

Paul Bartholomew

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I am a software architect at EPCC, University of Edinburgh with over nine years' experience working with, and developing, Computational Fluid Dynamics (CFD) software for research and industry. During this time I have developed extensive skills working with research software and programming in widely used scientific languages including C/C++, Fortran and Python and a passion for computational science.

Education

- 2013 – 2018 **PhD in Computational Fluid Dynamics**, *Department of Mechanical Engineering, Imperial College London*,
Title: Development of an Implicit Framework for the Two-Fluid Model on Unstructured Grids.
- Contributed to the development of a general-purpose CFD research code, implementing a fully-coupled solver for the two-fluid model
 - learned to write C and write software intended for parallel computing
 - Published in international peer-reviewed journal
 - Presented work at national and international conferences
 - Contributed to teaching of MSc students as a Graduate Teaching Assistant for the CFD course
- 2009 – 2013 **MEng. (First class) in Mechanical Engineering**, *Imperial College London*.
- Achieved the 3rd year Dean's list
- 2007 – 2008 **Advanced Highers**, *AAA in Chemistry, Maths and Physics*.
- Senior Proxime Accessit, Bearsden Academy
- 2006 – 2007 **Highers**, *AAAA in Chemistry, Maths, Physics and Technical Studies; B in English*.
- 2004 – 2006 **Standard Grades**, *Grade 1 in Art, Chemistry, French, Geography, Maths, Physics and Technical Studies; grade 2 in English*.

Professional/research experience

- 2019 – pres. **Software architect (Dec 2021 – pres.), Applications consultant in HPC (2019 – Dec 2021)**, EPCC, University of Edinburgh.
- Developed and won funding for further eCSE projects as technical staff member (ARCHER2 eCSE 03-02, 06-04), PI (ARCHER2 eCSE 09-05) and Co-I (ARCHER2 eCSE 10-01)
 - joined ARCHER2 eCSE 05-03 in a software-advisory role.
 - Entered and led the ASiMoV-CCS team at the UK National Open Hackathon 2023 developing a proof of concept for porting ASiMoV-CCS, written in modern Fortran, to GPU kernels.
 - Ported legacy code bases, removing compiler-specific behaviour to support new systems including ARCHER2.
 - Gained experience profiling and analysing codes to diagnose performance issues for HPC.
 - Developed good working relationships working with external partners, both industrial and academic.
 - Second supervisor to PhD students.
 - Proposed and supervised MSc and EPCC HPC Summer school projects.
 - Line management.
- 2018 – 2019 **PDRA: eCSE 13-03 A High-Order Accurate Solver for Free-Surface Flows**, Imperial College London.
- Awarded additional funding to continue work of eCSE 10-02 to develop a free-surface solver.
 - Key contributor to the Xcompact3d project to modernise the Incompact3d codebase.
 - Presented work at national and international conferences.
- 2017 – 2018 **PDRA: eCSE 10-02 An Adjoint Solver for Variable-Density Flows in the Low Mach Number Limit**, Imperial College London.
- Implemented a low Mach number solver in open-source CFD code Incompact3d
 - learned to write Fortran.
 - gained experience working with Tier-1/0 super computers.
 - Presented work at national conferences.
 - Published in international peer-reviewed journal.
- 2012 **Undergraduate Research Opportunities Programme**, Imperial College London.
- Won funding to join a research group in the Thermo fluids division of the Mechanical Engineering department at Imperial College for the summer between the third and final year of my undergraduate MEng. degree.
 - Gained experience working with Paraview.
 - Developed simple CFD code in Python.
- 2008 – 2009 **Year In Industry**, *BAE Systems*, Glasgow.
- Worked in the operations department at the Scotstoun shipyard.
 - Implemented a requisition tracking system to facilitate transfer of materials between projects.
 - Assisted in project management of the charity project to refit the Seagull barge.

Publications

Include:

J. Zarins, M. Weiland, P. Bartholomew, L. Lapworth, M. Parsons, *Detecting Scale-Induced Overflow Bugs in Production HPC Codes*, In: H. Anzt, A. Bienz, P. Luszczek, M. Baboulin (eds) High Performance Computing. ISC High Performance 2022. Lecture Notes in Computer Science, (2022).

P. Bartholomew, G. Deskos, R. Frantz, F. Schuch, E. Lamballais, S. Laizet, *Xcompact3d: An Open-Source Framework for Solving Turbulence Problems on a Cartesian Mesh*, SoftwareX, (2020).

P. Bartholomew, S. Laizet, *A New Highly Scalable, High-Order Accurate Framework for Variable-Density Flows: Application to Non-Boussinesq Gravity Currents*, Computer Physics Communications, (2019).

P. Bartholomew, F. Denner, M. H. Abdol-Azis, A. Marquis, B. van Wachem, *Unified Formulation of the Momentum-Weighted Interpolation for Collocated Variable Arrangements*, Journal of Computational Physics, (2018).

Skills

Technical knowledge.

- o Very strong background in numerical software, particularly CFD, having worked with and extended two research codes each using different numerical methods.
- o Contributed to the design and development of new software.
- o Able to effectively troubleshoot problems in simulations.

Computer programming and skills.

- o Have developed software in several of the major languages used in computational science including C/C++, Fortran and Python and have experience using MATLAB/Octave.
- o Have experience using unit testing frameworks including CATCH2 (C++), unittest (Python) and CTest (Fortran).
- o Have experience programming for distributed systems and a good knowledge of MPI and the PETSc library.
- o Familiar with Linux use and administration.
- o Experience using tier-1/0 HPC systems
 - experience using multiple profiling tools on tier-1/0 HPC systems.

Communication skills.

- o Strong presentation skills developed by presenting to both specialist and non-specialist audiences at national and international conferences.
- o Ability to explain concepts clearly, honed by working as a Graduate Teaching Assistant during my PhD and supervising PhD, MSc and undergraduate project students.
- o Contributed to the development of team members by producing a short introduction to git to present to PhD students in the group when working as a PDRA.
- o Precise and clear writing skills developed by publishing work in peer-reviewed journals.
- o Combining these skills with software development has great potential for scientific software
 - I have applied this with literate programming techniques to produce reports with integrated post-processing code, improving the presentation of the analysis and enabling reproducibility of the report.

Teamwork and collaboration.

- o Good teamwork skills having worked as part of a team through my PhD to present positions working on common software for research.
- o Experience working with source control management tools including git and svn.
- o Identification of areas for improvement
 - instigated development of a post-processing library (Py4Incompact3d) in collaboration with another PDRA, based on Python tools we had developed to encourage shared approaches to data analysis. This is used by other Xcompact3d users, and formed the basis of the ARCHER2 eCSE 03-02 project.

References

Available on demand.