

# SIMON WOLFGANG FUNKE

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## PERSONAL INFORMATION

Name: Funke, Wolfgang, Simon  
Date of birth: 17.10.1983  
Sex: Male  
Nationality: German

## POSITIONS

2016 - today **Research Scientist, Simula Research Laboratory, Oslo, Norway.**  
2015 - today **Adjoint Associate Professor, University of Oslo, Norway.**  
2014 - today **CTO, IMERSO AS, Oslo, Norway.**  
2013 - 2015 **Postdoctoral Fellow, Simula Research Laboratory, Oslo, Norway.**  
2014 - 2015 **Consultant, Kalkulo AS, Oslo, Norway.**  
2012 - 2014 **Postdoctoral Fellow, Imperial College London, London, UK.**  
20% adjoint position in 2014 in addition to the PostDoc position at Simula Research Laboratory  
2013 - 2014 **Consultant, E.ON AG, Düsseldorf, Germany.**

## EDUCATION

2009 - 2013 **PhD, Computational science, Imperial College London, UK.**

- Thesis title: *The automation of PDE-constrained optimisation and its applications.*
- Department of Earth Science and Engineering.
- Supervisors: M.D. Piggott, P.E. Farrell, P.A. Allison, G.J. Gorman.
- Date of approved disputation: 01.03.2013.

2007 **Erasmus student, École normale supérieure de Lyon, France.**  
2004 - 2009 **Diplom, Mathematics, Technische Universität München, Germany.**

- Passed with high distinction (1.0).
- Thesis title: *Fast solvers for the Navier-Stokes equations on high Reynold numbers.*
- Department of Mathematics.
- The German Diplom is equivalent to a Master degree.
- Supervisor: M. Ulbrich.

## AWARDS AND PRIZES

- **Wilkinson Prize for Numerical Software, 2015**  
The Wilkinson prize for Numerical Software is a prestigious prize in scientific computing, awarded every four years to the authors of an outstanding piece of numerical software. In 2015, the prize was awarded to Funke and his co-authors P.E. Farrell, D.A. Ham and M.E. Rognes for the high-level AD tool dolfin-adjoint.

- Best Poster Award, CSE 2015
- Imperial College Startup Venture Catalyst Award, 2013
- Imperial College Excellence Award, 2010
- Grantham Institute for Climate Change and Fujitsu CASE Studentship, 2009
- Google Interactivism Award, 2009
- Hurwitz-Association Award for an excellence diploma thesis, 2009

## FUNDING

- PI on NOK 7M FRIPRO Young Research Talent “Simulation-based optimisation with dynamic domains”, (#251237/F20), 2016
- EU Horizon 2020 SME instrument, IMERSO AS, 2015

## MOBILITY

Studied and worked ( $> 6$  months) in research institutions in **4 different countries**.

Research visits:

- Texas A&M University, USA (2015)
- Humboldt University of Berlin, Germany (2013)
- Simula Research Laboratory, Norway (2012)
- Isaac Newton Institute, Cambridge, UK (2012)
- Institut of Atmospheric Physics, Beijing, China (2011).

## SUPERVISION

**5 Master&Bachelor students** Faculty of Mathematics and Natural Sciences, University of Oslo, Norway and Department of Earth Science and Engineering, Imperial College London, UK.

**1 PhD student** co-supervisor, expected submission date 2016, Department of Earth Science and Engineering, Imperial College London, UK.

## TEACHING ACTIVITIES

2014 - today **Workshop**, FEniCS/dolfin-adjoint workshops: Simula (2014, 1 day), Zhejiang University (2014, 5 days), Simula (2016, 2 days), Suurph workshop, Simula (2016, 1 day), Technical University of Munich (2016, 5 days).

2015 - today **Lecture**, INF3331/INF4331 Higher-level programming, University of Oslo, Norway.

2010 - 2012 **Teaching assistant** several courses on computational science, programming and mathematics. Department of Earth Science and Engineering, Imperial College London, UK.

## COMMISSIONS OF TRUST

2013 - today **Reviewer** for SIAM Journal on Scientific Computing (SIAM), Computer Physics Communications (Elsevier), Energies (MDPI) and European Wave and Tidal Energy Conference Series and Geoscientific Model Development (GMD).

2015    **Organiser** of a Workshop on Advanced Techniques in Biomedical Computing, *Center for Biomedical Computing*.

2015    **Organiser** of a Mini-symposium on Efficient Solvers for PDE-constrained Optimization, *SIAM CSE15*.

## **RESEARCH INTEREST/RESEARCH PROFILE**

Funke's research interests center around optimisation problems governed by partial differential equations, with a focus on their numerical solution. In particular, he is interested in the automated derivation of adjoint and tangent linear models and their use in optimal control, data inversion and design optimisation. He is a founder of the dolfin-adjoint project, a software which automatically derives adjoint models from complex computer models solving partial differential equations based on a high-level symbolic problem specification language that mimics mathematical notation.

Funke applies these advances to applications in a wide variety of different domains including renewable energy and bioengineering. For the renewable energy sector, he developed OpenTidalFarm, an open-source software for optimising of tidal turbine farms, such as the optimal position of turbines within the farm. In bioengineering, he develops data assimilation techniques for blood flow simulations, with the aim to tune high-fidelity numerical blood flow models to match with MRI measurements.

## JOURNAL PUBLICATIONS

1. *SW Funke, SC Kramer, MD Piggott*. Design optimisation and resource assessment for tidal-stream renewable energy farms using a new continuous turbine approach, *Renewable Energy*, doi:10.1016/j.renene.2016.07.039, 2016.
2. *DM Culley, SW Funke, SC Kramer, MD Piggott*. Integration of cost modelling within the micro-siting design optimisation of tidal turbine arrays, *Renewable Energy*, doi:10.1016/j.renene.2015.06.013, 2016.
3. *S Rao, H Xue, M Bao, SW Funke*. Determining tidal turbine farm efficiency in the Western Passage using the disc actuator theory, *Ocean Dynamics*, doi:10.1007/s10236-015-0906-y, 2015.
4. *PE Farrell, A Birkisson, SW Funke*. Deflation techniques for finding distinct solutions of nonlinear partial differential equations, *SIAM Journal on Scientific Computing*, doi:10.1137/140984798, 2015.
5. *R Venell, SW Funke, S Draper, C Stevens*. Designing Large Arrays of Tidal Turbines: a synthesis and review, *Renewable & Sustainable Energy Reviews*, doi:10.1016/j.rser.2014.08.022, 2015.
6. *SW Funke, PE Farrell, MD Piggott*. Tidal turbine array optimisation using the adjoint approach, *Renewable Energy*, doi:10.1016/j.renene.2013.09.031, 2014.
7. *PE Farrell, CJ Cotter, SW Funke*. A framework for the automation of generalised stability theory. *SIAM Journal on Scientific Computing*, doi:10.1137/12090074, 2014.
8. *PE Farrell, DA Ham, SW Funke, ME Rognes*. Automated derivation of the adjoint of high-level transient finite element programs, *SIAM Journal on Scientific Computing*, doi:10.1137/120873558, 2013.
9. *SW Funke, CC Pain, SC Kramer, MD Piggott*. A wetting and drying algorithm with a combined pressure/free-surface formulation for non-hydrostatic models, *Advances in Water Resources*, doi:10.1016/j.advwatres.2011.

## CONFERENCE PUBLICATIONS

1. *CT Jacobs, SC Kramer, MD Piggott, SW Funke*. On the validity of tidal turbine array configurations obtained from steady-state adjoint optimisation, *ECCOMAS Congress 2016*, PDF, 2016.
2. *DM Culley, SW Funke, SC Kramer, MD Piggott*. Tidal stream resource assessment through optimisation of array design with quantification of uncertainty, *EWTEC 2015 proceedings*, PDF, 2015.
3. *T Roc, SW Funke, KM Thyng*. Standard methodology for tidal array project optimisation: An idealized study of the Minas Passage, *EWTEC 2015 proceedings*, PDF, 2015.
4. *SC Kramer, SW Funke, MD Piggott*. A continuous approach for the optimisation of tidal turbine farms, *EWTEC 2015 proceedings*, PDF, 2015.
5. *DM Culley, SW Funke, SC Kramer, MD Piggott*. A hierarchy of approaches for the optimal design of tidal turbine arrays, *Proceedings of the 5th International Conference on Ocean Energy*, PDF, 2014.

## IN REVIEW

1. *SW Funke, M Nordaas, Ø Evju, MS Alnæs, K-A Mardal*. Variational data assimilation for transient blood flow simulations, *SISC*, 2016.
2. *SD Parkinson, SW Funke, J Hill, MD Piggott, PA Allison*. Application of the adjoint approach to optimise the initial conditions of a turbidity current (AdjointTurbidity 1.0), *Geoscientific Model Development (GMD)*, 2016.

3. *DM Culley, SW Funke, SC Kramer, MD Piggott*. A surrogate-model assisted approach for optimising the size of tidal turbine arrays, *International Journal of Marine Energy*, 2016.
4. *Roan du Feu, SW Funke, SC Kramer, DM Culley, J Hill, BS Halpern, MD Piggott*. The trade off between tidal-turbine array yield and environmental impact: a multi-objective optimisation problem, *Renewable Energy*, submitted, 2016.

## DISSEMINATION: SELECTED PRESENTATIONS

Designing Tidal Turbine Arrays With PDE-constrained Optimisation, *ESCO2016*, Plzeň, Czech Republic, 2016

**Best poster award**, dolfin-adjoint, automated adjoint models for FEniCS, *SIAM Conference on Computational Science*, Salt Lake City, USA, 2015

Tidal Farm Layout Optimisation and Resource Assessment based on PDE-constrained optimisation, *International Conference on Ocean Energy*, Halifax, Canada, 2014

**Invited talk**, Introduction to FEniCS and automated adjoints, *Norwegian Meteorological Institute*, Oslo, Norway, 2014

PDE-constrained optimisation in Hilbert spaces, *FEniCS'14*, Paris, France, 2014

**Invited talk** An introduction to libadjoint, Institut of Atmospheric Physics, Beijing, China, July 2011