David Frederick Fletcher: Curriculum Vitae and Publication List

Affiliations

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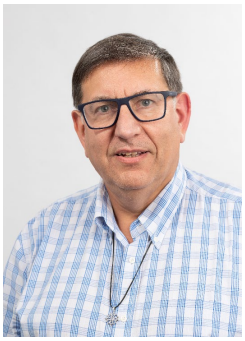

Qualifications

- Habilitation à Diriger des Recherches, Institut National Polytechnique de Toulouse, France, 2002.
- PhD (Mathematics), University of Exeter, UK, 1982. Thesis title: The calculation of heat or mass transfer in separated flows.
- BSc (Hons) First Class in Mathematics, University of Exeter, UK, 1979. (Awarded the University Prize for Mathematics.)

Work Experience

After completing my PhD studies at the University of Exeter, which were supported financially by the United Kingdom Atomic Energy Authority (UKAEA), I worked for ten years as a research scientist at their Winfrith and Culham Laboratories, where I performed research into multiphase explosions and fire safety. I contributed work to the enquiry into the Chernobyl nuclear reactor accident and towards the licensing of the Sizewell B Pressurised Water Reactor (PWR). In 1989, I spent four months as a visiting scientist at Argonne National Laboratories in the USA. I also carried out a variety of industrial projects involving Computational Fluid Dynamics (CFD), using Harwell FLOW3D, the forerunner of the CFX code. When I left the UK to migrate to Australia, I was a section leader managing five staff.

Since 1993 I have been associated with the University of Sydney in various research capacities, where I am now an Adjunct Professor in the School of Chemical and Biomolecular Engineering. I have been a Visiting Professor at the Université de Toulouse on numerous occasions, and I was a CNRS visiting fellow in 2004 and 2007. As a result, I have developed strong ties with the Laboratoire de Génie Chimique, Institut National Polytechnique de Toulouse.

I am active in research, being a named investigator on ARC discovery and industry linkage grants. I act as supervisor or co-supervisor of on average four PhD students. I have now graduated 50 PhD students as either the supervisor or as a co-supervisor where I made a significant contribution to their research project. This number includes two cotutelle students who carried out their doctoral studies partly in France and partly in Australia.

I carry out this work via my own CFD research and consultancy business as a sole trader, working for a variety of industrial and university clients. I am the senior CFD specialist for the local Ansys software distributor, LEAP Australia. In this capacity, I conduct mentoring in the use of Ansys CFD and have taught many customized advanced training courses in areas as diverse as combustion, radiation, multiphase flow, gas dynamics and turbulence modelling. I perform custom model development as a service to many clients, allowing them to implement CFD quickly and effectively in their business. I also provide peer review services for many companies in Australia and Europe. These activities mean that in the past 30 years I have contributed directly or indirectly to the successful use of CFD in numerous companies over a very wide range of applications.

Technical Expertise

I have forty years of experience in the field of CFD, where I have been involved in a wide spectrum of activities ranging from algorithm development to simulation of complex industrial flows. I have worked on an exceptionally broad range of applications due to my involvement with the Ansys distributors. In addition to this I have significant experience of multiphase, reacting flows and combustion arising from my research work at the UK Atomic Energy Authority and at the University of Sydney. In summary:

- I have studied and worked in the field of applied mathematics and computational physics, applied to the areas of fluid dynamics, heat transfer and mass transfer. I have written my own CFD codes to study single and multiphase flows, and to investigate multiphase explosions.
- I have considerable knowledge and experience of industrial Computational Fluid Dynamics (CFD) based around the Ansys CFX and FLUENT software packages. I have strong links with the software developers and contribute to software testing and design. In many projects, I extend these models via FORTRAN, C, Scheme, Perl and Python programming. I use Ansys Mechanical for structural simulations, particularly in two-way coupled fluid structure interactions (FSI), Ansys LS-Dyna for FSI of flexible bodies and Ansys CHEMKIN in combustion work.
- I have performed major CFD-based research and/or development projects, including modelling of a rotary swirl cyclone used for SO_2 scrubbing, a biomass gasification plant, multiphase mixing of slurries and particle jets, particle classifiers, extrusion of multi-component pastes, oil-fired and gas-fired furnaces, digesters, calciners, spray dryers, moving bed dryers, fluidized beds, design studies of cyclones, gas dispersion and plume modelling, wind loading on structures, coupled chemistry problems, flows in rotating machinery, supersonic particle laden gas flows, mechanically-agitated vessels, bubble columns, precipitators, micro-mixers and micro-structured heat transfer devices, microfluidic devices, membrane systems, biomedical flows and pharmaceutical dry powder inhalers.
- I have performed CFD modelling of fires, fire extinguishment and smoke movement in multi-compartment buildings, tunnels and on offshore platforms. This work also involved use of consequence modelling software (PHAST), design of experiments, data analysis and integration of results from CFD studies into risk assessments.
- I spent twelve years studying the physics and modelling of steam explosions (often called vapour explosions or Rapid Phase Transitions) involving the explosive transfer of heat from a hot liquid to a cold volatile liquid. I have acted as a consultant to Nuclear Electric, USNRC, CEA, Ontario Hydro, JAERI and various metal production companies and provided advice to the UK Health and Safety Executive. For this work, I developed computer codes for multiphase flow to simulate fluid mixing and shock wave propagation in multiphase mixtures.
- I have considerable knowledge of phase change heat transfer arising from my nuclear experience, which I applied to film boiling droplets, and nuclear safety applications. I have also worked extensively on heat transfer and boiling in micro-channels and micro-scale two phase flows. This work involved both CFD and experimental studies involving micro-PIV and other advanced diagnostics. The focus was on the design of compact heat exchangers and other micro-structured devices.
- I worked on Fluid Structure Interaction (FSI) problems concerning modelling of the stomach that involved a collaboration with the CSIRO using their SPH code, as well as assisting with experimental design/interpretation using Ansys Fluent-Mechanical System Coupling tools. I am currently mentoring the lead computational engineer on a project to design a left ventricular heart valve for children, a project that uses Ansys LS-Dyna for FSI simulations and Ansys OptiSlang for design optimization.

Languages

- French as a passion for 40 years, in which I give seminars, examine theses and have written several book chapters.
- Italian as a hobby for 25 years.

Other Achievements

- I have h-indices of 71, 57 and 52 in the Google Scholar, Scopus, and Web of Science databases, respectively.
- I was listed in the top 2% of ***all*** researchers world-wide in the 2017 (0.47%), 2019 (0.26%), 2021 (0.31%) and 2023 (0.24%) PLoS Biology analysis of career publication data.
- I have been a guest editor for multiple special issues appearing in Nuclear Engineering and Design, Applied Mathematical Modelling, Chemical Engineering Science, Chemical Engineering Research and Design, Progress in Computational Fluid Dynamics, and Journal of Computational Multiphase Flow.
- I have given plenary/keynote presentations at the following conferences/workshops:
    - SCONA 2023 (Society for Computational fluid dynamics Of the Nose and Airway), Brisbane, Australia, 8 March 2023.
    - International Conference on Advances in Differential Equations and Numerical Analysis (ADENA2020), IIT Guwahati, India, 12-15 October 2020.
    - Recent Advances in Bubble Columns, SFGP Workshop, Paris, France, 5 November 2019.
    - Thirteenth International Conference on CFD in the Minerals and Process Industries, Melbourne, Australia, December 2018.
    - Fluids in New Zealand, Christchurch, New Zealand, January 2015.
    - Institute for Infrastructure Engineering Inaugural Meeting, Sydney, Australia, November 2012.
    - 7th International Symposium on Heat Transfer, Beijing, China, October 2008.

- 3rd Rhodia International Conference, Lyon, France, July 2003.
- OECD/CSNI Specialist Meeting on Fuel-Coolant Interactions, Tokai-mura, Japan, May 1997.
- International Symposium on the Physics of Vapor Explosions, Tomakomai, Japan, October 1993.

- I am certified by Ansys to perform training and technical support for their fluid modelling products, as well as for having advanced knowledge of turbulence modelling.

Journal articles and book chapters **ORCID ID: https://orcid.org/0000-0003-2221-4192**

[1] J. Emmerling, S. Vahaji, D.A.V. Morton, D.F Fletcher and K. Inthavong, *Scale resolving simulations of the effect of glottis motion and the laryngeal jet on flow dynamics during respiration.* ***Comput. Meth. Prog. Bio.***, 108064, (2024).

[2] V. Chaugule, L.G. dos Reis, D.F. Fletcher, P.M. Young, D. Traini and J. Soria, *A counter-swirl concept for dry powder inhalers.* ***Int. J. Pharm.,*** 650, 123694, (2024).

[3] Y.K. Chong, D. F. Fletcher and Y. Y. Liang, *CFD simulation of hydrodynamics and concentration polarization in osmotically assisted reverse osmosis membrane systems.* ***J. Water Proc. Eng.,*** 57, 104535*,* (2024).

[4] D. Alam, S. Lee, J. Hong, D.F. Fletcher, D. McClure, D. Cook, P.J. Cullen and J.M. Kavanagh, *Experimental investigations of Per- and Poly-fluoroalkyl Substances (PFAS) degradation by non-thermal plasma in aqueous solutions*. ***J. Environ. Chem. Eng.***, 11, 111588, (2023).

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[10] A. Lee, X. Liu, J.E. Giaretta, T.P. Hoang, M. Crago, S. Farajikhah, L. Mosse, D.F. Fletcher, F. Dehghani, D.S. Winlaw and S. Naficy, *Bioinspired polymeric heart valves: A combined in vitro and in silico approach*. ***JTCVS Open***, 15, C, 113-124, (2023).

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[12] G. Nadal-Rey, J.M. Kavanagh, B. Cassells, S. Cornelissen, D.F. Fletcher, K.V. Gernaey and D.D. McClure, *Modelling of industrial-scale bioreactors using the particle lifeline approach.* ***Biochem. Eng. J.***, 198, 108989, (2023).

[13] K. Shrestha, J. van Strien, D.F. Fletcher and K. Inthavong, *Primary spray break-up from a nasal spray atomizer using Volume of Fluid to Discrete Phase Model.* ***Phys. Fluids***, 35, 053312, (2023).

[14] H. Salati, P. Warfield-McAlpine, D.F. Fletcher and K. Inthavong, *Fan respirator reduces CO_2 concentrations and refreshes air temperature for inhalation − A CFD analysis.* ***Phys. Fluids***, 35, 051902, (2023).

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[23] V. Ngu, D.F. Fletcher, J.M. Kavanagh, Y. Rafrafi, C. Dumas, J. Morchain and A. Cockx, *H_2 mass transfer – a key factor for efficient biological methanation: Comparison between pilot-scale experimental data, 1D and CFD models*. ***Chem. Eng. Sci.***, 268, 118382, (2023).

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[37] M. Khamooshi, H. Salati, S. Vahaji, S. Gregory, D.F. Fletcher and K. Inthavong, *Assessment of the nasal air conditioning and paranasal sinus ventilation from nasal assisted breathing therapy*. ***Phys. Fluids***, 051912, (2022).

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[39] H. Salati, D.F. Fletcher, M. Khamooshi, J. Dong, K. Ito, S. Vahaji and K. Inthavong, *Exhaled jet and viral-laden aerosol transport from nasal sneezing*. ***Aerosol Air Qual. Res.***, 22(4), 210338, (2022).

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[41] V. Chaugule, C.Y. Wong, K. Inthavong, D.F. Fletcher, P.M. Young, J. Soria and D. Traini, *Combining experimental and computational techniques to understand and improve dry powder inhalers*. ***Expert Opin. Drug Del.***, 19(1), 59-73, (2022).

[42] G.J. Brown, D.F. Fletcher, J.W. Leggoe and D.S. Whyte, *Impact of impeller modelling approaches on SBES simulations of flow and residence time in a draft tube reactor*. ***Chem. Engng. Res. Des.***, 178, 157-163, (2022).

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[45] G. Coorey, G.A. Figtree, D.F. Fletcher and J. Redfern, *The health digital twin: an innovation to advance precision cardiovascular medicine*. ***Nat. Rev. Cardiol.***, 18(12), 803-804, (2021).

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[52] Z. Peng, J. Zanganeh, R. Ingle, P. Nakod, D.F. Fletcher and B. Moghtaderi, *CFD investigation of flame and pressure wave propagation through variable concentration methane-air mixtures in a tube closed at one end.* ***Combust. Sci. & Tech.,*** 193(7), 1203-1230, (2021).

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Significant Competitive Research Grants (bold grants are active)

[1] D. Winlaw, D.F. Fletcher, F. Dehghani and S. Naficy, **NHMRC Medical Research Future Fund** (ARGCHD000015), *Personalised pulmonary valved conduits reducing re-operations in congenital heart disease.* $2,082,000, 2020-2024.

[2] F. Dehghani, D.F. Fletcher, S. Naficy and D. Winlaw, ARC Discovery Grant (DP200102164), *Engineering a valved conduit structure in a single step from multicomponent elastic biomaterials*. $465,000, 2020-2023.

[3] P.J. Cullen, J.M. Kavanagh, D.D. McClure, D.F. Fletcher and T. Walker, **Special ARC Linkage** (SR180200046) with ICD (Asia Pacific) Pty Ltd, *Plasma bubble column for one step remediation of PFAS.* $758,000, 2019-2023.

[4] D. Traini, D.F. Fletcher, J. Soria and D. Lewis, ARC Linkage (LP170100551) with Chiesi, *Smart hybrid system for the formulation and design of dry powder inhalers.* $555,000, 2018-2021.

[5] S. Grieve, P. Bannon, R. Jeremy, J. Gamble, B. Hamble, D.F. Fletcher and R. Liu, NHMRC (APP1130610), *"Beyond the Tape Measure" measuring the impact of abnormal flow dynamics on dilation of the ascending aorta.* $723,700, 2017-2020.

[6] F. Dehghani, J.M. Kavanagh, G.W. Barton, T.A.G. Langrish, V.G. Gomes, D.F. Fletcher, A. Abbas, K.M. Downard, Q. Dong, S. Chae, D. Raubenheimer, R. McConchie, L. Copeland, K.-Y. Phan-Thien, E. Arab-Tehrany, H. Regtop, T.R. Lang, G.C. Wright, L.P. Ling, A.S. Cuthbertson, R. Heatley, Q. Adil, B. Challacombe, M. Simonetta and K.L. Norman, ARC Industrial Training Transformation Centre (IC140100026) with AB Mauri Technology and Development Pty Ltd, Agricure Pty Ltd, Batlow Premium Juices, Casella Wine Pty Ltd, Ecopha, Lang Technologies Pty Ltd, Marine Biotechnology Australia Pty Ltd, Peanut Company of Australia, Perfection Fresh Australia Pty Ltd, PharmaCare Laboratories Pty Ltd, Stahmann Farms Enterprises Pty Ltd, *Training centre for the Australian food processing industry in the 21st century*. $ 2,970,000, 2014-2017.

[7] A. Abbas, T.A.G. Langrish and D.F. Fletcher, ARC Discovery (DP130103742), *Dynamic input adjustment to improve the stability of transient swirling flows in spray dryers.* $300,000, 2013-2015.

[8] P.M. Young, D. Traini, D. Lewis and D.F. Fletcher, ARC Linkage (LP120200744) with Chiesi, *Ultra-low dose dry powder inhaler technology for the treatment of respiratory diseases.* $340,000, 2013-2015.

[9] G.W. Barton, J.M. Kavanagh, D.F. Fletcher and A. Balzan, ARC Linkage (LP120100608) with AB Mauri Technology and Development Pty Ltd, *Yield improvement in large-scale bubble column fermenters.* $210,000, 2012-2014.

[10] B.S. Haynes and D.F. Fletcher, ARC Discovery (DP120103235), *On the mechanism of boiling instability in microchannels.* $335,000, 2012-2014.

[11] P.M. Young, H.-K. Chan, D. Traini, and D.F. Fletcher, ARC Linkage (LP0776892) with Pharmaxis, *Engineering a delivery device and development of a novel formulation for chronic obstructive pulmonary disease.* $333,000, 2007-2009.

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[24] J.H. Kent, D.F. Fletcher and A.R. Green, ARC Collaborative grant with Tyco International and the WorkCover Authority of NSW, *Computational modelling of building fire extinguishmen*t. $250,000, 1994-1996.