

NICK CALVERT

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EDUCATION

University College London, UK

October 2011 - September 2015

PhD, Radiation Physics, Title: *Time-of-Flight X-ray Compton Scatter Imaging*

Award date: July 2016

Supervisors: Prof. R.D. Speller & Dr. M.M. Betcke

Brief abstract: A new x-ray imaging modality was introduced, using time resolved x-ray scatter measurements to reconstruct the position of scatter and therefore a three dimensional image of the object under inspection. Monte Carlo simulations in C++ were performed to test the feasibility of the method and design the required detectors. Two laboratory-based experimental runs were performed and preliminary experimental measurements were also performed using a conventional, commercially available, Linear Accelerator. An analytic forward model was derived based on the Radiative Transfer Equation. The corresponding inverse problem of image reconstruction was solved using a number of nonlinear solvers (Gauss-Newton, Levenberg-Marquardt, and ADMM) in MATLAB. This work was sponsored by Rapiscan Systems, Ltd. During my PhD I collaborated on side-projects with AWE and LightPoint Medical focused on different imaging techniques.

University College London, UK

September 2011 - September 2012

MRes, Security Science, Title: *Feasibility Study of Time-of-Flight X-ray Compton Scatter Imaging*

University of Manchester, UK

September 2005 - September 2009

MMath, Mathematics, Dissertation Title: *Gamma Tomography Reconstruction*

Supervisors: Prof. W.R.B. Lionheart

WORK EXPERIENCE

Nuclear Medicine Group Christie NHS Foundation Trust, Manchester, UK. *March 2017 - December 2019*

Senior Research Scientist Molecular Radiotherapy.

I worked on the EMPIR funded MRTDosimetry project, in collaboration with a number of European hospitals and metrology institutes, as well undertook in-house research at the Christie. I designed 3D printed phantoms that were used as standard SPECT imaging and Molecular Radiotherapy test objects for a number of European Hospitals. I performed data analysis of SPECT images using both MATLAB and Python and optimised the commercially available image reconstruction and partial volume correction algorithms that we used, and performed DICOM header manipulation in Python. I also supervised MPhys students, summer students, and work experience placements.

Rapiscan Systems Ltd, Cargo Division, Stoke on Trent, UK. *October 2009 - September 2011 & October 2015 - March 2017*

Scientist Engineer.

I worked on transmission X-Ray and Gamma-Neutron detection systems for Cargo and Vehicle inspection, writing Monte Carlo simulations in C++ for many applications. I also wrote algorithms in MATLAB to classify materials in X-Ray transmission images and tested & commissioned of low- and high-energy systems in the UK and abroad. I Developed a digital pulse processing algorithm for x-ray detectors to improve materials classification in low-energy x-ray screening systems. My final role at the company, was part of a team that built a prototype next generation metal detector based on electromagnetic induction, providing location and metallic properties of hidden objects. Responsibilities included implementing the inversion algorithm, based on a Levenberg Marquardt method, prototype development, and object classification based on k-nearest neighbours.

CONFERENCE & WORKSHOP PRESENTATIONS

Invited Talks:

- Workshop on Applications of 3D printing for medical phantoms 2017, London.
- EANM 2019 Congress, Barcelona, Spain.

Proffered Talks:

- EANM 2018 Congress, Dusseldorf, Germany.
- IPEM Quantitative SPECT 2018, Newcastle, UK.
- MRTDosimetry Workshops: Prague 2018, London 2019.
- The 13th International Meeting on Fully Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine 2015, Newport, USA.
- SPIE Defence, Security, and Sensing 2015, Baltimore, USA.
- IEEE Nuclear Science Symposium 2013, Seoul, South Korea.

PUBLICATIONS

- N. Calvert, D.S. Tuch, S. R. Arridge, and D. Stoyanov. A Simulation Study of Spectral Cerenkov Luminescence Imaging Tumor Margin Estimation. In Proc. SPIE Medical Imaging, 2017.
- N. Calvert, M.M. Betcke, E.J. Morton, and R.D. Speller. Reconstruction of Electron Density from Time Resolved In-Plane Compton Backscatter Measurements. In The 13th International Meeting on Fully Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine, 13:705-710, 2015.
- N. Calvert, et al. The Use Of Short and Wide X-ray Pulses for Time-of-Flight X-ray Compton Scatter Imaging in Cargo Security. In Proc. SPIE 9456, Sensors, and Command, Control, Communication, and Intelligence Technologies for Homeland Security, Defence, and Law Enforcement XIV, 2015.
- N. Calvert, et al. Feasibility Study of Time-of-Flight Compton Scatter Imaging Using Picosecond Length X-ray Pulses. IEEE Trans. Nucl. Sci, 61(6):3701-3710, 2014.
- N. Calvert, E.J. Morton, and R.D. Speller. Preliminary Monte Carlo Simulations of Linear Accelerators in Time-of-Flight Compton Scatter Imaging for Cargo Security. Crime Science, 2(1):1-12, 2013.

SKILLS

- Team working in small teams, including working with team members in a different country, and collaborations with members of different universities and hospitals.
- Algorithm development in MATLAB, Python (NumPy, SciPy, Pandas, scikit-learn, fast.ai), and Julia for a range of Applied Mathematics and Physics applications.
- Monte Carlo modelling using GEANT4, a toolbox implemented in C++. I organised a GEANT4 workshop at Rapiscan Systems Stoke-on-Trent for their Physics group.