess the feasibility of scans and projects before doing the real scan saving staff and instrument time.

Our facility has the objective to train students and researcher to use X-ray CT equipment, WebCT will be a very valuable add on to our training program: it will permit users to familiarise to CT system without the risk of damaging very expensive instruments. For example, detectors can be damaged by users crashing samples into them or saturating them, with detectors costing over £50000 each.

Best regards

Amin Garbout
PhD

Re. CoSeC Impact Award 2023

To whom it may concern,

I would like to express my full support for Mr Iwan Mitchell's application to for the CoSeC Impact Award 2023. I am an EPSRC Manufacturing Research Fellow (EP/R012091/1) at the Zienkiewicz Institute, Swansea University; Director of the Centre of Excellence in Advanced Data Driven Engineering Design (ADDED); and a CoI on the CCPi Tomographic Imaging grant (EP/T026677/1). Furthermore, I launched the "Image-Based Simulation for Industry" (IBSim-4i) annual event series in 2018, to which Iwan has been a significant contributor in recent years and has made significant impact.

During his PhD at Bangor University, Iwan has been working on various implementations and adding capabilities to the gVXR open-source code to perform realistic simulations of industrial X-ray images. Part of this activity has been to connect gVXR to the 'Core Image Library' (CIL) which is developed by the RSE team at STFC and supported by CCPi and CoSeC. That is, through Iwan's work, it is now possible to simulate radiographs with gVXR and reconstruct these into an XCT volume with CIL through a fully open-source workflow. This was then used during the 2-day training course given at the 2022 IBSim-4i event at the Institute of Physics, where Iwan prepared and delivered training material in collaboration with the CIL RSE team. Furthermore, he has developed a web frontend (WebCT) to facilitate access to these two softwares. This is particularly beneficial to those without significant coding knowledge and experience with UNIX, as it is possible to have a web installation running and provide access to anyone anywhere in the world.

The potential benefits of this are numerous. For example, it is possible to perform initial training of new XCT users virtually without needing to consider the safety aspects of working with ionising radiation and also saving on valuable beamtime. An extension of this, is being able to explore various scanning parameters to optimise the imaging process before arriving on site (either at a synchrotron beamline or at a lab based XCT scanner). This allows the user to search for the preferred scanning parameters (e.g., which energies, filters, number of projections etc.) whilst considering the impact on scan time and image quality. The potential time and thus cost saving is significant.

Finally, we are working with Iwan to develop a XCT demonstrator (which uses simulated X-rays) that can be used both for training and STEM outreach events. Again, successful realisation of this activity is expected to have a tangible impact and will be invaluable to the XCT community.

I am confident that Iwan would be a fully deserving recipient of the CoSeC Impact Award 2023 and fully support his application. Please do not hesitate to contact me for further details.

Kind regards,

Llion Evans

Dr Llion Marc Evans
EPSRC Manufacturing Research Fellow
Director of the Centre of Excellence in Advanced Data-Driven Engineering Design (ADDED)
Exec Member of the Collaborative Computational Project in Tomographic Imaging (CCPi)
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U N I V E R S I T Y

To whom it may concern,

19th July 2023

Mr Iwan Mitchell has our full support for his application to the CoSeC Impact Award 2023. We are his PhD supervisors at Bangor University's School of Computer Science & Electronic Engineering. Iwan's research is focused on X-ray Computed Tomography (XCT) and Machine Learning for the energy sector. His research is funded by the UKRI CDT in Artificial Intelligence, Machine Learning and Advanced Computing (AIMLAC). Iwan's work heavily rely on

1. gVirtualXray (gVXR): fast X-ray simulation to generate a large amount of image data,

2. Core Imaging Library (CIL): CT reconstruction from the simulated images. CIL is developed at STFC and is supported by CCPi and CoSeC.

3. Experimental data: beamtime has been awarded at both the Diamond Light Source (synchrotron facility) and the UK's National Research Facility for lab-based X-ray Computed Tomography (NXCT). Surrogate nuclear fuel pellets were scanned.

4. Digital twins: Additional data was acquired to build digital twins of the scanning devices (both synchrotron and NXCT's lab XCT). Iwan is currently in France visiting INSA-Lyon working with Prof. Buffière (leading expert in the characterisation of fatigue cracks in metallic objects using XCT) and Dr. Létang (extensive experience in NDT by ionising radiation as well as in physically-based simulation of X-ray imaging). Iwan Mitchell is conducting experiments to finely model INSA-Lyon's new state-of-the-art device, the Dual Tube High Energy (DTHE) X-Ray System by RX Solutions.

5. Machine learning: Using experimental data to build digital twins in gVXR allows Iwan to generate a fast amount of extremely realistic data. It is reconstructed in CIL and used to train a machine learning algorithm detect defects in XCT volumes of fuel pellets.

We are working at the Nuclear Futures Institute on the design and production of safe and high efficiency fuel for the next generation of reactor systems. Iwan demonstrated the feasibility and usefulness of non-destructive testing using synchrotron CT to assess surrogate nuclear fuel pellets: Defects such as cracks, inhomogeneities and porosities were clearly visible on the images. He was able to show that one of the tested pellets was highly defective, with no identifiable kernels. These results are extremely important as the cracks highlight the manufacturing method requires finessing. His results point towards useful observations to optimise the kernel-matrix composites for nuclear fuel manufacture.

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An open-source Web front-end (WebCT, `https://github.com/WebxCT/WebCT`) is available so that the XCT community can benefit from his work. With a Web-browser, i.e. without a single line of code to write, users can upload their own CAD models and simulate XCT scans using realistic experimental conditions.It can be used to tweak scanning parameters, e.g. to minimise artefacts and maximise the image quality, or just to evaluate the feasibility of a scan on a specific device.

Some of his research has been published in the special issue of *Precision Engineering* (ISSN: 1873-2372) on the *Developments in X-ray computed tomography for precision engineering* and presented at Image-Based Simulation for Industry (IBSim-4i) in 2022 and Dimensional X-ray Computed Tomography Conference (dXCT) 2022. we won the best poster contribution at dXCT for our work on *WebCT: Fully Featured Browser-Based Interactive X-Ray Simulations for Scan Planning and Training.* Iwan also helped in the preparation and delivery of a 2-day training event focus on X-ray simulation using gVXR (Day 1) and CT reconstruction (Day 2). The data simulated during Day 1 corresponded to examples that were used during Day 2 by CIL's team. The training was delivered during IBSim-4i 2022 at the Institute of Physics. It was oversubscribed. It was run in close collaboration with STFC's team who is developing CIL.

As a summary, Iwan's contribution is useful in several ways and to several communities, from nuclear energy, machine learning, simulation, XCT, to material science as well as education in NDT. He has worked in close collaboration with STFC's team developing CIL on several occasions. His research is hitting on both a fundamental excellence level, as well as making waves with industrial impact.

Cordialement,

Dr. Franck P. Vidal   Prof. Simon Middleburgh
Reader   FIMMM MInstP
Director of Research   Co-director of the Nuclear Futures Institute
School of Computer Science & Electronic Engineering
f.vidal@bangor.ac.uk   s.middleburgh@bangor.ac.uk

WebCT and CCPi

Edoardo Pasca - STFC UKRI <edoardo.pasca@stfc.ac.uk>
Fri 11/11/2022 19:40
To:Franck Vidal (Staff) <f.vidal@bangor.ac.uk>;Iwan Mitchell <i.t.mitchell@bangor.ac.uk>;Martin Turner <martin.turner@manchester.ac.uk>

Dear Franck, Iwan and Martin,

I think it'd be great if Franck/Iwan could present WebCT at the upcoming CCPi Working Group meeting.

I think it would also be good for CCPi to sponsor it somehow. What do you think?

Edo

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Training Training Events Events Community Community ˅

Working Group Meeting (Hybrid)

Home » Working Group Meeting (Hybrid)

📅 December 9, 2022

🕐 9:00 am

🕐 11:30 am

🔗 **Eventbrite - please register**

Working Group Meeting (Hybrid)

CCPi holds working group meetings twice a year. Here, we meet to review current progress and future plans for the CCP. Everyone is welcome to join, to learn about what's going on in CCPi or to contribute their ideas or requirements for future work.

Agenda: 9am-10:30am

- Approval of CCPi Working Group and Exec Meeting minutes (20 Jul 2022).

- Facility Engagement: **Edo Pasca / Jay Warnett**
- Workflows and Industrial Links: **Llion Evans**

- **ACTION** approval for Core Staff activities:
  - Software development – including how to contribute and licensing process
  - Networking activities – conference and workshops for 2023 and beyond

- **ACTION** request for funds and support:
  - Letter of Support for **Thomas Blumensath**'s ML/DL code integration to CIL for Iterative Reconstruction (UKRI EPSRC proposal Jan 2023)
  - **Bill Lionheart**: Finance open for speakers and attendance at special CCPi-INI pre-week session 8-12 May 2023
  - **Matthias Ehrhardt** and **Paul Quinn** application for PhD Scholarships from Ada Lovelace Centre due 9 Dec 2022
  - **Charlotte Hagen and Darren Batey** application for PhD Scholarships from Ada Lovelace Centre due 9 Dec 2022
  - **Alice Macente** (Leeds): Travel required to Vienna for: https://www.egu.eu/ , 23-28 April 2023, and the title of the oral contribution is "The Evolution of Paleo-Porosity in Basalts: Reversing Pore-Filling Mechanisms Using X-Ray Computed Tomography" based on my recent paper in Transport of Porous Media (https://doi.org/10.1007/s11242-022-01869-2)
  - **Rehman, Sumera** Request travel costs to Hercules European school – neutrons and synchrotron radiation for science
  - **Franck Vidal** EPSRC grant for a new XCT facility focused on material types

- **ANNOUNCEMENT** Items from WG members:

HomeHome News News Reports Reports Software Software ⌄

Training Training Events Events Community Community ⌄

Invited Seminar: 10:30am-11am

10:30am Talk "WebCT — Fully Featured Browser-Based Interactive X-Ray Simulations for Scan Planning & Training: Application to fuel pellet scanning."
Iwan Mitchell and Franck Vidal

Links
– WebCT: https://webct.io
– gVirtualXRay: https://gvirtualxray.sourceforge.io

Participation

The meeting will be hybrid.

All visitors to the site need to contact Edo Pasca to be signed in.

At the Rutherford Appleton Laboratory there will be limited capacity (up to 15) in the **meeting room CR22 – RL, R1.**

and online participation at the following **link**

Meeting ID: 970 6058 8004   **Passcode:** 949227

https://zoom.us/j/97060588004

Dial in: +44 (0) 2080806592   +44 (0) 3300885830

See all events

. CCPi acknowledges previous funding support by the EPSRC grants **EP/J010456/1** and **EP/M022498/1**.

The CCPi Flagship "A Reconstruction Toolkit for Multichannel CT" was funded by the EPSRC grant **EP/P02226X/1**.
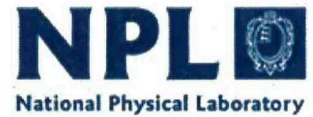
δXCT

NPL
National Physical Laboratory

Winner

Best Non-commercial Poster

Iwan Mitchell

**First prize sponsored by
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δXCT virtual conference
13th – 16th June 2022