

# David Moxey

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## Employment

present Lecturer in Engineering, CEMPS, **University of Exeter**

- My research aims to better understand the transition to turbulence in fluid flows.
- I investigate fundamental fluids problems and how this translates to real-world industry.
- To do this I develop new methods for highly parallel computational simulations.
- I lecture & administer courses and supervise a number of Ph.D./M.Sc. projects.
- Senior developer of the *Nektar++* spectral/*hp* element framework ([www.nektar.info](http://www.nektar.info)).

11/15 - 3/17 Research & Teaching Fellow, Dept. of Aeronautics, **Imperial College London**

6/11 - 11/15 Research Associate, Department of Aeronautics, **Imperial College London**

## Education

Jun. 2011 Ph.D. Mathematics, **University of Warwick**

thesis *Spatio-temporal dynamics in pipe flow*, supervised by Prof. Dwight Barkley.

Jun. 2007 M.Math. Mathematics (1st class hon.), **University of Warwick**

dissertation *Simulation of polymer chains using Monte Carlo methods*, supervised by Prof. Mike Allen.

Jun. 2003 **Queen Mary's Grammar School**

GCE A2 Mathematics, Further Mathematics, Physics, Computing (all at A grade).

GCSE 12 in total – 5A\*, 5A, 2B. Mathematics and English at A\*.

## Awards

Jul. 2018 NVIDIA GPU Grant Program (approx. £5,000)

Mar. 2018 **PRISM: Platform for Research In Simulation Methods (£1,612,965)**

Co-I on EPSRC Platform Grant EP/R029423/1.

Nov. 2015 **ARCHER Leadership Project (£165,796)**

Co-I on EPSRC application for substantial leadership-scale computing resource on the UK national supercomputer ARCHER. This project will use around 20 million CPU hours to produce the first scale-resolving simulations over extremely complex Formula 1 geometries.

Jun. 2015 ARCHER Resource Allocation Panel (£22,256)

Apr. 2015 PRISM platform grant project (6 months funding)

Apr. 2015 **Horizon 2020 project ExaFLOW (€346,125 at ICL, €3.3m total)**

I am a co-investigator and leader of the algorithmic development work package for the EU Horizon 2020 project ExaFLOW, which will develop numerical methods for CFD on exascale computing platforms. ICL is part of a consortium of 8 academic and industrial partners.

Jul. 2014 EPCC Embedded CSE grant (1 person year)

Jan. 2014 ARCHER Resource Allocation Panel (£16,153)

Oct. 2007 EPSRC Ph.D. scholarship (£13,000 p.a.)

## Publications

### Journal Publications

under review On weak Dirichlet boundary conditions for elliptic problems in the continuous Galerkin method  
M. Vymazal, D. Moxey, S. Sherwin, C. D. Cantwell and R. M. Kirby  
*under review in J. Comput. Phys.*

- in press [Interpolation error bounds for curvilinear finite elements and their implications on adaptive mesh refinement](#)  
D. Moxey, S. P. Sastry and R. M. Kirby  
*under review in J. Comput. Phys.*
- 2018 [Accelerating high-order mesh generation with an architecture-independent programming model](#)  
 J. Eichstädt, M. Green, M. Turner, J. Peiró and D. Moxey  
*Comput. Phys. Commun.* **229**, pp. 36–53. DOI: [10.1016/j.cpc.2018.03.025](#).
- [DNS of a compressible boundary layer flow past an isolated three-dimensional hump in a high-speed subsonic regime](#)  
 D. de Grazia, D. Moxey, S. J. Sherwin, M. A. Kravtsova and A. I. Ruban  
*Phys. Rev. Fluids* **3**, p. 024101. DOI: [10.1103/PhysRevFluids.3.024101](#).
- [Curvilinear mesh generation using a variational framework](#)  
 M. Turner, J. Peiró and D. Moxey  
*Comput. Aided Design* **103**, pp. 73–91. DOI: [10.1016/j.cad.2017.10.004](#).
- 2017 [A  \$p\$ -adaptation method for compressible flow problems using a goal-based error estimator](#)  
 D. Ekelschot, D. Moxey, S. J. Sherwin and J. Peiró  
*Comput. Struct.* **181**, pp. 55–69. DOI: [10.1016/j.compstruc.2016.03.004](#).
- 2016 [An adaptable parallel algorithm for the direct numerical simulation of incompressible turbulent flows using a Fourier spectral/hp element method and MPI virtual topologies](#)  
 A. Bolis, C. D. Cantwell, D. Moxey, D. Serson and S. J. Sherwin  
*Comput. Phys. Commun.* **206**, pp. 17–25. DOI: [10.1016/j.cpc.2016.04.011](#).
- [Implicit large-eddy simulation of a wingtip vortex](#)  
 J.-E. W. Lombard, D. Moxey, S. J. Sherwin, J. F. A. Hoessler, S. Dhandapani and M. J. Taylor  
*AIAA J.* **54** (2), pp. 506–518. DOI: [10.2514/1.J054181](#).
- [Optimizing the performance of the spectral/hp element method with collective linear algebra operations](#)  
D. Moxey, C. D. Cantwell, R. M. Kirby and S. J. Sherwin  
*Comput. Meth. Appl. Mech. Eng.* **310**, pp. 628–645. DOI: [10.1016/j.cma.2016.07.001](#).
- [High-order curvilinear meshing using a thermo-elastic analogy](#)  
D. Moxey, D. Ekelschot, Ü. Keskin, S. J. Sherwin and J. Peiró  
*Comput. Aided Design* **72**, pp. 130–139. DOI: [10.1016/j.cad.2015.09.007](#).
- [To CG or to HDG: a comparative study in 3D](#)  
 S. Yakovlev, D. Moxey, S. J. Sherwin and R. M. Kirby  
*J. Sci. Comp.* **67** (1), 192–220. DOI: [10.1007/s10915-015-0076-6](#).
- 2015 [Nektar++: An open-source spectral/hp element framework](#)  
 C. D. Cantwell, D. Moxey, A. Comerford, A. Bolis, G. Rocco et al.  
*Comput. Phys. Commun.* **192**, pp. 205–219. DOI: [10.1016/j.cpc.2015.02.008](#).
- [Dealiasing techniques for high-order spectral element methods on regular and irregular grids](#)  
 G. Mengaldo, D. de Grazia, D. Moxey, P. E. Vincent and S. J. Sherwin  
*J. Comput. Phys.* **299**, pp. 56–81. DOI: [10.1016/j.jcp.2015.06.032](#).
- [An isoparametric approach to high-order curvilinear boundary-layer meshing](#)  
D. Moxey, M. D. Green, S. J. Sherwin and J. Peiró  
*Comput. Meth. Appl. Mech. Eng.* **283**, pp. 636–650. DOI: [10.1016/j.cma.2014.09.019](#).
- 2014 [Simplifying the Development, Use and Sustainability of HPC Software](#)  
 J. Cohen, C. D. Cantwell, N. P. Chue Hong, D. Moxey, M. Illingworth et al.  
*J. Open Res. Soft.* **2** (1). DOI: [10.5334/jors.az](#).
- [Stability of projection methods for incompressible flows using high order pressure-velocity pairs of same degree: Continuous and Discontinuous Galerkin formulations](#)  
 E. Ferrer, D. Moxey, S. J. Sherwin and R. H. J. Willden  
*Commun. Comp. Phys.* **16** (3), pp. 817–840. DOI: [10.4208/cicp.290114.170414a](#).

## Connections between the discontinuous Galerkin method and high-order flux reconstruction schemes

D. de Grazia, G. Mengaldo, **D. Moxey**, P. E. Vincent and S. J. Sherwin  
*Int. J. Numer. Meth. Fl.* 75 (12), pp. 860–877. DOI: [10.1002/flid.3915](https://doi.org/10.1002/flid.3915).

2011 [The onset of turbulence in pipe flow](#)

K. Avila, **D. Moxey**, A. de Lozar, M. Avila, D. Barkley and B. Hof  
*Science* 333 (6039), pp. 192–196. published as a research article. DOI: [10.1126/science.1203223](https://doi.org/10.1126/science.1203223).

2010 [Distinct large-scale turbulent-laminar states in transitional pipe flow](#)

**D. Moxey** and D. Barkley  
*Proc. Nat. Acad. Sci.* 107 (18), pp. 8091–8096. DOI: [10.1073/pnas.0909560107](https://doi.org/10.1073/pnas.0909560107).

## Book Chapters

2015 [On the generation of curvilinear meshes through subdivision of isoparametric elements.](#)

**D. Moxey**, M. D. Green, S. J. Sherwin and J. Peiró.  
*New Challenges in Grid Generation and Adaptivity for Scientific Computing*, pp. 203–215.  
DOI: [10.1007/978-3-319-06053-8\\_10](https://doi.org/10.1007/978-3-319-06053-8_10).

Curvilinear mesh generation for boundary layer problems.

**D. Moxey**, M. Hazan, S. J. Sherwin and J. Peiró.  
*IDIHOM: Industrialization of High-Order Methods-A Top-Down Approach*, pp. 41–64.  
DOI: [10.1007/978-3-319-12886-3\\_3](https://doi.org/10.1007/978-3-319-12886-3_3).

High-order visualization with ELVis.

J. Peiró, **D. Moxey**, B. Jordi, S. J. Sherwin, B. W. Nelson et al.  
*IDIHOM: Industrialization of High-Order Methods-A Top-Down Approach*, pp. 521–534.  
DOI: [10.1007/978-3-319-12886-3\\_24](https://doi.org/10.1007/978-3-319-12886-3_24).

## Conference Proceedings

2018 [High-order curvilinear hybrid mesh generation for CFD simulations](#)

J. Marcon, M. Turner, J. Peiró, **D. Moxey**, C. R. Pollard et al.  
*2018 AIAA Aerospace Sciences Meeting*.  
DOI: [10.2514/6.2018-1403](https://doi.org/10.2514/6.2018-1403).

2017 [Towards  \$p\$ -adaptive spectral/ \$hp\$  element methods for modelling industrial flows](#)

**D. Moxey**, C. D. Cantwell, G. Mengaldo, D. Serson, D. Ekelschot et al.  
*Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2016*, pp. 63–79.  
DOI: [10.1007/978-3-319-65870-4\\_4](https://doi.org/10.1007/978-3-319-65870-4_4).

[A framework for the generation of high-order curvilinear hybrid meshes for CFD simulations](#)

M. Turner, **D. Moxey**, J. Peiró, M. Gammon, C. R. Pollard and H. Bucklow.  
*Procedia Engineering*. Vol. 203, pp. 206–218.  
DOI: [10.1016/j.proeng.2017.09.808](https://doi.org/10.1016/j.proeng.2017.09.808).

2016 [The wing-tip vortex test case](#)

J.-E. Lombard, **D. Moxey** and S. J. Sherwin.  
*European Congress on Computational Methods in Applied Sciences and Engineering, Crete, Greece*.

[Automatic generation of 3D unstructured high-order curvilinear meshes](#)

M. Turner, **D. Moxey**, S. J. Sherwin and J. Peiró.  
*Proceedings of the European Congress on Computational Methods in Applied Sciences and Engineering*, pp. 428–433.  
DOI: [10.7712/100016.1825.8410](https://doi.org/10.7712/100016.1825.8410).

[A variational framework for high-order mesh generation](#)

M. Turner, J. Peiró and **D. Moxey**.  
*Procedia Engineering*. Vol. 82, pp. 127–135.  
DOI: [10.1016/j.proeng.2016.11.069](https://doi.org/10.1016/j.proeng.2016.11.069).

- 2015 [TemPSS: A service providing software parameter templates and profiles for scientific HPC](#)  
 J. Cohen, C. Cantwell, D. Moxey, J. Nowell, P. Austing et al.  
*IEEE eScience (Munich, Germany)*.  
 DOI: [10.1109/eScience.2015.43](#).
- [Ensuring an effective user experience when managing and running scientific HPC software](#)  
 J. Cohen, D. Moxey, C. D. Cantwell, P. Austing, J. Darlington and S. J. Sherwin.  
*2015 IEEE/ACM 1st International Workshop on Software Engineering for High Performance Computing in Science (SE4HPCS)*, pp. 56–59.  
 DOI: [10.1109/SE4HPCS.2015.16](#).
- [Automatic mesh sizing specification of complex three dimensional domains using an octree structure](#)  
 M. Turner, D. Moxey and J. Peiró.  
*24th International Meshing Roundtable*.
- 2014 [A thermo-elastic analogy for high-order curvilinear meshing with control of mesh validity and quality](#)  
D. Moxey, D. Ekelschot, U. Keskin, S. J. Sherwin and J. Peiró.  
*Procedia Engineering*. Vol. 82, pp. 127–135.  
 DOI: [10.1016/j.proeng.2014.10.378](#).
- 2013 [Simplifying the Development, Use and Sustainability of HPC Software](#)  
 J. Cohen, C. D. Cantwell, N. P. Chue Hong, D. Moxey, M. Illingworth et al.  
*WSSPE13 Workshop, Supercomputing*.
- [Nekkloud: A software environment for high-order finite element analysis on clusters and clouds](#)  
 J. Cohen, D. Moxey, C. D. Cantwell, P. Burovskiy, J. Darlington and S. J. Sherwin.  
*2013 IEEE International Conference on Cluster Computing*, pp. 1–5.  
 DOI: [10.1109/cluster.2013.6702616](#).
- 2012 [libHPC: Software sustainability and reuse through metadata preservation](#)  
 J. Cohen, J. Darlington, B. Fuchs, D. Moxey, C. D. Cantwell et al.  
*First Workshop on Maintainable Software Practices in e-Science, 8th IEEE International Conference on eScience*.
- Dissertations**
- 2011 [Spatio-temporal dynamics in pipe flow](#)  
D. Moxey  
 Ph.D. thesis. University of Warwick, Oct. 2011.
- 2007 [“Snakes on a plane”: An introduction to the study of polymer chains using Monte Carlo methods](#)  
D. Moxey  
 Master’s thesis. University of Warwick, July 2007.

## Teaching Experience

- ’08 – today Lecturer, *Fundamental Tools*, **University of Warwick**  
*Fundamental Tools* is an intensive week-long course, designed to prepare students for the Financial Mathematics M.Sc. and test their mathematical ability. It covers topics in linear algebra, differential equations and basic statistics. My responsibilities include setting a course syllabus, providing lectures and comprehensive lecture notes, organising seminar sessions/problem sheets and setting and marking examinations.
- ’15 – today Lecturer, *Introductory Mathematics*, **Imperial College London**  
 This introductory mathematics course, taken by around 60 students, is part of two M.Sc. courses in the Department of Aeronautics, covering topics in vector calculus, linear algebra and basic real analysis. Responsibilities include setting lecture notes, delivering lectures to students and providing support.

2009 – 2011 Lecturer, *Programming for Scientists*, **University of Warwick**

This popular first-year undergraduate mathematics course of around 150 students introduces the basic concepts of mathematical and object-oriented programming using Java. My responsibilities included renewing the course syllabus to incorporate the latest Java techniques, rewriting lecture notes and programming lab sessions to adopt a more interactive lecturing style, as well as general course administration, setting assessments and marking the projects comprising the students' final grades.

2008 – 2011 Lecturer, *C++ for Financial Mathematics*, **University of Warwick**

This course is taken by students enrolled on the Financial Mathematics M.Sc. and provides a comprehensive overview of C++ from basics to multiple inheritance and STL usage, culminating in a project where students implement a finite-difference numerical solver for the Black-Scholes equation.

2011 Teaching Assistant, **Imperial College London**

2008 – 2011 Teaching Assistant, **University of Warwick**

2006 – 2010 Undergraduate Supervisor, **University of Warwick**

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## Presentations & Conferences

### Recent presentations

2018

Advances in high-order mesh generation

ICOSAHOM 2018, London, UK, July 2018.

Developing methods for exascale CFD simulations at high orders

Platform for Advanced Scientific Computing Conference, Basel, Switzerland, July 2018.

Organiser of the International Conference on Spectral and High-Order Methods (ICOSAHOM)

ICOSAHOM 2018, **Conference organiser**, London, UK, July 2018.

[Towards automatic high-order mesh generation for industrial geometries](#)

ICOSAHOM 2018, **Minisymposium organiser**, London, UK, July 2018.

[Recent developments in high-order mesh generation](#)

European Conference on Computational Fluid Dynamics, **Minisymposium organiser**, Glasgow, UK, June 2018.

Spectral/hp element modelling for high fidelity simulation

Culham Centre for Fusion Energy, Culham, United Kingdom, June 2018.

2017

[Targeting the spectral/hp element method for exascale platforms](#)

Platform for Advanced Scientific Computing Conference, Lugano, Switzerland, June 2017.

[h-to-p efficiently: the use of collections with accelerators within Nektar++](#)

SIAM Computational Science & Engineering, Atlanta, GA, USA, Feb. 2017.

2016

[NekMesh: an open-source high-order mesh generator](#)

DiPaRT 2016, CFMS, Bristol and Bath Science Park, UK, Nov. 2016.

[Optimising the performance of the spectral/hp element method with collective linear algebra operations](#)

PRISM Workshop on Embracing Accelerators, Imperial College London, London, UK, Apr. 2016.

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## Referees

- **Prof. Spencer Sherwin**, *Professor of Computational Fluid Mechanics*. Department of Aeronautics, Imperial College London, London, SW7 2AZ, UK. [s.sherwin@imperial.ac.uk](mailto:s.sherwin@imperial.ac.uk).
- **Dr. Joaquim Peiró**, *Reader in Aerodynamics*. Department of Aeronautics, Imperial College London, London, SW7 2AZ, UK. [j.peiro@imperial.ac.uk](mailto:j.peiro@imperial.ac.uk).
- **Prof. Dwight Barkley**, *Professor of Mathematics*. Mathematics Institute, University of Warwick, Coventry, CV4 7AL, UK. [D.Barkley@warwick.ac.uk](mailto:D.Barkley@warwick.ac.uk).