Pádraig Ó Conbhuí

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Experience

University Of Edinburgh — Edinburgh, Scotland

PhD Student — *2013 - Present*

Investigated numerical techniques for understanding how rocks record changes in the earth's magnetic field. This was done primarily through the lens of micromagnetic modelling.

- Developed a meshing program, MEshRRILL, using the CGAL library to generate tetrahedralized geometries of interest to us. This included simple polyhedra like cubes and truncated octahedra, but also realistic grain geometries reconstructed from FIB slice and view data. Meshes and surface reconstructions generated by this software have been used in publications.
- Developed software to produce simulated electron holography data from our micromagnetic models. This allowed us to directly compare experimental and simulation data for a given magnetic grain. This was wrapped up as a ParaView plugin and has been optimized to produce holography results in near real-time. Data generated by this software has been used in publications.
- Developed a computational technique for including magnetostrictive effects in micromagnetic models with free boundaries. The differential equations described by the problem are solved using the Finite Element Method, using the FEniCS environment to transform the equations into a matrix problem, and PETSc or Eigen to solve them. This was included in our group's serial micromagnetics code, MERRILL, and is compatible with our parallel code, DUNLOP.
- Developed workflows for compiling and distributing software so it could be reliably distributed as a standalone folder. This included static versions of programs like MERRILL, but also a shared version of MEshRRILL with dependencies installed in a subfolder, so it could easily be used as a C++ library to define complex geometries. The holography software was also compiled to work out of the box with a given ParaView binary downloaded from their website.

Dublin Web Summit Limited — Dublin, Ireland

Technical Analyst — *Summer 2012*

Evaluated new technologies for use in projects. Built and maintained applications for internal and external use. Analyzed and modified applications to handle higher user loads as necessary.

- Developed browser based app leveraging Facebook's JavaScript API and FBQL to find users attending a Facebook event and list them in order of mutual friends with the current user, displaying those mutual friends, and showing which of them were also attending the event. This was tested against an event of about 3000 attendees and loaded results in several seconds.
- Analyzed ticketing system used for event, identified features causing the system to slow to an unacceptable pace when the user base grew large enough and presented solutions.
- Implemented caching and distribution of content through a CDN for the main site when hosting servers began straining under high traffic.
- Researched and made recommendations on IaaS platforms, deployments in cloud environments and NoSQL database systems for use with apps being built in house.

LULI, Ecole Polytechnique — Palaiseau, France

Intern — *Summer 2011*

Investigated alignment errors found in experiments which used an ellipsoidal plasma mirror (EPM).

- Developed numerical model of an experimental setup testing an EPM using the Zemax optics software.
- Set up an equivalent physical model of the experimental setup using a Helium-Neon laser in a lab.
- Investigated alignment errors numerically due to geometric effects using ray tracing models, and compared them to diffractive errors by using wave front propagation models.
- Investigated alignment errors physically by playing with the lab setup.

Software Development

My preferred language is C++, and my preferred application domain is anything I haven't done yet. Ideally, something that's never been done. I have a great interest in high performance programming and computational physics. I like to keep up to date with popular programming techniques and paradigms whenever possible.

The technologies listed here are ones I would be happy to claim some expertise in.

Projects:
github.com/poconbhui
bitbucket.org/poconbhui

Technologies used:
Bash, C, C++, Fortran 90, Python, MPI, OpenMP, Cuda C, UPC, Coarray Fortran,
SWIG, FEniCS, CGAL, VTK, ParaView, Mathematica, MATLAB, Zemax, Gnuplot, LaTeX,
PulseAudio, GStreamer, SBC, Bluetooth,
HTML/CSS, JavaScript, PHP, Ruby, Ruby On Rails, Node.js, jQuery,
SQL, CouchDB, MongoDB, Redis, Neo4j

Education & Training

University Of Edinburgh — Edinburgh, Scotland

MSc, High Performance Computing — *2012 to 2013*
Grade: MSc With Distinction

The course centred around building high performance applications, primarily through parallelisation, and through deep understanding of the underlying architecture of a given system and language.

Subjects: Message Passing Programming, Threaded Programming, Parallel Numerical Algorithms, Parallel Programming Languages, HPC Architectures, HPC Ecosystems, Performance Programming, Software Development, Advanced Parallel Programming, Parallel Design Patterns.

Trinity College, Dublin — Dublin, Ireland

BA Mod, Theoretical Physics — *2008 to 2012*
Grade: 2.1

The course taught problem solving and analytical thinking, providing tools necessary to break down and understand complex problems, primarily in the fields of Mathematics and Physics. A joint effort by both the School of Maths and the School of Physics, this course offered training as both a mathematician and a physicist. This training aimed primarily towards understanding condensed matter physics from the physics side, and quantum field theory and general relativity from the maths side. I completed a dissertation in the final year on performing particle physics calculations on GPUs using CUDA C.

Subjects: Computer Simulation, GPU Programming, Classical Mechanics, Quantum Mechanics, Classical Field Theory, Quantum Field Theory, Special Relativity, General Relativity, Classical Statistical Mechanics, Quantum Statistical Mechanics, Condensed Matter Physics, Spectroscopy, Optics, Electromagnetism, Thermodynamics, Electronics, Chaos and Complexity, Linear Algebra, Analysis, Topology.

Awards

- Winner Castle Meeting 2016 Outstanding Participation.
- Creer Fund recipient 2016.
- Winner Geosciences PGR Conference 2013 Best Presentation.
- Included on TCD Dean of Students' Roll of Honour 2011.
- Three TCD book prizes for achieving 1st class honors grade in years 1-3.
- Awarded an Entrance Exhibition to Trinity College Dublin based on outstanding achievement in Leaving Certificate examination.
- Received full college scholarship "Scoláireacht Neamhteoranta" for outstanding results in Irish language exams in the Leaving Certificate.
- Won battle of the bands, Coláiste Eoin, 2008 as singer and bassist of heavy metal band Capulus.
  (Demo available upon request)

Published

Almeida, T. P., Muxworthy, A. R., Kovács, A., Williams, W., Nagy, L., Conbhuí, P. Ó., ... & DuninBorkowski, R. E. (2016). Direct observation of the thermal demagnetization of magnetic vortex structures in nonideal magnetite recorders. Geophysical Research Letters, 43(16), 8426-8434.

Einsle, J. F., Harrison, R. J., Kasama, T., Conbhuí, P. Ó., Fabian, K., Williams, W., ... & Midgley, P. A. (2016). Multi-scale three-dimensional characterization of iron particles in dusty olivine: Implications for paleomagnetism of chondritic meteorites. American Mineralogist, 101(9), 2070-2084.

Einsle, J. F., Fu, R. R., Weiss, B. P., Kasama, T., Fabian, K., Conbhuí, P. Ó., ... & Harrison, R. J. (2015). Focused Ion Beam Nanotomography of Chondritic Meteorites: Closing the Mesoscale Length Gap in Paleomagnetic Studies. Microscopy and Microanalysis, 21(S3), 2261-2262.

Under Review

Non-Uniformly Magnetized Particles Shown to Retain Billion-Year Paleomagnetic Recordings
: Results from MERRILL's action minimization showing PSD grains are much more stable than previously thought.

In Preparation

MERRILL: Micromagnetic Earth Related Robust Interpreted Language Laboratory
: An overview of the MERRILL program and a brief tutorial on its uses.

DUNLOP: Distributed μmagnetic Numerical Lem OPtimizer
: An introduction to the highly parallel C++/Python code we've used In Edinburgh for micromagnetic modelling of huge grains.

The Effect of Magnetosriction on Magnetic Remanence in TM60
: An overview of how magnetostriction effects TM60 for a number of boundary conditions and stresses.

HoloMag: Electron Holography Simulation with Reference Magnetic Structures
: An introduction to the HoloMag software and some examples of simulated remanent states, e.g. uniform, vortex, flower, for a number of geometries, e.g. sphere, cube, octahedron, and the electron holograms they produce at various angles. In addition, a general guide to interpreting electron holograms and potential pitfalls.

Theoretical Blocking Temperatures of Iron Spheres with Non-Uniform Remanence States
: Results from MERRILL's action minimization showing the relationship for blocking temperature vs. size in iron spheres.

Evolution of Domain Structures in Magnetite from Single Domain to Multi Domain
: Results on size hysteresis simulations using DUNLOP from small SD grains up to large proto-MD grains.

Collaborations

I enjoy collaborating with others with skills very different to my own. Particularly when I can build or provide tools or knowledge that can make their work easier or more accurate. The collaborators here are friends or groups with a number of friends that I've had the pleasure of meeting at various conferences, and I enjoy working with towards shared goals.

Wyn Williams, Karl Fabian
: Got insight into magnetostriction and modelling. Helped with building and maintaining MERRILL software.

NanoPaleoMagnetism (Cambridge)
: Got FIB nanotomography data. Built software for reconstructing surfaces from coarse FIB nanotomography images. Provided consultation on running models in MERRILL. Provided scripts for data interpolation.

Natural Magnetism Group (Imperial College London)
: Got electron holography data and grain tomography images. Built and ran electron holography simulations to match the electron holography data, which was used as evidence for matching physical and simulated remanent magnetization states.

Ann Hirt (ETH Zürich)
: Provided insight on interpreting results from MERRILL for interacting nanoparticles.

Various
: Provided support for MERRILL for getting started and also for solving program crashes.